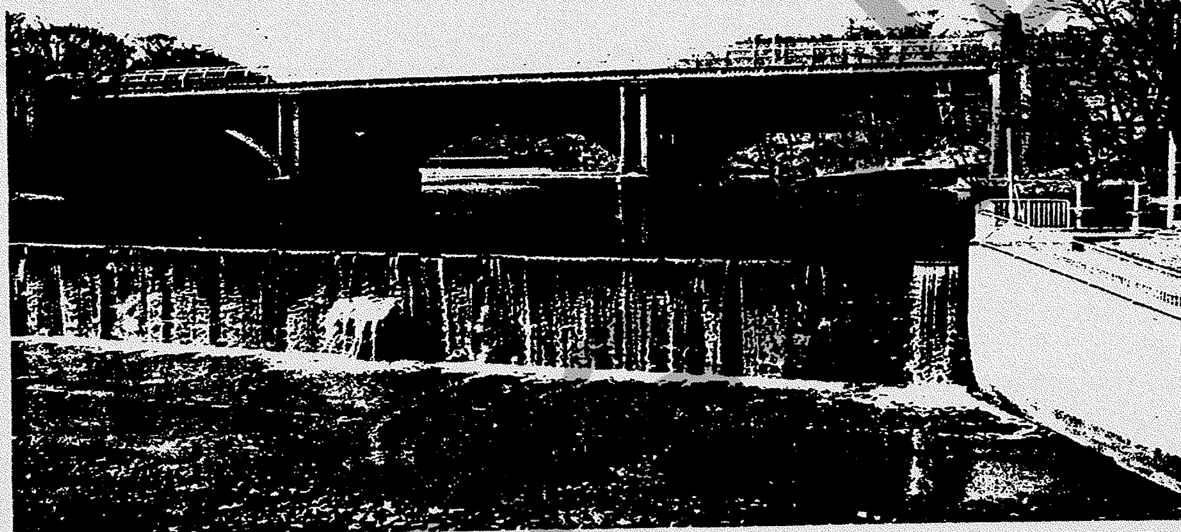
New Jersey Department of Transportation



Bridges and Structures Design Manual

DEPARTMENT OF TRANSPORTATION
THE STATE OF NEW JERSEY

Fourth Edition, 2002

To users of the NJDOT Bridges and Structures Design Manual, 4th Edition – 2002

Instructions

Interim Revisions have been made to the 4th Edition of the NJDOT Bridges and Structures Design Manual. BDC04MB-01 contains revised pages that stipulate the Interim Revisions. They have been designed to replace the corresponding pages in the Manual and are accordingly numbered.

The vertical line in the right side margin indicates the line that has been changed. To maintain your copy of the Manual, please replace the appropriate pages in the Manual with those in this BDC.

A Commentary to explain the respective changes is also contained in this BDC.

Commentary on enclosed changes to the NJDOT Bridges and Structures Design Manual, 4th Edition – 2002

Division 1 – Policies

Page 1-2, the title of Subsection 1.7.2 is changed to "Alternate Retaining Wall Systems". This title is more appropriate for the guidance that is provided in the Subsection.

Subsection 1.1-2 – Reference Publications

Page 1.1-2, editing is done to provide the proper title to the reference publication.

Subsection 1.3.2 – Vehicular Bridge Structures

Page 1.3-4, changes have been made to the Note designations of the Table and a Title is provided for the left most column.

Page 1.3-5, Note 3 has been edited to better clarify alternate route criteria allowance. Also, it is now more clearly stated that for the listed roadway classification, a vertical underclearance of less than 14'-6" will not be permitted.

Page 1.3-8, a definition is provided to define the span length that is to be considered when designing for the deflection limitation of the continuous span superstructure.

Pages 1.3-21 and 1.3-22, editing has been done to clarify the AASHTO Specifications that are to be used for designing substructure and foundation elements. Also, the current Edition of the AASHTO Standard Specifications is now stated.

Subsection 1.3A.1 – Vehicular Bridges

Page 1.3A-7, editing has been done to the definition of a span length when designing for deflection of a continuous span. Also, the live load deflection for pedestrian bridges is changed to be consistent with the criteria that is established for LRFD designs.

Page 1.3A-10, the designation of the AASHTO Standard Specifications has been updated.

Subsection 1.4.1 – Design Criteria

Page 1.4-1, the reference to "Con-Rail" is removed from the statement that establishes the design load for rail carrying bridges and structures. The design guidance is now generic.

Subsection 1.5.2 – Geometrics

Page 1.5-3, an editorial change is made to Subpart g. "Upper" roadway is now stated versus "lower" roadway.

Subsection 1.7.1 – General

Page 1.7-3.
A Vessel Collision Report is added to the Preliminary Submission requirements identified in subpart c.

The Design Appraisal Statement item is changed to Design Recommendation Summary. This is consistent with the Pipeline terminology.

Subsection 1.7.2 – Retaining Walls

Page 1.7-3, the title of Subsection 1.7.2 is changed to "Alternate Retaining Wall Systems". Editing has been done to paragraph a. to clarify the type of alternate retaining wall systems that may be constructed.

Subsection 1.7.3 – General Notes

Page 1.7-7, notes formerly in parenthesis concerning the Retest Limits have been removed. A Baseline Document Change (BDC) issued on February 7, 2003 included changes to the formerly referenced Table 914-4 of the NJDOT Standard Specifications. As included in the BDC, Table 914-4 no longer specifies the Retest Limit that is equal to the design compressive strength; therefore, the Design Manual's previous reference is no longer consistent.

Subsection 1.8.3 – Alternate Retaining Wall Submissions

Page 1.8-2, editing has been done to item 2. to better clarify what is required when site conditions limit the wall type system selection. Also, submission of calculations to verify the internal stability analysis is now required.

Subsection 1.9A.1 – Concrete Bridge Decks

Page 1.9A.2, an editorial correction is made in subparagraph (d) (2). The word "roper" is changed to "proper".

Subsection 1.9A.6 – Superstructure Replacements or Bridge Widening Projects

Pages 1.9A-4 and 5, with the issuance of the AASHTO Manual for Condition Evaluation and Load and Resistance Factor Rating (LRFR) of Highway Bridges, it can now be referred to for guidance on the substructure analysis that is required for widening projects. The guidance that was contained in the Manual was based on the unpublished AASHTO Manual guidance.

Subsection 1.9B.2 – Contract Pay Items and Quantities

Page 1.9B-3, an overtype printer error (the word "This") is corrected in Note 5.

Subsection 1.9C.3 – Recommended Restoration Procedures

Page 1.9C-10, Procedures Table, editing to the "Testing" row of the permanent "Restoration" column is done to clarify that Steps 1 & 2 are the probable steps that will be necessary in the recommended procedure.

Subsection 1.10A.3 – List of Bridge Pay Items

Page 1.10A-7, pay items are added for Relief slab and Sleeper slab Integral Abutment work.

Subsection 1.12.2 – Plan Preparation for Design

Page 1.12-4

1. A change to English unit measurements is made in Item A.3.

2. A reference on the use of overlays is now included in B.1.

Subsection 1.13.1 – General

Page 1.13-1, a change is made to remove "parapets" as a permitted element where utilities may be attached.

Subsection 1.13.2 – Location

Page 1.13-1, an editorial change is made to subpart c. to reference Section 34 of the Manual for guidance on Utility attachments.

Subsection 1.13.3 – Installation and Plan Requirements

Page 1.13-1, an editorial change is made in subpart a. The word "unusually" is changed to "usually".

Subsection 1.15.3 – Design Procedure Guidelines

Page 1.15-4, the title of Subpart B. is changed to "Skew Angle/Curved Girders". A sentence is added to establish that horizontally curved girder bridges cannot be designed as integral abutment type bridges.

Page 1.15-5, in the 1st sentence of the 2nd paragraph of item 3., the word "hold" is changed to "hole".

Page 1.15-6, to be consistent with changes that are made to the Standard Drawings, the references in items 2 & 3 are changed.

Page 1.15-12, in item 4. the type of joint filler material is better defined.

Subsection 1.15.4 – Construction Procedures

Page 1.15-13:
To be consistent with the changes to the Standard Drawings, the entire Subsection is re-written.

Page 1.15-14:
Pay items for payment of Sleeper slabs and Relief slabs are clarified.

Subsection 1.15.5 – Semi-Integral Abutment Design

Page 1.15-14 a grammatical error is corrected in the 2nd paragraph of Subpart B. The word "conceptional" is changed to "conceptual".

Subsection 16 – Foundations Design Criteria

Page 1.16-1, to be consistent with the changes on page 1.3-12, changes are made to the narrative for Foundation Design Criteria.

Subsection 1.16.5 – Prestressed Concrete Pile Connections

Page 1.16-8, this subsection is added to provide guidance for the titled work.

Subsection 1.17.2 – Abutments and Walls, Design Parameters

Page 1.17-3, item number 6 is edited to clarify the permissible deflection of cantilever sheet pile retaining walls.

Subsection 1.17.3 – Alternate Retaining Wall Systems

Pages 1.17-3 through 1.17-6, changes are made to more clearly establish the types of Alternate Retaining Wall systems that are permitted. Also, guidance on a height limitation is established for proprietary wall systems.

Subsection 1.18.1 – Design Criteria

Page 1.18-1, Guidance on Abutment design is referenced to the Section 3 criteria.

Subsection 1.19.3 – Railroads

Page 1.19-2, a change is made to identify the contact for obtaining specific information regarding excavation adjacent to railroad tracks. The Bureau of Civil Engineering is now identified vs. the Utility and Railroad Engineering Unit.

Subsection 1.19.9 – Vessel Collision

Page 1.19-6, previous paragraph 4.e., that was located on page 1.19-7, is moved to be paragraph 2. Existing paragraph 2. is deleted. This paragraph establishes the basis for assigning the Importance Category (IC) for bridges crossing navigable waterways.

Subsection 1.20.1 – High Performance Concrete (HPC) Deck Slabs

Page 1.20.1, a paragraph is added and editing is done to state that sidewalks, parapets, and curb lines are also to be constructed with HPC.

Subsection 1.20.2 – Design Criteria

Page 1.20-2, Subpart g. is added to provide direction for the design of deck overhangs.

Subsection 1.20.5 – Corrosion Protected Reinforcement in Deck Slabs

Page 1.20.4, a change is made to require that both layers of reinforcement in the top slab of culverts are to be corrosion protected when the top slab is the riding surface.

Subsection 1.20.8 – Haunches on Stringer Bridges

Page 1.20-9, a sentence is added to require a minimum haunch dimension of 1 inch.

Subsection 1.20.9 – Concrete Placing Sequence

Page 1.20-10

1. A reference to the NJDOT Standard Specifications is added to Item b.

2. Guidance on designing transverse construction joints, when planning for a deck placing sequence, is changed to not be just a consideration. The joint is to be designed as an edge beam.

Subsection 1.20.10 – Machine Finishing

Page 1.20-10, a correction is made to Item 2). The word "that" is changed to "than".

Subsection 1.20.11 – Approach Slabs

Page 1.20-11, a change is made to the Approach Slab requirements for bridges not on the State highway system. Either of the described circumstances will exclude provision of approach slabs.

Subsection 1.21.1 – Fixed and Expansion

Page 1.21-1, a correction is made to the single gap occurrence limitation measurement. The previous defined measurement was in error.

Subsection 1.21.3 – Strip Seal Expansion Dams

Page 1.21-3, an editorial change is made in subpart e. to describe the direction in which the allowable joint width is to be measured.

Subsection 1.23.1 – Fencing Warrants

Page 1.23-1, the word "may" is removed from the sentence that introduces the conditions for fencing warrants.

Page 1.23-2, changes are made to the fencing requirements for Pedestrian bridges and ramps. For new and existing pedestrian bridges, enclosed fencing is required for stairs and ramps as well as the bridge itself.

Subsection 1.23.2 – Types of Parapets, Bridge Railings

Page 1.23-4, a paragraph is added to state that according to the AASHTO LRFD provisions, crash tested bridge railing systems do not have to be re-designed. Also paragraphs are added to provide stipulations for the use of architectural enhancements to bridge railings.

Subsection 1.24.2 – Type of Steel

Page 1.24-1, clarification on use of HPS hybrid girders is provided in the 4th paragraph of subpart (a).

Subsection 1.24.7 – Camber

Page 1.24-5

1. The word "sag" is changed to "crest" in the second sentence of the first paragraph under Camber Table.

2. Editorial change has been made to reference pages.

Subsection 1.24.18 – Paint Coating Systems

Page 1.24-13 & 15, due to page renumbering, reference to page numbers are changed.

Page 1.24-18, editing has been done to correct the text alignment. A paragraph is added to provide guidance on finish color selection.

Subsection 1.24.19 – Weathering Steel

Page 1.24-20

The identification of the Guide Plate for drip plate detailing is changed to Guide Plate 3.9-23 vs. 3.9.23.

Clarification is provided on the type of bearing systems that are to be designed and those that are to be designed via shop drawing submissions in A.1.

Subsection 1.24.20 – Bearing Devices

Page 1.24-22, editing is done to reference the location of the bearing Load Group Table.

Subsection 1.25.4 – Design/Construction Criteria

Page 1.25-6, an editorial change has been made to remove a repetitive line in Item 11. of the Subsection.

Subsection 1.25.9 – Continuity Design for Live Load

Page 1.25-11, in the comparison Table, a change is made to correct a metric unit designation in the "Deck Diaphragms at Pier" comparison.

Subsection 1.26.1 – Reinforcement Presentation

Page 1.26-1, the paragraph titled "Soft Metric Reinforcing Bars" has been designated to be subpart "a.".

Page 1.26-3, subpart "b." has been added to specify the locations where corrosion protected reinforcement is required. Also, subpart "c" is added to identify the types of permitted corrosion protected reinforcement.

Page 1.26-5, due to page renumbering, reference to page number is changed.

Subsection 1.27.1 – The NJDOT Standard Specifications

Page 1.27-1, a column has been added to designate the design compressive strength value for the various classes of concrete.

Subsection 1.30.5 – Design Criteria for Precast Reinforced Concrete Box Sections for Culverts

Page 1.30-3, a correction is made to the AASHTO Subsection reference for the design criteria of precast culverts.

Subsection 1.32.2 – Variable Message Sign (VMS) Support Structures

Pages 1.32-2, 3, 5 and 6, with the issuance of the 2001 Edition of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals editing is done to reference its criteria for the fatigue design of VMS support structures.

Subsection 1.32.6 – Standard Drawings

Page 1.32-9, subpart a. has been edited to remove the reference to availability of mylars of the sign support structure standard drawings.

Subsection 1.32.8 – General

Page 1.32-10, a sentence is added to subpart f. to state that sign panel locations are to be measured from the centerline of an end post.

Pages 1.32-11 thru 14 and 16, the right most moment column is changed to correct unit conversion errors.

Subsection 1.38.1 – General

Page 1.38-1, a change is made to subpart (a) to remove the reference to the CPS software.

Subsection 1.40.3 – Cantilever and Overhead Sign Structures

Page 1.40-2, a sentence has been added to state that assigned structure numbers for sign support structures should be indicated on the contract plans.

Subsection 1.41.2 – Evaluation Criteria

Page 1.41-2, a paragraph has been added to state the requirement for performing an inspection and rating analysis of a new or replacement bridge structure.

Subsection 1.45.2 – General

Page 1.45-2, a paragraph is added to subpart 7. to establish the Performance Level for the use of the NCHRP Report 472 seismic design criteria.

Subsection 1.45.5 – Seismic Retrofit of Existing Highway Bridges

Page 1.45-5, subpart 2. is rewritten to establish the Performance Category for seismic retrofitting of bridge structures. Also, guidance on addressing retrofit needs is provided.

Page 1.45-6, editing is done to the third bullet of subpart 3.b. to better define retrofitting limits and editing is done to the reference in subpart b.1.

Subsection 1.46.1 – General

Page 1.46-1, subparts 2 and 3 are edited to better define the flood intervals for scour designs.

Subsection 1.46.2 – Preliminary Scour Analysis

Page 1.46-3, the current NJDEP Technical Manual is now referenced in part d.

Subsection 1.46-5 – Scour Countermeasure Development Procedures

Page 1.46-12, a clarification is made to the criteria for locating a footing at the proper scour depth elevation.

Subsection 1.47.1 – General

Page 1.47-3, the combined height, exposure and location coefficient (C_c) is changed in Table 47-4. The change is a result of the issue of the 2002 Interim to the AASHTO Guide Specifications for Structural Design of Sound Barriers wherein the coefficient was changed.

Division II – Standard Drawings

 # 2.2-1, the material designation for the ¾" x 2" studs for connecting the rails to the post is changed to F1554 Grade 36 in the respective notes.

 # 2.2-2, note 8 is expanded to provide tolerance settings for the post anchor bolts and note 9 is edited to specify the corrected material designation and to state that the bolting is to be done in an alternative pattern.

 # 2.2-3, note 4 is expanded to reference permitted types of corrosion protected reinforcement. In the Elevation view for Section A-A, the reinforcement detailing is changed to indicate a contraction joint instead of a construction joint. In the Tube Splice Detail, the dimension of the connection pin is changed from a metric unit to the ¼ inch English unit. Note 12 is added to specify the payment provision for the steel railing component of the barrier.

 # 2.2-4, in the Elevation view, the reinforcement detailing is changed to indicate a contraction joint instead of a construction joint. Note 4 is expanded to reference permitted types of corrosion protected reinforcement.

 # 2.3-1, note 9 is expanded to reference permitted types of corrosion protected reinforcement.

 # 2.4-1, 2.4-2, 2.4-3 and 2.4-4, the note under the "Schedule of Mild Steel Reinforcement" is expanded to reference permitted types of corrosion protected reinforcement.

 # 2.4-3, in the "Typical Beam Sections" view, the reinforcement designation at the top of the beams is changed to metric units. This is consistent with current industry practice.

 # 2.5-1 & 2.5-2, to make the drawing form generic, Tables that denoted specific plate sizes and other specific size component information are removed.

 # 2.5-3, information for dimensioning a sole plate is removed. This permits a more generic presentation of the drawing.

 # 2.6-1, the lettering panel is changed to denote the current year and the lettering panel legend is changed to denote future years.

 # 2.6-2, dimensional changes are made to the Frame and Cover Junction box and a view of a 10" x 36" Junction box is provided.

 # 2.8-1, in the Typical Noise Barrier Unit view, a note is added to denote a minimum 6 inch bed coarse of aggregate at the bottom of the caissons.

 # 2.8-3, in the Plan view detail, the dimensions of the Neoprene Bearing Pad is changed to ½ inch thickness.

 # 2.9-1 through 2.9-6, changes have been made to provide more current conceptual detailing for integral abutment detailing.

 # 2.10-1, editing is made to the Concrete Design Stresses note and the limit of the Precast Wall Element is defined in the Work Items table.

 # 2.10-2, a reference is added in Note 1 to provide guidance for types of permitted corrosion protected reinforcement.

 # 2.11-1, a reference is added in Note 5 to provide guidance for types of permitted corrosion protected reinforcement.

 # 2.11-2, a reference is added in Note 3 to provide guidance for types of permitted corrosion protected reinforcement.

Division III – Guide Plates

Page III-4, the reference to new Guide Plate 3.9-27 is added.

Page III-7, Guide Plate 3.16-1 has been re-titled to be for a HL-93 vehicle loading configuration.

 # 3.1-3, the title for the In Charge signature has been changed.

 # 3.1-4, the "Recommended By" and "Approved By" signature lines have been removed.

 # 3.1-5, signature line titles have been changed to provide full titling for PE license holders.

 # 3.3-1 and 3.3-2, a reference is added to clarify the requirement for a "seismic hook" in the footing detail. Also, Note 10 is added to clarify the types of permitted corrosion protected reinforcement.

 # 3.3-3, the dimension from the edge of footing to the controlling slope protection point is changed from 3 feet minimum to 4 feet minimum.

 # 3.4-1, Note 6 is expanded to reference the Section where corrosion protected reinforcement types are specified.

 # 3.4-2, Note 3 is expanded to reference the Section where corrosion protected reinforcement types are specified.

 # 3.4-3, Note 3 is expanded to reference the Section where corrosion protected reinforcement types are specified.

 # 3.4-4, Note 2 is expanded to reference the Section where corrosion protected reinforcement types are specified.

 # 3.4-7 & 3.4-8, indicator arrow to reference Note 7 is changed so that it does not point to the broken stone pocket that is to be placed around the under-drain pipe.

 # 3.4-7, the stone pocket detail notes are changed to specify the type of geotextile material that is to be used around the stone pocket.

 # 3.4-8, Note 1 is changed to state that the Common Structure Volume is to be governed by the "widest" limit of allowable alternates versus the "narrowest" limit. Also, the stone pocket is changed to specify the geotextile material requirement.

 # 3.4-9 & 3.4-10, the title of the Plate has been changed to denote the Doublewal system. Note 5 which references backfill material guidance is changed to refer to the Standard Specifications. This addresses an inconsistency between previous Notes on the Guide Plate and the Specifications.

 # 3.4-10, Note 1 is changed to state that the Common Structure Volume is to be governed by the "widest" limit of allowable alternate versus the "narrowest" limit.

 # 3.4-11, note 1 is expanded to reference the types of permitted corrosion protected reinforcement. Other changes are made to provide general requirements for both type wall systems and to provide distinct requirements for the respective wall types.

 # 3.4-12, Note 3 is changed so that there is consistency with the Standard Specifications' criteria.

 # 3.5-1, the note at the bottom of the Plate is expanded to reference the types of permitted corrosion protected reinforcement.

3.5-2, note 2 is expanded to reference the types of permitted corrosion protected reinforcement.

3.5-3, note 1 is expanded to reference the types of permitted corrosion protected reinforcement.

3.6-1& 3.6-2, note 4 is expanded to reference the types of permitted corrosion protected reinforcement.

3.7-1, note 4 is expanded to reference the types of permitted corrosion protected reinforcement.

#3.8-11, the width limitation for the preformed bituminous joint filler between the approach slab and the headwall has been changed from 2" to 1".

#3.9-5, the Bearing Stiffener detail is changed to remove the "plus fillet weld" requirement when the "mill to bear" method is used in connecting the plate to the flange. This is consistent with current AASHTO specifications.

3.9-27, Guide Plate is added to provide detailing for Shear Locks at deck slab open joint locations. This Plate was included in earlier Editions of the Manual. It is now re-inserted to address occurrences where shear lock provisions are needed.

3.10-1 & 2, note 3 is expanded to reference the types of permitted corrosion protected reinforcement.

3.10-3, note 1 is expanded to reference the types of permitted corrosion protected reinforcement.

3.10-4, note 5 is expanded to reference the types of permitted corrosion protected reinforcement.

3.10-5 & 7 & 8, note 5 is expanded to reference the types of permitted corrosion protected reinforcement.

3.10-15, note at the bottom of the Plate is expanded to reference the types of permitted corrosion protected reinforcement.

3.10-20, note 7 is expanded to reference the types of permitted corrosion protected reinforcement.

3.10-22 & 24, note 1 is expanded to reference the types of permitted corrosion protected reinforcement.

3.12-1, note 4 is expanded to reference the types of permitted corrosion protected reinforcement.

3.16-1, plate is changed to provide detailing for the HL-93 vehicle loading.

State of New Jersey

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JAMES E. MCGREEVEY
Governor

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Commissioner

This Design Manual shall be the vehicle by which the policy for the Design and the Evaluation and Rating of Bridges and Structures, in the State of New Jersey, is established. The contents of this Fourth Edition supersede the previous Edition dated 1998 and all Baseline Document Changes issued to date. Baseline Document Changes, to amend the Policies herein, will be issued when warranted.

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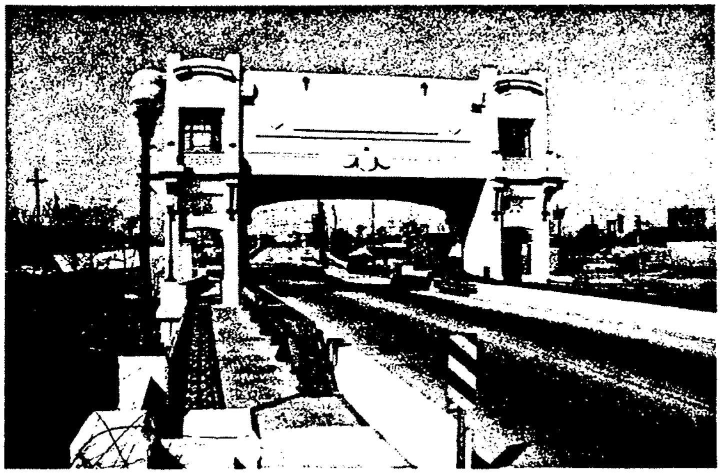


A NEW JERSEY HISTORIC BRIDGE SAMPLE

Federal Street over Cooper River
Camden County, New Jersey
Constructed: 1906

COVER PAGE

NJ 18 NB over Westons Mill Pond (Lawrence Brook)
Middlesex County, New Jersey
Constructed: 1931

FORWARD

This 4th Edition of NJDOT's Bridges and Structures Design Manual primarily introduces the use of the AASHTO LRFD Bridge Design Specifications for the design of New Jersey's bridge structures. In 1986 the AASHTO Subcommittee on Bridges and Structures initiated an effort to study existing bridge design specifications both in the United States and abroad. This study led to the creation of the LRFD design philosophy. It is believed that the LRFD design philosophy will lead to improved bridge design and analysis methods that will provide superior bridge serviceability, enhanced maintainability and more uniform levels of safety. To this end New Jersey has adopted the use of the LRFD Bridge Design Specifications as its bridge design code.

The Design Manual also addresses where the existing AASHTO Standard Specifications may continue to be used. Also, the Design Manual establishes use of improved materials; such as, High Performance Concrete and High Performance Steel. Guidance on seismic design and scour design have been enhanced. Additionally, new Guide Plates for detailing the fabrication of structural steel are provided in the Manual.

The guidance provided in the 4th Edition is broad base with respect to designing and evaluating the condition of New Jersey's bridge structures. Given that as technology in both design and construction of bridge structures is ever changing, users of the Manual are encouraged to contact the Department's Structural Engineering staff to advise them as to potential changes or additions to the Design Manual's contents.

AASHTO LRFD NEW JERSEY DEPARTMENT OF TRANSPORTATION

DESIGN MANUAL FOR BRIDGES AND STRUCTURES

CONTENTS

(Customary U.S. Units)

DIVISION 1

POLICIES

NEW JERSEY DEPARTMENT OF TRANSPORTATION

AASHTO LRFD NJDOT DESIGN MANUAL for BRIDGES AND STRUCTURES

DIVISION 1 - POLICIES

CONTENTS

SECTION 1

INTRODUCTION

1.1.1 GENERAL

(a) This Manual, supplemented by other NJDOT Manuals, operating procedures and policies, is the vehicle by which the policy for design and inspection and evaluation of bridges and structures is implemented. Presented herein is a compilation of NJDOT Structural Design guidance, specification interpretations, standard practices, details, guidelines, and bridge inspection and evaluation practices which constitute "policy".

(b) While this Manual attempts to unify and clarify structural bridge design and inspection policy for work done by or for the New Jersey Department of Transportation, it does not preclude justifiable exceptions, subject to the approval of the Manager, Bureau of Structural Engineering, provided the exceptions are based on sound engineering principles. Good design practice will always require a combination of basic engineering principles, experience and judgment in order to furnish the best possible structure to suit an individual site within reasonable economic limitations.

(c) This Manual is a living document in that Baseline Document Changes will be issued, as warranted, because of changes in design criteria and policies.

1.1.2 REFERENCE PUBLICATIONS

(a) The following publications, as modified in this Manual, govern the design of bridges and structures:

AASHTO LRFD Bridge Design Specifications

AASHTO LRFD Bridge Construction Specifications

AASHTO A Policy on Geometric Design of Highways and Streets

AASHTO Standard Specifications for Highway Bridges

AASHTO Standard Specifications for Movable Highway Bridges

AASHTO LRFD Movable Highway Bridge Design Specifications

AASHTO Guide Specifications and Commentary for Vessel Collision Design of Highway Bridges

AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals

AASHTO Manual on Foundation Investigations

ANSI/AWS Structural Welding Code D1.1

ANSI/AASHTO/AWS Bridge Welding Code D1.5

AASHTO Guide Specifications for Horizontally Curved Steel Girder Highway Bridges

AASHTO Guide Specifications for Fracture Critical Non-Redundant Steel Bridge Members

AASHTO Guide Specifications for Highway Bridge Fabrication with HPS 70W Steel

AREMA Manual for Railway Engineeing

The above publications are approved references to be used in conjunction with this Manual. Primarily they set forth minimum nationwide requirements which are consistent with current practice, but require modifications to suit local conditions. In the event of conflict in the requirements, the instructions in this Manual shall govern.

1.1.3 OTHER REFERENCES

(a) The following is a list of other publications to which reference is made in this Manual:

Subsections	Publication
1.10A.3 1.27.1 1.37.1	The NJDOT Standard Specifications for Road and Bridge Construction
1.34.4	NJDOT Rules Establishing Utility Accommodations Policy
1.34.5	Specifications for Pipeline Occupancy of Consolidated Rail Corporation Property
1.41.1	FHWA (USDOT) Bridge Inspector's Training Manual No. 90
1.41.2	AASHTO Manual for Condition Evaluation of Bridges

1.41.3C(2)b	FHWA, 2000, Recording and Coding Guide for the Inventory and Appraisal of the Nation's Bridges.
1.41.3C(2)b	NJDOT, April 1990, Recording and Coding Guide for the Structure Inventory and Appraisal of New Jersey Bridges.
1.41.4	Pontis Elemental Inspection of Bridges Guidance Manual

SECTION 2

BRIDGE TERMS

The following is a list of bridge terms usually found in bridge plans or referred to in bridge construction:

ABUTMENT

The portion of the bridge substructure at either end of a bridge which transfers loads from the superstructure to the foundation and provides lateral support for embankment.

ALIGNMENT BEARING

A bearing that prevents transverse movement of the superstructure. Normally, one beam on each span has an alignment bearing. However, seismic considerations may warrant provision of more than one alignment bearing.

BACKWALL

The portion of an abutment behind the bridge seats which extends upward from the top of the bridge seats to the top of the abutment or bottom of the header.

BATTER

A deviation from the vertical, commonly found on the back sides of walls and on piles.

BEARING

Usually, a device which supports the end of a girder and distributes superstructure loads to the abutment or pier. Fixed bearings do not provide for longitudinal movement of the superstructure to compensate for expansion and contraction due to temperature changes.

BENT

A row or group of piles in a structure, a row of columns. Piers are also referred to as bents when the piles extend above the ground to the pier cap.

BORING

An exploration of subsurface material. Borings are used by the Design Engineer in determining the types and dimensions of foundations required. Borings are used by Construction personnel to determine the type of materials in which piles are to bear and to determine suitable bearing strata in foundation excavations.

BORROW EXCAVATION, BRIDGE FOUNDATION (BEBF)

Select compacted material used for foundations.

BRIDGE SEAT

The horizontal surface on an abutment or pier on which the girders are to be supported.

BULKHEAD

1. Usually, bulkheads (timber, concrete, or steel sheeting) are constructed adjacent to railroads or waterways to retain embankments or prevent erosion.

2. A temporary vertical form at a construction, contraction or expansion joint.

CAMBER

A slight parabolic curvature constructed into a girder to:

1. Compensate for deflections in the girder due to the weight of the girder and weight of concrete supported by it.

2. Provide curvature to the superstructure if the roadway profile is on a vertical curve.

3. Provide architectural curvature to the girder.

CAP BEAM

A steel, timber or concrete beam capping a bent of piles or columns.

CENTERLINE OF BEARINGS

A horizontal alignment control line through the centers of the bearings which is used in abutment or pier layout and girder erection.

CHAMFER

The inclined flat surface formed by removing a square edge or corner; a beveled edge.

COLUMN

A vertical compression member usually circular or rectangular in cross section. In piers, columns transfer loads from the superstructure to the footing foundation.

CONSTRUCTION JOINT

A joint where adjacent portions of the structure are joined together. This is usually roughly finished and has reinforcement steel extending through it. Abbr.: Const. Jt.

CONTRACTION JOINT

A joint which separates two adjacent portions of the structure and contains a bond break such as a paraffin coating. *Abbr.: Contr. Jt.*

COPING

A projecting course of concrete. Usually, this is a projection on the outside of bridge sidewalks. It is also found on wingwalls of stub abutments and some pier cap beams.

CUTOFF WALL

A type of concrete header constructed under headwall aprons, culvert invert slabs and culvert wingwall footings to prevent washouts caused by scouring action of the water.

DIAPHRAGM

Channel, angle steel or cast-in-place concrete cross bracing between girders.

DOWEL

A reinforcement bar extending through a construction joint connecting two adjacent portions of the structure.

ELEVATION VIEW

A front or side view.

EXPANSION JOINT

A joint which separates two adjacent portions of a structure and contains compressible material to allow for concrete expansion. *Abbr.: Exp. Jt.*

FASCIA BEAMS

The outermost girders on any span.

FLANGE

The projecting portion of a beam or channel. The top or the bottom plate of a steel girder.

FOOTING

Part of a foundation, normally wider than the supported wall or column, which transmits loads from above to the soil below either by direct contact or through piles.

FOUNDATION

The part of a structure which is usually placed below the surface of the ground which distributes the load upon the subsoil.

GIRDER

A horizontal supporting structural member. (Beam, Stringer)

HEADER

A concrete wall on the top of an abutment backwall usually found between the end of a deck slab and the roadway approach slab.

INTEGRAL ABUTMENT BRIDGE

A bridge whose superstructure is rigidly connected to its abutments.

LIFE CYCLE COST

The total cost of an item's ownership over a specified period of time. For NJDOT Bridge Projects, this period will be 100 years. This includes initial acqusition costs (right of way, planning, design, construction), operation, maintenance, modification, replacement, demolition, financing, taxes, disposal and salvage value as applicable.

PARAPET

A concrete railing or barrier located on the bridge deck fascia and the tops of retaining walls.

PIER

The portion of the bridge substructure which transfers loads from the superstructure to the foundation. Provides intermediate support for multi-span bridges.

PILES

Shafts of concrete, timber, or steel which are used to transfer foundation loads through subsurface materials.

PITCH

The vertical distance covered by one turn of spiral reinforcement in columns.

PLAN VIEW

Top view.

RETAINING WALL

A wall designed to retain embankment and prevent erosion.

SECTION VIEW

An internal view. In Bridge Plans, sections are usually shown through all parts of the structure.

SHEAR CONNECTORS

Usually stud type connectors welded to the top of girders or U type reinforcement protruding from prestressed concrete beams and embedded in the concrete deck slabs.

SOFFIT

The underside portion of a deck slab overhanging the exterior of fascia girders.

STIFFENER

Longitudinal or vertical plates (welded to structural steel beams) to prevent buckling.

SUBSTRUCTURE

The part of a structure below the superstructure.

SUPERSTRUCTURE

In a bridge, the superstructure consists of bearings, girders, decks, sidewalks, etc. (All above the substructure).

WINGWALL

A wall at the end of an abutment or culvert for retaining slopes and preventing erosion.

VIADUCT

A bridge made up of multi-spans supported on piers carrying the roadway over streets, highways, railroads and/or streams.

SECTION 3

AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, NJDOT STIPULATIONS

1.3.1 LOAD AND RESISTANCE FACTOR DESIGN (LRFD) DESIGN PHILOSOPHY

The design of new bridge structures in New Jersey shall primarily be completed with the use of the AASHTO LRFD Bridge Design Specifications. Designs for the Reconstruction or Rehabilitation of existing bridge structures shall be completed in accordance with the guidance provided in Sections 9A and 9B of this Manual.

The LRFD bridge design philosophy is based on the premise that four Limit States are stipulated to achieve the basic design objectives of constructability, safety and serviceability. All Limit States are given equal importance.

The four Limit States are:

1. SERVICE LIMIT STATE: Stress, deformation and crack width are limited under service conditions.

2. FATIGUE AND FRACTURE LIMIT STATE: Fatigue stress range is limited for the expected number of stress cycles due to a single design truck in order to control crack initiation and propagation, and to prevent fracture during the design life of the bridge.

3. STRENGTH LIMIT STATE: Strength and stability are provided to resist the significant load combinations that a bridge is expected to experience in its design life.

4. EXTREME EVENT LIMIT STATES: Structures are proportioned to resist collapse due to extreme events, such as, major earthquake, flood, ice flow, collision by a vessel, etc.

Equation 1.3.2.1-1 of the AASHTO LRFD Bridge Design Specifications, unless otherwise specified, must be satisfied for each Limit State:

Where $\eta = \eta_D \eta_R \eta_I \geq 0.95$

η = A factor relating to ductility, redundancy and operational importance.
η_D = A factor relating to ductility
η_R = A factor relating to redundancy
η_I = A factor relating to importance
γ_I = Load factor: A statistically based multiplier
ϕ = Resistance Factor: A statistically based multiplier
Q_I = Force Effect
R_n = Nominal Resistance
R_r = Factored Resistance: ϕR_n

Subsection 1.3 of the LRFD Specifications may be referred to for additional commentary concerning the philosophy of the Specifications' development.

1.3.2 VEHICULAR BRIDGE STRUCTURES

The current Edition of the AASHTO LRFD Bridge Design Specifications (with current Interims), with the following stipulations to the respective AASHTO LRFD Sections, shall govern the design of bridge structures in New Jersey.

(**NOTE:** The following Section numbers refer to the Section numbering of the AASHTO LRFD Bridge Design Specifications.

SECTION 1 - INTRODUCTION

1.3.5 OPERATIONAL IMPORTANCE

The following is added:

The Operational Importance strength limit state classification shall be as follows:

NHS Structures - n = 1.05
NON-NHS Structures - n = 1.00

SECTION 2 - GENERAL DESIGN AND LOCATION FEATURES

2.3.2 BRIDGE SITE ARRANGEMENT

2.3.2.2 Traffic Safety

2.3.2.2.1 Protection of Structures

The following is added:

The NJDOT Design Manual Roadway shall be referred to for additional guidance concerning lateral clearance requirements.

2.3.3 CLEARANCES

2.3.3.1 Navigational

The following is added:

The guidance provided in Subsection 17.8 of the NJDOT Procedures Manual shall be followed in procuring U.S. Coast Guard permits.

2.3.3.2 Highway Vertical

The following is added:

The minimum vertical underclearances that are tabulated in the Table on the next page and that are based on the provisions of the AASHTO Geometric Design of Highways and Streets Manual shall control the design of bridge structures in New Jersey.

TABLE 2.3.3.2 - MINIMUM VERTICAL UNDERCLEARANCES FOR BRIDGES AND STRUCTURES

Roadway Functional Classification Facility Type	Vehicular and Railroad Over Crossings	Pedestrian and Bikeway Over Crossings	Overhead Sign Structures	Tunnels	Remarks
Interstates Freeways Expressways	16'–6"	17'–6"	17'–9"	16'–6"	Notes 1,3,9
Rural Arterials	16'-6"	17'-6"	17'-9"	16'-6"	Notes 2,3,9
Urban Arterials	16'-6"	17'-6"	17'-9"	16'-6"	Notes 2,3,9
Local Roads and Streets and Collector Roads and Streets	14'-6"	17'-6"	17'-9"	14'-6"	Note 8
Railroads	23'-0"	23'-0"	--	23'-0"	Note 4
Electrical Tracks	24'-6"	24'-6"	--	24'-6"	Note 4
Inter-Coastal Waterway	55'-0"	--	--	--	Note 5
Navigable Waterways	Varies	--	--	--	Note 6
Other Waterways	Varies	--	--	--	Note 7
Existing Bridges and Structures	--	--	--	--	Note 9

NOTES

1. Bridge structures over Interstate routes shall meet the minimum underclearance stated in the Table. Exceptions to this standard are the portions of existing Interstate routes where existing control make the 16′-6″ standard impractical or when, due to unusual conditions, the cost of the higher standard becomes excessive. In such cases, any variations in the vertical clearances shall be as approved by the Federal Highway Administration and as recommended by the Manager, Bureau of Structural Engineering. The request to the Federal Highway Administration shall be signed by the Director, Division of Design Services.

2. Exceptions to this standard are the portions of existing State Highway System routes where existing controls make the 16′-6″ standard impractical or when, due to unusual conditions, the cost of the higher standard becomes excessive. In such cases, any variations in the vertical clearances shall be as approved by the Director, Division of Design Services and as recommended by the Manager, Bureau of Structural Engineering. Such request shall be signed by the NJDOT Project Manager.

3. Bridge structures to be replaced, widened or are to have their superstructures replaced shall meet the criteria of Table 2.3.3.2. In highly urbanized areas where a 16′-6″ underclearance is required, a minimum clearance of 14′-6″ may be provided if there is one route, within the approximate location of the bridge in question, that provides an existing 16′-6″ minimum underclearance. Concurrence to this alternate route allowance shall be obtained from the Manager, Bureau of Structural Engineering. Also, in such instances, signing to the alternate route should be called for in the Contract Plans.

   Under no circumstances will a concurrence to a vertical underclearance of less than 14′-6″ be granted for the listed roadway classification.

4. The 23′-0″ for a vertical clearance above the top of rails (24′-6″ for electrified tracks) includes an allowance of 1′-0″ for future ballasting of the railroad tracks and minor structure encroachment during construction or maintenance operations and still provides clearance in compliance with AREMA standards. Changes to the standard vertical clearances may be approved when ordered by the State regulatory agency having jurisdiction over such matters. Greater vertical clearance may be required at individual locations where necessary and when justified on the basis of extraordinary site conditions.

5. Changes to the standard 55′-0″ clearance (above M.H.W.) may be approved if justified by marine traffic and cost studies or ordered by the U.S. Coast Guard.

6. Clearance contingent on marine traffic and cost studies. Clearance subject to approval by the U.S. Coast Guard.

7. Freeboard clearance contingent on hydraulic and hydrologic studies. Subject to approval by N.J. Division of Water Resources.

8. The clearance shall apply over the entire roadway width including any contiguous auxiliary lanes and shoulders.

9. State Laws, N.J.S.A. 27:5G-1 through 27:5G-4, require that every bridge or overpass carrying municipal, county, or state roads, including railroads, with a vertical clearance of less than 14'-6" from the roadway beneath shall have a minimum clearance marked or posted thereon in accordance with the current standards prescribed by the "Manual of Uniform Traffic Control Devices for Streets and Highways".

   Signs warning persons operating motor vehicles that they are approaching a bridge or overpass with less than 14'-6" clearance shall be placed at the last safe exit or detour preceding the bridge or overpass. The minimum clearance of the bridge or overpass shall be indicated on these signs.

   The signs required by this section shall be maintained by the appropriate government entity which has jurisdiction over the roadway underneath the bridge or overpass. The above provisions do not apply to toll road authorities.

GENERAL VERTICAL UNDERCLEARANCE PROVISIONS

If it is anticipated that future lanes will be required for the lower roadway, the clearance stipulated in this policy shall be applied to the future lane.

The clearance for ramps shall be that of the connecting highway. In the case where a ramp connects highways with different vertical clearance criteria, the higher clearance shall be used.

The clearances tabulated on page 1.3-4 include a 6 inch allowance for future resurfacing.

For spans between 120'–0" and 150'-0", the need for bolted splice (located near one quarter-point) should be anticipated in calculating the minimum vertical clearance. An allowance of ¾ inch (fastener head) plus thickness of bottom flange splice plate shall be considered.

For spans over 150 feet, two splices located near each quarter-point should be anticipated. An allowance of ¾ inch (fastener head) plus thickness of bottom flange splice plate shall be considered.

2.3 LOCATION FEATURES

2.3.3.3 Highway Horizontal

The following is added:

Lateral clearances shall conform to Section 5-11 of the NJDOT Design Manual – Roadway. Bridge sketch plans (see Section 6 of this Manual) shall be submitted on a project to project basis.

2.3.3.4 Railroad Overpass

The following is added:

Refer to the Table 2.3.3.2 for Minimum Vertical Underclearance requirements.

2.5 DESIGN OBJECTIVES

2.5.2.2 Inspectability

The following is added:

For all bridge structures, to assure inspectability access, the design details shall be reviewed and certified by an Engineer who meets NJDOT NBIS requirements for qualification as a team leader. Such certification shall be provided, via a letter, to the Manager, Structural Engineering with the final plan submission.

2.5.2.3 Maintainability

The second sentence of the 1st paragraph is changed to:

When the climatic and/or traffic environment is such that the bridge deck may need to be replaced prior to the required service life, provisions shall be shown on the plans for replacement of the deck and/or bearings.

2.5.2.4 Rideability

The last paragraph is deleted and the following is added:

A thickness of ½ inch shall be provided to compensate for surface wear. The ½ inch of the concrete deck slab thickness shall be considered as a wearing surface. Consequently, it shall be considered as dead load, but shall not be considered effective in carrying secondary dead loads (except future overlay wearing surface) or live loads and impact. Also see 1.20.3 of this Manual for Two-Course deck slab designs.

2.5.2.6 Deformations

2.5.2.6.2 Criteria for Deflection

The following is added:

The criteria stated within this Subsection is required for design of New Jersey bridge structures. The following deflection limits shall be used for steel, aluminum and/or concrete construction:

- Vehicular load, general.................Span/1000
- Vehicular and/or pedestrian loads..Span/1000
- Vehicular load on cantilever arms..Span/400
- Vehicular and/or pedestrian loads on cantilever arms.....................Span/400

The following additional criteria shall be followed:

- The span length shall be the distance between supports for simple spans.
- For continuous spans, the span length shall be the distance between points of contraflexure.
- Although the design of continuous beams will not consider the combination of the reinforcement steel in the negative moment region, the reinforcement steel contribution will be considered in determining deflections.

2.5.2.6.3 Optional Criteria for Span to Depth Ratios

The following is added:

The use of the optional criteria, including Table 1, stated within this Subsection, is not required.

2.5.2.7 Consideration of Future Widening.

2.5.2.7.2 Substructure

The paragraph is changed to:

When future widening can be anticipated, the substructure shall be designed for the widened condition. The Designer shall notify the Manager, Structural Engineering as to the anticipated future condition. Upon approval by the Manager, Structural Engineering, the design shall satisfy all widened and un-widened condition design requirements.

SECTION 3 - LOADS AND LOAD FACTORS

3.4 LOAD FACTORS AND COMBINATIONS

3.4.1 Load Factors and Load Combinations

The last paragraph is changed to:

The load factor for live load in Extreme Event Load Combination I, γ_{EQ} shall be taken as 0.50.

The following is added:

For Integral Abutment Jointless Bridge designs, the maximum Load Combination and Load Factors under the "TU, CR, SH" column of Table 3.4.1-1 shall be used and the maximum permanent load factors listed in Table 3.4.1-2 shall be used.

3.5 PERMANENT LOADS

3.5.1 Dead Loads: DC, DW and EV

The following is added:

Superstructure designs for bridge structures that utilize one course deck slab construction shall include a 25 p.s.f. additional dead load. The 25 p.s.f. shall be considered as a secondary dead load.

3.6 LIVE LOADS

3.6.1 Gravity Loads: LL and PL

3.6.1.1 Vehicular Live Load

3.6.1.1.2 Multiple Presence of Live Load

The following is added:

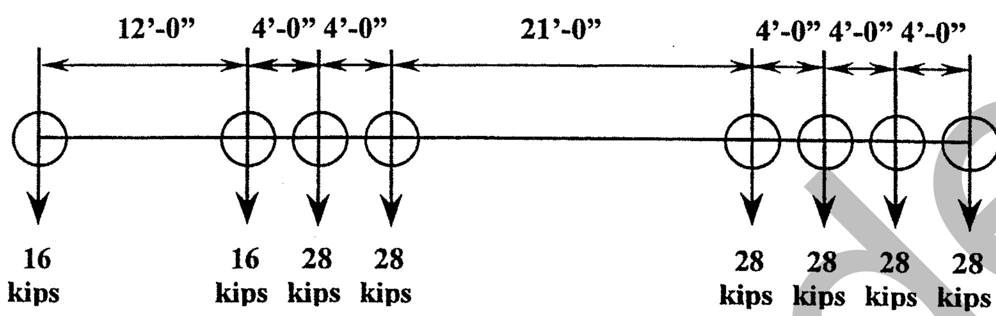
When analyzing for the NJDOT Permit Vehicle configuration, its presence shall only be considered to occur once on a bridge structure. Additional design lanes shall be considered to be occupied by the HL-93 loading.

3.6.1.2 Design Vehicular Live Load

3.6.1.2.1 General

The following is added:

In addition to the HL-93 analysis a Strength II Limit State calculation shall be made for the following permit vehicle configuration:



LRFD Permit Vehicle, NJDOT

Also, when designing for prestressed concrete components, a Service III Limit State calculation shall be made for the above permit vehicle configuration. However, in lieu of the changes stated under Subsection 5.9.4, Table 5.9.4.2.2-1, (see page 1.3-14) specified Stress Limit limitations stated in the AASHTO LRFD Bridge Design Specification shall be accounted for in the permit vehicle check.

3.6.5 Vehicular Collision Force: CT

3.6.5.2 Vehicle and Railway Collision with Structures

The first paragraph is changed to:

Unless protected as specified in Article 3.6.5.1., abutments and piers located within a distance of 30 feet to the edge of roadway, or within a distance of 50 feet to the centerline of a railway track, shall be designed for an equivalent static force of 400 kips. The equivalent static force shall be assumed to act from a point that is offset by 15 degrees from the centerline of the tracks or from the edge of roadway. The force shall be taken in a horizontal plane at a distance of 4 feet above the ground.

3.10 EARTHQUAKE EFFECTS: EQ

3.10.1 General

The following is added:

Refer to Section 45 of this Manual for additional guidance concerning seismic analysis of New Jersey bridge structures.

3.10.3 Importance Categories

The following is added:

All bridge structures in New Jersey shall initially be considered to be "Essential". However, consideration for increasing the category is permitted. This consideration shall strictly be based on social/survival and security/defense factoring of the bridge structure's location. That is, if social/survival or security/defense importance factors of the bridge structure's location clearly indicate the location's critical nature, then increasing of the Importance Category may be considered. Approval of the increasing of the Importance Category shall be obtained from the Manager, Structural Engineering.

3.11 EARTH PRESSURE: EH, ES, LS, and DD

3.11.5 Earth Pressure: EH

3.11.5.1 Basic Lateral Earth Pressure

The second paragraph is changed to:

Unless otherwise specified, the resultant lateral earth loads due to the weight of the backfill shall be assumed to act at a height of 0.33H above the base of the wall, where "H" is the total wall height measured from the surface of the ground to the bottom of the footing.

3.11.5.5 Equivalent-Fluid Method of Estimating Rankine Lateral Earth Pressures

The first paragraph is changed to:

The equivalent fluid pressure shall not be less than 35 pounds per cubic feet.

3.12 FORCE EFFECTS DUE TO SUPERIMPOSED DEFORMATIONS: TU, TG, SH, CR, SE

3.12.2 Uniform Temperature

The following is added:

For rigid frame concrete piers on typical highway grade crossings that are on continuous footings, the temperature differential shall be 15 degrees F for rise in temperature and 20 degrees F for fall in temperature. The temperature values established for "cold climate" in Table 3.12.2.1-1 shall be used for all other cases.

3.12.3 Temperature Gradient

The following is added:

The temperature gradient shall be neglected for multi-beam bridge structures.

SECTION 4 - STRUCTURAL ANALYSIS AND EVALUATION

4.6 STATIC ANALYSIS

4.6.2 Approximate Methods of Analysis

4.6.2.2 Beam Slab Bridges

4.6.2.2.2 Distribution Factor Method for Moment and Shear

The following is added:

The distribution factor for the HL-93 loading shall also be used for the permit vehicle in performing Strength II calculations. However, the guidance provided under Subsection 3.6.1.2.1 shall be followed.

SECTION 5 - CONCRETE STRUCTURES

5.4 MATERIAL PROPERTIES

5.4.1 General

The first paragraph is changed to:

Designs shall be based on the use of materials and concrete classes that conform to the construction materials as specified in the NJDOT Standard Specifications for Road and Bridge Construction.

5.4.2 Nominal and Structural Low Density Concrete

5.4.2.3 Shrinkage and Creep

5.4.2.3.2 Creep and 5.4.2.3.3 Shrinkage

The following is added:

The average relative humidity (percent) (H) should be assumed to be 70% throughout the State.

5.4.3 Reinforcing Steel

The following is added:

Reinforcing steel properties shall conform to the requirements of the NJDOT Standard Specifications for Road and Bridge Construction.

5.4.4 Prestressing Steel

5.4.4.1 General

The first paragraph is changed to:

Prestressing steel properties shall conform to the requirements of the NJDOT Standard Specifications for Road and Bridge Construction.

The following is added:

Low relaxation strands shall be used and accounted for in the design of prestressed concrete beams.

5.9 PRESTRESSING AND PARTIAL PRESTRESSING

5.9.4 Stress Limits for Concrete

The following is added:

Generally, the design strength for prestressed concrete shall be $f'c = 5{,}000$ psi (Class P concrete). The Engineer may use an optional, higher design strength of $f'c = 5{,}500$ psi (Class P-1 concrete) or $f'c = 6{,}000$ psi (Class P-2 concrete).

If a Designer wishes to use a higher design strength than stated above, it is permitted. However, the provisions of Subsection 914.02 of the NJDOT Standard Specifications must be studied and suitably amended to account for the control and acceptance testing requirements in the fabrication of the higher strength concrete.

5.9.4.2 For Stresses at Service Limit State After Losses – Fully Pretensioned Components

5.9.4.2.2 Tension Stresses

Table 5.9.4.2.2-1 is changed to:

Bridge Type	Location	Stress Limit
Other Than Segmentally Constructed Bridges	Tension in the Precompressed Tensile Zone Bridges, Assuming Uncracked Sections	
	• For components with bonded prestressing tendons or reinforcement that are subjected to not worse than moderate corrosion conditions.	No tension *
	• For components with bonded prestressing tendons or reinforcement that are subjected to severe corrosive conditions.	No tension *
	• For components with unbonded prestressing tendons.	No tension
Segmentally Constructed Bridges	Longitudinal Stresses Through Joints in the Precompressed Tensile Zone	
	• Type A joints with minimum bonded auxiliary reinforcement through the joints sufficient to carry the calculated longitudinal tensile force at a stress of 0.5 f_y; internal tendons.	No tension
	• Type A joint without the minimum bonded auxiliary reinforcement through joints.	No tension
	• Type B joints; external tendons.	No tension
	Transverse Stresses Through Joints	
	• Tension in the transverse direction in precompressed tensile zone.	No tension
	Stresses in Other Areas	
	• For areas without bonded reinforcement.	No tension
	• Bonded reinforcement sufficient to carry the calculated tensile force in the concrete computed on the assumption of an uncracked section at a stress of 0.5 f_{sy}.	No tension
	• Principal Tensile Stresses in box girder webs.	$4\sqrt{f'c}$ psi

* Refer to 1.3-10 of this Manual for additional guidance on assessing the permit vehicle effects when designing prestressed concrete components.

5.9.5 Loss of Prestress

5.9.5.4 Refined Estimates of Time-Dependent-Losses

5.9.5.4.2 Shrinkage

The following is added:

The average ambient relative humidity (percent) (H) should be assumed to be 70% throughout the State.

5.10 DETAILS OF REINFORCEMENT

5.10.8 Shrinkage and Temperature Reinforcement

5.10.8.1 General

The following is added:

Concrete deck slab temperature - distribution steel shall not be less than #16 reinforcing bars spaced @ 15 inches.

5.10.8.3 Mass Concrete

The following is added:

Mass Concrete is defined as any large volume of cast-in-place or precast concrete with dimensions large enough to require that measures be taken to cope with the generation of heat and attendant volume change so as to minimize cracking.

When the minimum dimensions of a concrete component exceed 3 feet and the ratio of volume of concrete to surface area is greater than one foot or 12 inches, then Mass Concrete requirements shall be applied. The surface area will include all of the cumulative area of all surfaces of the concrete component being considered including the full underside (bottom) surface of footings, caps, etc. Volume and surface area calculations shall be in units of feet. Therefore, the volume shall be measured in units of cubic feet and the area in units of square feet.

The Designer shall consider the consequences of Mass Concrete requirements in selecting member sizes and shall avoid Mass Concrete whenever practicable. However, when Mass Concrete is unavoidable, the

Designer shall indicate on the plans those portions of the concrete elements in the bridge that are Mass Concrete.

Seal concrete or concrete deck slabs shall **not** be considered as Mass Concrete.

5.11 DEVELOPMENT AND SPLICES OF REINFORCEMENT

5.11.5 Splices of Bar Reinforcement

5.11.5.2 General Requirements

5.11.5.2.1 Lap Splices

The following is added to the first paragraph:

The splice design length shall be based on the use of Grade 60 reinforcement. The dimensions of all laps shall be detailed on the plans.

5.12 DURABILITY

5.12.4 Protective Coatings

The last sentence is deleted and the following is inserted:

Cover to corrosion protected reinforcement shall conform to Table 5.12.3-1 denotations except that top reinforcement cover shall be 2½ inches for One-Course bridge deck slabs and top reinforcement cover shall be 1½ inches in the first course for Two-Course deck slabs. Also, the reinforcement cover shall be 2½ inches for overlay deck slabs on prestressed concrete slab or box beams.

Also refer to Subsection 1.20.2 of this Manual for additional deck slab requirements and to Subsection 1.19.6 of this Manual for requirements concerning pile bents in a marine environment.

5.13 SPECIFIC MEMBERS

5.13.2 Diaphragms, Deep Beams, Brackets, Corbels and Beam Ledges

5.13.2.2 Diaphragms

The 4th paragraph is deleted and the following is inserted:

Diaphragms shall be provided as stated in the first three paragraphs above.

Also, refer to Section 25 of this Manual for additional criteria concerning Prestressed Concrete.

SECTION 6 – STEEL STRUCTURES

6.1 SCOPE

The 2nd paragraph is changed to:

Curved girder steel structures shall be designed in accordance with the Allowable Stress Design Method of the current AASHTO Standard Specifications for Highway Bridges.

6.6 FATIGUE AND FRACTURE CONSIDERATIONS

6.6.2 Fracture

The following is added:

Refer to Subsection 917.10 of the NJDOT Standard Specifications for Road and Bridge Construction for Charpy V-Notch Impact requirements.

6.7 GENERAL DIMENSION AND DETAIL REQUIREMENTS

6.7.2 Dead Load Camber

The following is added:

An additional 8 p.s.f. shall be included in the camber computations to account for the dead load of permanent stay-in-place forms and 5 p.s.f. shall be included to account for the average 3/8 inches additional thickness of deck concrete which fills the forms. Also, refer to Subsections 1.20.2c for additional dead load requirements when S.I.P. forms, in conjunction with the main reinforcement not in alignment, when the S.I.P. forms are used.

6.7.3 Minimum Thickness of Steel

The first paragraph is changed to:

Structural Steel shall not be less than 3/8 inches in thickness.

6.7.4 Diaphragms and Cross Frames

6.7.4.1 General

The first sentence is changed to:

Diaphragms or cross frames shall be placed at the end of the structure, across interior supports and intermittently across the spans.

6.10 I SECTIONS IN FLEXURE

6.10.1 General

The following is added:

Compact Sections are desirable throughout a bridge structure.

The following is added to the 3rd paragraph:

In continuous spans, the design of the shear connectors in the negative moment portion shall consider the contribution of the longitudinal reinforcement steel.

6.10.7 Shear Resistance

6.10.7.4 Shear Connectors

6.10.7.4.1 General

The 1st paragraph is changed to:

Welded studs shall be used for shear connectors. Refer to Guide Plate 3.9-2 of this Manual for guidance.

The following is added to the 3rd paragraph:

Composite sections shall be designed without consideration of the contribution of the reinforcement steel in the negative moment region of continuous spans. This is except as noted for design of shear connectors and for deflection calculations.

6.10.8 Stiffeners

6.10.8.1 Transverse Intermediate Stiffeners

6.10.8.1.1 General

The following is added:

Whenever possible, a thicker web should be used to minimize the number of or eliminate the need of transverse stiffeners.

6.10.8.3 Longitudinal Stiffeners

The following is added:

The use of longitudinal stiffeners shall be limited to spans greater than 200 feet.

The following note shall be added to Plans whenever a longitudinal stiffener is used:

A maximum of 2 splices will be permitted for longitudinal stiffeners. Under the requirements for Quality Control Inspection, prior to welding the stiffener to the stringer, the butt welds shall be radiographed.

6.10.9 Cover Plates

6.10.9.1 General

The following is added:

Welded cover plates shall be narrower than the flange to which they are attached. Research indicates that when cover plates are wider than the flange, fatigue strength is significantly reduced. If fatigue strength is reduced edge cracks may occur in the flange.

6.13 CONNECTIONS AND SPLICES

6.13.3 Welded Connections

6.13.3.1 General

The following is added:

Welding shall conform to the requirements of the current Edition of the ANSI/AASHTO/AWS Bridge Welding Code D1.5, except that electro-slag weldments on main structural tension and reversal stress members will not be permitted.

Also, refer to Section 24 of this Manual for additional criteria concerning Structural Steel.

SECTION 9 - DECKS AND DECK SYSTEMS

9.4 GENERAL DESIGN REQUIREMENTS

9.4.3 Concrete Appurtenances

The following is added:

The guidance of Subsection 1.20.13 of this Manual concerning provision of open deflection and contraction type joints in parapets, barriers and sidewalks shall be followed.

9.7 CONCRETE DECK SLABS

9.7.1 General

9.7.1.5 Design of Cantilever Slabs

The following is added:

The maximum effective deck overhang shall be maintained at 4'-6". The effective slab section, in maintaining this distance, shall be based on the following limits:

For prestressed concrete girders, whose top flange width is greater than its bottom flange width, and for structural steel members, the effective slab section shall be the distance that is from ¼ the flange width to the edge of the deck slab.

For other prestressed concrete girders, Concrete T beams and prestressed slab and box beams, the effective slab section shall be the distance that is from the edge of the flange to the edge of the deck slab.

9.7.2 Empirical Design

9.7.2.1 General

The following is added:

The provisions of 9.7.3 - Traditional Design shall primarily be followed for concrete deck slab designs. The Tables provided in Section 20 of this Manual may be referred to for uniformity of reinforcement detailing. If the bridge structure configuration entails straight longitudinal superstructure members, then the Empirical Method may be used.

Also, refer to Section 20 of this Manual for additional criteria concerning concrete deck slabs.

SECTION 10 - FOUNDATIONS

10.1 SCOPE

The existing paragraphs are deleted and the following is inserted:

The Structural Designer shall design the superstructure and substructure, except foundations and earth retaining elements, in accordance with the current AASHTO LRFD Bridge Design Specifications and the current AASHTO LRFD Bridge Construction Specifications. Foundations; such as, piles, drilled shafts and footings for earth retaining elements, and earth retaining elements; such as, retaining walls, wingwalls and abutment walls, shall be designed by the Service Load method of the 17th Edition of the AASHTO Standard Specifications for Highway Bridges, by using Combinations of Loads as defined in that Specifications' Subsection 3.22. The Combinations of Loads shall be determined by unfactoring the LRFD derived Load Combinations and correlating the respective load definitions. Footings for non-earth retaining elements shall be designed according to the provisions of the AASHTO LRFD Specifications.

To verify the stability of substructure elements and, to evaluate the soil-structure interaction, the geotechnical design shall be in accordance with the criteria of the 17th Edition of the AASHTO Standard Specifications for Highway Bridges, and as modified in Sections 3 and 16 of the 1998 NJDOT Design Manual - Bridges and Structures. Factors of safety shall be applied to the ultimate geotechnical resistance for the proposed foundation systems.

The geotechnical analysis methods shall be in accordance with the following FHWA publications: HI 97-013 and HI 97-014 - Design and Construction of Driven Pile Foundations", IF-99-025 – Drilled Shafts, and HI-88-009 - Soils and Foundations. Other current FHWA publications should be referenced when appropriate.

If, in the opinion of the Engineer, the foundation systems resulting from the above procedure appear to be non-typical or unusual for the structure being designed, contact the Bureau of Structural Engineering.

To establish the correlation between the LRFD Load Combinations and the AASHTO Standard Specification's Combination of Loads, the following criteria shall be followed:

- Strength I is equivalent to Group I.
- Strength II (permit vehicle) is equivalent to Group IB.
- Fatigue loading should be neglected for the foundations.
- Collision Vehicle loading has no comparable Group. It may be treated like an extreme seismic event. A Group 7CV may be formed. Bearing pressures/pile capacities may be checked against ultimate capacities.

Reinforced concrete footings/pile caps may be checked using a 33% increase in allowable stress.

- Friction is present in all LRFD groups except Fatigue, whereas the 16th edition of AASHTO considers it only in Groups III, IV & V. It is recommended that the full friction load be applied to Groups III, IV & V. A portion of lateral loads occurring in other Groups, which are transmitted through friction at expansion bearings, would be accounted for in other groups.

- The TU/CR/SH & TG loads would be applied to Groups III, IV & V. Note that the LRFD code applies different factors to these loads for different conditions and cases. A factor 1.00 should be applied vs. the permitted 0.5 permitted for strength.

10.6 SPREAD FOOTINGS

10.6.3 Resistance at the Strength Limit State

10.6.3.1 Bearing Resistance of Soils Under Footings

10.6.3.1.1 General

The following is added:

The criteria under 10.6.3.1.3 – Semiemperical Procedures shall be followed in the design of spread footings.

Also, refer to Section 16 of this Manual for additional criteria concerning Foundation designs.

SECTION 11 - ABUTMENTS, PIERS AND WALLS

11.1 SCOPE

The existing text is changed to:

The design of partial depth and full depth abutments, conventional retaining walls, anchored walls, mechanically stabilized earth (MSE) walls, and prefabricated modular walls shall be based on the Allowable Stress Design (Service Load Design) Method of the current AASHTO Standard Specifications for Highway Bridges.

11.10 MECHANICALLY STABILIZED EARTH (MSE) WALLS

11.10.1 General

The following is added:

The use of extensible reinforcement in MSE walls is not permitted.

Also, refer to Section 17 of this Manual for additional criteria concerning Retaining wall designs.

SECTION 12 – BURIED STRUCTURES AND TUNNEL LINERS

12.11 REINFORCED CONCRETE CAST-IN-PLACE AND PRECAST BOX CULVERTS AND REINFORCED CAST-IN-PLACE ARCHES

12.11.1 General

The 2nd paragraph is changed to:

Designs shall conform to applicable articles of these Specifications, except as provided otherwise herein, and with the additional exception that Precast Concrete Box Culverts, Precast Concrete Arch Structures and Precast 3-Sided Concrete Structures shall be designed in accordance with the Working Stress (Allowable Stress) Method of the current AASHTO Standard Specifications for Highway Bridges.

SECTION 13 - RAILING

13.4 GENERAL

The last sentence of the third paragraph is deleted.

13.7 TRAFFIC RAILING

13.7.1 Railing System

13.7.1.1 General

The following is added:

Railing system dimensions shall preferably conform to those systems detailed in Section 23 of this Manual. The NJDOT Roadway Design Manual should also be referred to assure proper geometry between the roadway of bridge section. Bridge curb heights should be the same as roadway curb heights.

13.7.2 Test Level Selection Criteria

The following is added:

Refer to Section 23 of this Manual for guidance in determining bridge railing crash tested level selection.

13.11 CURBS AND SIDEWALKS

13.11.2 SIDEWALKS

When curb and gutter sections are used on the approach roadways to a bridge, the curb height on the bridge shall match the curb height of the approach roadway.

SECTION 14 - JOINTS AND BEARINGS

14.5 BRIDGE JOINTS

14.5.3.2 Movements In Service

Equation 14.5.3.2-1 is changed to:

$W \leq 2$ inches

14.7 SPECIAL DESIGN PROVISIONS FOR BEARINGS

14.7.10 Other Bearing Systems

The following is added:

Only those bearing systems that are discussed in Section 24 of this Manual are permitted.

(NOTE: End reference to AASHTO LRFD Section Number Designations)

1.3.3 OVERHEAD AND CANTILEVER SIGN SUPPORT STRUCTURES

The current NJDOT Sign Support Structure Standard designs are in accordance with the current AASHTO Standard Specifications for Highway Bridges and the 1994 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

For structural design criteria concerning Variable Message Sign (VMS) structures, refer to Section 32 of this Manual for guidance.

For additional information, see Sections 32 and 33 of this Manual.

1.3.4 PEDESTRIAN/BICYCLE TRAFFIC BRIDGE STRUCTURES

(a) The AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS (with current Interims) and as modified throughout this Manual shall govern the design of bridge structures for use by pedestrian or bicycle traffic. Also, the AASHTO Guide Specifications for Design of Pedestrian Bridges and the AASHTO Guide for the Development of Bicycle Facilities may be referred to for additional guidance.

Additionally, NJDOT has published the Pedestrian Planning and Design Guidance that may also be referred to for guidance.

(b) In accordance with the provisions of Subpart 3.6.1.6 of the AASHTO LRFD Bridge Design Specifications, bridges that only carry pedestrian and/or bicycle traffic shall be designed for a live load of 0.085 kips per sq. ft.

(c) When vehicular access is not physically restricted, the potential for the use of a pedestrian bridge by an occasional maintenance vehicle should be considered in the design of the bridge. According to the provisions of the above referenced AASHTO Guide Specifications, the following vehicular loads should be used for the indicated lane widths:

- Clear deck width: 6 ft. to 10 ft. – 10,000 lbs (H-5 Truck)
- Clear deck width: over 10 ft. – 20,000 lbs (H-10 Truck)

(d) Vertical underclearances shall be as established in Subsection 1.3.2 of this Manual.

(e) Ramp type approaches together with auxiliary stairways and fencing shall be used. Ramps shall be a minimum of 8'-0" wide with a maximum grade of 8.33 percent. Stairway width shall be 6'-0", with 11 inch treads and 7 inch risers. Non-slip nosing shall be provided on stairs. Intermediate level platforms shall be provided in all cases.

(f) Walkway width on the span(s) shall equal the width of the approach that includes graded shoulders but, shall not be less than 8'-0".

(g) Chain link fence (enclosed type) shall be provided on the portion of the bridge which spans the roadway, including shoulders. Use of chain link fence on ramps and/or stairways of the pedestrian bridges will be determined on a project to project basis. See Clearance Diagrams on pages 1.23-6 and 1.23-7.

(h) Simple or continuous spans members shall be designed so that the deflection due to service live load shall not exceed 1/800 of the span length.

1.3.5 MOVABLE BRIDGE STRUCTURES

The design of movable bridge structures shall be in accordance with the AASHTO LRFD Movable Highway Bridge Design Specifications. (It is intended that these specifications be used in conjunction with the requirements of Subsection 1.3.1 of this Manual).

When the design of a Movable Bridge involves the design of approach bridge sections, the approach bridge sections shall be designed in accordance with the AASHTO LRFD Bridge Design Specifications and as modified within this Manual.

The inspection, evaluation and maintenance of movable bridge structures shall conform to the requirements of the current AASHTO Movable Bridge Inspection, Evaluation and Maintenance Manual.

SECTION 3A

AASHTO DESIGN SPECIFICATIONS, NJDOT MODIFICATIONS

This Section is applicable to the design of those bridge structures described in Section 44 of this Manual. As described in Section 44, the continued use of the AASHTO Standard Specifications for Highway Bridges is permitted. The following criteria applies to the limited use of the AASHTO Standard Specifications.

All Guide Plates and Standard Plates in this Manual are based on the use of the AASHTO LRFD Bridge Design Specifications. They shall be accordingly modified when Section 3A criteria is to be followed.

1.3A.1 VEHICULAR BRIDGES

The current Edition of the AASHTO Standard Specifications for Highway Bridges (with current Interims) and the following modifications, to the respective AASHTO sections, shall govern the design:

(NOTE: All references to the document listed above will hereinafter be referred to as the AASHTO Standard Specifications for Highway Bridges. The following Section numbers refer to the AASHTO Division I section number designations.)

SECTION 2 - GENERAL FEATURES OF DESIGN

2.2.5 CURBS AND SIDEWALKS

When curb and gutter sections are used on the roadway approaches to a bridge, the curb height on the bridge shall match the curb height on the roadway approach.

2.2, 2.3
2.4, 2.5 HIGHWAY CLEARANCES FOR BRIDGES

For lateral clearances refer to Section 3 of the AASHTO Standard Specifications.

For vertical underclearances refer to the Table in Section 3 of this Manual.

2.7.1 Vehicular Railing

Vehicular railing shall be in accordance with Section 23 of this Manual.

SECTION 3-LOADS

3.3 DEAD LOAD

Superstructure designs for bridges which utilize One-Course deck slab construction shall include a 25 psf additional dead load to provide for a future 2 inch thick concrete overlay protective system. The 25 psf shall be considered as a secondary dead load.

Bridges with Two-Course slab construction, shall ***not*** include the 25 psf additional dead load.for superstructure design.

The top ½ inch of the concrete deck slab thickness shall be considered as a wearing surface. Consequently, it shall be considered as dead load, but shall not be considered effective in carrying secondary dead loads (except future overlay wearing surface) or live loads and impact.

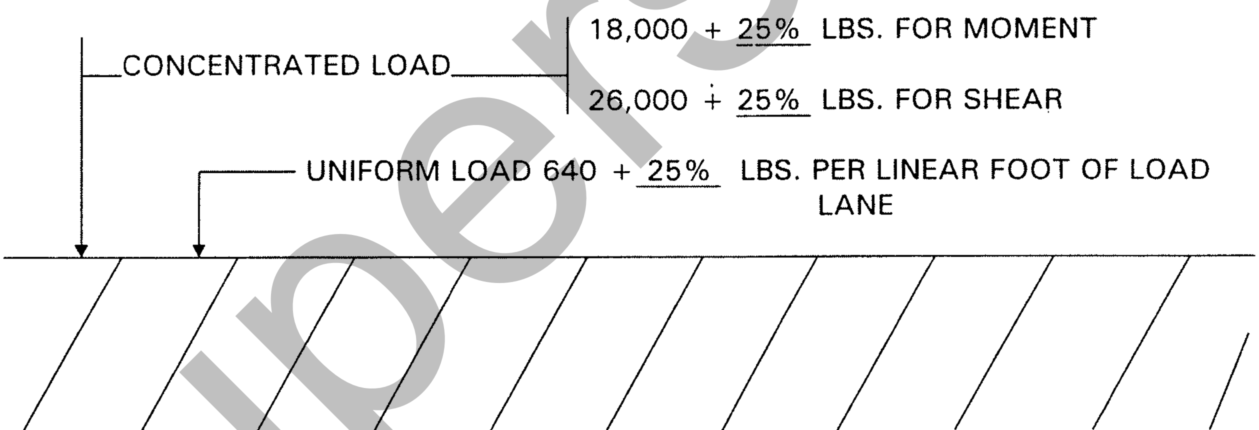
Also see Article 10.14 - Camber, as modified elsewhere herein, for metal Stay-In-Place forms and additional thickness of deck concrete.

Design calculations for slab thickness and reinforcement steel areas shall be made assuming removable forms.

3.7 HIGHWAY LOADS

3.7.2 CLASSES OF LOADING

The following Class illustration shall be added to AASHTO Figure 3.7.6 B:



HS20 + 25% (HS25)

Add the following STANDARD HS TRUCK to AASHTO Figure 3.7.7 A:

HS20 + 25% (HS25) SEE GUIDE PLATE 3.16-1.
Forces shown for HS 20 loading shall be proportionately increased by 25%.

Loading for HS20 + 25% (HS25) is 125 percent of the loading for HS20.

3.7.3 DESIGNATION OF LOADINGS

The increased design loading shall be designated HS20 + 25% (HS25).

3.7.4 MINIMUM LOADING

Refer to Section 44 of this Manual for vehicular loading usage.

3.16 THERMAL FORCES

In determining stresses for rigid frame piers on typical highway grade crossings on continuous footings, the temperature differential shall be 15° F for rise in temperature and 20° F for fall in temperature.

The temperature values established for "cold climate" shall be used for all other cases.

3.20 EARTH PRESSURE

3.20.1

". . . no structure shall be designed for less than an equivalent fluid pressure of 35 pounds per cubic foot . . ."

3.21 EARTHQUAKES

SEISMIC DESIGN AND RETROFIT OF HIGHWAY STRUCTURES

1. Refer to Section 45 of this Manual for Seismic Design and Retrofit criteria.

2. The Seismic Performance Category (SPC), as indicated in Table 3.4 of the above AASHTO Specifications, shall be **Category B** for the entire State.

3.24 DISTRIBUTION OF LOADS AND DESIGN OF CONCRETE SLABS

3.24.3 BENDING MOMENT

Add another line at the end of paragraph 2:

P20 + 25% = 20,000 pounds for H20 + 25% loading.

Add the following at end of HS15 loading formula for Case A method:

HS20 + 25% (HS25) loading:

Use 1.25 times the values obtained from the formulas for HS20 loading.

Add the following at end of HS15 loading formula for Case B method:

HS20 + 25% (HS25) loading:

Use 1.25 times the values obtained from the formulas for HS20 loading.

3.24.8 LONGITUDINAL EDGE BEAMS

3.24.8.2

Revise value of P in second paragraph as follows:

P = Wheel load, in pounds P20 (PS18 + 25%)

3.25 DISTRIBUTION OF WHEEL LOADS ON TIMBER FLOORING

3.25.1 TRANSVERSE FLOORING

3.25.1.3

Add K (design constant) for HS20 + 25% (HS25) in maximum moment formula:

HS20 +25% (HS25) = 0.64

3.29 MOMENTS, SHEARS AND REACTIONS

All values in the Table for HS20 Loading in Appendix A shall be proportionately increased 25% to conform to the above designated truck and lane load.

SECTION 4 - FOUNDATIONS and
SECTION 5 - RETAINING WALLS

5.8.1 STRUCTURE DIMENSIONS

Criterion for ultimate bearing capacity shall be in accordance with Article 4.4.7 for footings on soil and Article 4.4.8 for footings on rock.

5.8.3 BEARING CAPACITY AND FOUNDATION STABILITY

Criterion for ultimate bearing capacity shall be in accordance with Article 4.4.7 for footings on soil and Article 4.4.8 for footings on rock.

5.8.4.2 EXTENSIBLE REINFORCEMENTS

The use of extensible reinforcements for MSE walls is not permitted.

SECTION 8 - REINFORCED CONCRETE

8.14.1 DESIGN METHODS

8.14.1.1

The design of reinforced concrete members shall be made with reference to service loads and allowable stresses provided in SERVICE LOAD DESIGN.

8.15.2 ALLOWABLE STRESSES

8.15.2.1.1 FLEXURE

Extreme fiber in compression, deck slabs of vehicular bridges only...... $fc = 1{,}400$ psi

8.18 REINFORCEMENT OF COMPRESSION MEMBERS

Reinforcement in the compression face of deck slab shall not be considered in the design.

8.20 SHRINKAGE AND TEMPERATURE REINFORCEMENT

Deck slab top layer temperature - distribution steel shall be #16 @ 15″ centers.

8.22 PROTECTION AGAINST CORROSION

8.22.1

Top reinforcement cover shall be 2½ inches for One-Course bridge deck slabs. Top reinforcement cover shall be 1½ inches in the first course for Two-Course deck slabs.

Reinforcement cover shall be 2½ inches for overlay deck slabs on prestressed concrete slab or box beams.

Also refer to Subsection 1.20.2 of this Manual for additional guidance.

8.32 SPLICES OF REINFORCEMENT

The length of lap shall be designed based on the use of Grade

60 bars. The dimensions of all laps shall be shown on the Contract Plans.

SECTION 9 - PRESTRESSED CONCRETE

9.13 GENERAL

9.13.1 DESIGN THEORY AND GENERAL CONSIDERATIONS

9.13.1.2

Allowable Stress Design (Service Load Design Method) shall be used as the standard design method for all structure types. The ultimate moment capacity of the beam section shall be checked by the Strength Design Method (Load Factor Design Method) and be checked against the calculated cracking moment in accordance with Article 9.18.2. This moment capacity must be 1.2 times cracking moment of section to insure ductile failure.

Low relaxation strands shall be used and accounted for in the design of prestressed concrete beams.

Prestressing of strands shall be accomplished by pretensioning. The strands may be debonded or harped (draped).

9.15 ALLOWABLE STRESSES

Generally the design strength for prestressed concrete shall be f'c = 5000 psi (Class P concrete). The stress transfer shall not be made to the bridge members until the test specimens indicate that the concrete has reached a compressive strength of at least 4000 psi. The Engineer may use an optional, higher design strength of 5500 psi (Class P1 concrete) or 6000 psi (Class P2 concrete). For these cases,the respective specified concrete release strength shall be 4500 psi or 5000 psi.

9.15.2.2 STRESS AT SERVICE LOAD AFTER LOSSES HAVE OCCURRED.

Tension in the precompressed tensile zone shall be zero.

9.28 EMBEDMENT OF PRESTRESSED STRAND

9.28.1

The development length for all strand sizes up to and including 0.6

inches shall be determined as 1.6 times the AASHTO equation 9-32.

SECTION 10 - STRUCTURAL STEEL

10.3 REPETITIVE LOADING AND TOUGHNESS CONSIDERATIONS

10.3.2. LOAD CYCLES

10.3.2.1

The number of cycles of maximum stress range to be considered in the design shall be Case I from Table 10.3.2A for all vehicular bridges regardless of Type of Road. Any exceptions shall be subject to approval prior to the Preliminary Plan Submission.

10.3.3 CHARPY V-NOTCH IMPACT REQUIREMENTS

Section 917.10 of the NJDOT 2001 Standard Specifications for Road and Bridge Construction designates Zone 2 temperatures.

10.6 DEFLECTION

10.6.2

Members having simple or continuous spans shall be designed so that the deflection due to service live load plus impact shall not exceed 1/1000 of the span length.

The span length shall be considered as the distance center to center of bearing for simple spans.

For continuous spans, the span length shall be considered as the distance between points of contraflexure.

10.6.3

The deflection of cantilever arms due to service live load plus impact shall be limited to 1/400 of the cantilever arm.

The live load deflection for pedestrian bridges shall be limited to 1/400 of the span length.

10.8 MINIMUM THICKNESS OF METAL

Structural steel . . . shall be not less than 3/8 inch in thickness. (See Article 10.34.3 elsewhere herein for minimum web thickness of welded plate girders).

10.13 COVER PLATES

Welded cover plates shall be narrower than the flange to which they are attached. Research indicates that when cover plates are wider than the flange, fatigue strength is significantly reduced. If fatigue strength is reduced edge cracks may occur in the flange.

10.14 CAMBER

An additional 8 pounds per square foot shall be included in the camber computations to account for the dead load of permanent stay-in-place forms and 5 pounds per square foot shall be included to account for the average 3/8 inch additional thickness of deck concrete which fills the forms.

Reference Subsection 1.20.2 c. for additional concrete dead load which might be required if it is anticipated that the stay-in-place forms will be dropped to achieve minimum 1 inch concrete cover for curved or skewed bridge decks.

10.23 WELDING

10.23.1 GENERAL

Welding shall conform to the requirements of the ANSI/AASHTO/AWS Bridge Welding Code D1.5.

10.29 FIXED AND EXPANSION BEARINGS

10.29.1.3

Bearings shall be designed in accordance with Section 14 Division I and Section 18 Division II of the AASHTO Standard Specifications for Highway Bridges and the NJDOT Standard Specifications for Road and Bridge Construction.

PART C - SERVICE LOAD DESIGN METHOD (ALLOWABLE STRESS DESIGN)

10.31 SCOPE

Allowable stress design shall be used as the standard design method for all structure types.

10.34 PLATE GIRDERS

10.34.3 THICKNESS OF WEB PLATES

Minimum web thickness shall be 7/16 inches.

10.34.4 TRANSVERSE INTERMEDIATE STIFFENERS

Design should minimize the number of intermediate stiffeners to the extent practical.

See Guide Sheet Plate 3.9-19 of this Manual for treatment of ends of stiffeners at compression and tension flanges.

Connection plates for utilities and other appurtenances should be bolted when it is necessary to secure them to main component members of the girders which are in tension.

10.34.5 LONGITUDINAL STIFFENERS

The use of longitudinal stiffeners shall be limited to spans greater than 200 feet.

The following note shall be added to Plans whenever a longitudinal stiffener is used:

A maximum of 2 splices will be permitted for longitudinal stiffeners. Under the requirements for Quality Control Inspection, prior to welding the stiffener to the stringer, the butt welds shall be radiographed,

10.38 COMPOSITE GIRDERS

10.38.2 SHEAR CONNECTORS

Welded Studs shall be used for shear connectors. See Guide Plate 3.9-2 of this Manual.

10.38.4 STRESSES

In continuous spans, the positive moment portion shall be designed with composite sections as in simple spans. The negative moment portion shall be designed as a non-composite section; however, shear connectors shall be provided at a nominal pitch of 24 inches to 36 inches. Additional stud shear connectors shall be placed adjacent to the point of dead load contraflexure.

SECTION 12 - SOIL-CORRUGATED METAL STRUCTURE INTERACTION SYSTEMS

12.2 SERVICE LOAD DESIGN

Service Load Design shall be used as the standard design method for all structure types.

SECTION 17 - SOIL- REINFORCED CONCRETE STRUCTURE INTERACTION SYSTEMS

17.1.4 DESIGN

Design shall be based on the working stress principles. An alternate design method may be used, subject to the approval of the Manager, Bureau of Structural Engineering.

17.7 REINFORCED CONCRETE BOX, PRECAST

17.7.4.1 GENERAL REQUIREMENTS

Design shall conform to applicable sections of these specifications except as provided otherwise in this section and as modified by Subsection 1.30.4 of this Manual.

(NOTE: End reference to AASHTO Division 1 Section Number Designations)

1.3A.2 GENERAL NOTES

The following notes (when applicable) shall be used as design criteria and shown in the right hand corner of the General Plan and Elevation Sheet for each structure. Note 10 shall be deleted from the plan sheet at the time of the final submission.

1. Design Specifications

   (a) AASHTO Standard Specifications for Highway Bridges, 17th Edition, as modified by Section 3A of the NJDOT Design Manual for Bridges and Structures.

   (b) Allowable Fatigue Stresses based on Case 1 of AASHTO Table 10.3.2A.

2. Construction Specifications

   (a) NJDOT Standard Specifications for Road and Bridge Construction as modified by the Special Provisions. (Insert current date as appropriate)

3. Live Load

   (a) AASHTO HS20 + 25% (HS25) or tandem 24 kips axles at 4 foot centers, whichever governs. (As per the criteria of Section 44 of this Manual, HS20 + 10% may be used.)

4. Concrete Design Stresses

(a) Specified Design Compressive Strength f'_c

(In accordance with the Retest Limit for Pay-Adjustment Items as specified in Table 914-4 of the NJDOT Standard Specifications and as may be modified by the Special Provisions).

Class A .... 4000 psi
Class B .... 3000 psi

(The retest limit for non-pay-adjustment items shall be as specified on the last line of Table 914-4 of the NJDOT Standard Specifications and as may be modified by the Special Provisions).

(b) Class Design Strengths

(In accordance with Table 914-3 of the NJDOT Standard Specifications).

Class A .... 4600 psi
Class B .... 3700 psi

(c) Allowable Stresses Extreme Fiber in Compressive (fc)

Class A .... 1600 psi
Deck Slab of
Vehicular Bridges .... 1400 psi
Class B .... 1200 psi

5. Reinforcement Steel

ASTM A615 (Grade 60) (fs) = 24,000 psi

6. Superstructure

* (a) Dead load includes a 25 lbs/sq.ft. provision for a future 2 inch thick concrete overlay protective system on the bridge deck.

(b) Structural Steel: AASHTO M 270M/M 270, Grade ___________ (ASTM A 709/A 709M, Grade _________) with Supplementary Requirements for Notch Toughness for all member components marked (T).

(c) See Structural Steel Plans for Cleaning and Painting Systems, and Finish Coat Color.

(d) See Structural Steel Plans for any member or member components designated FCM's under the Fracture Control Plan.

(e) See Prestressed Concrete Beam Plan Sheets for details and notes.

* This note is applicable only for bridges which utilize one-course deck slab construction in accordance with Subsection 3.3, "Dead Load" and Subsection 1.20.2(f), "Deck Slabs, Design Criteria", of this Manual.

7. Seismic Design Notes

Seismic Performance Category (SPC) ____________________
Acceleration Coefficient "A" = ______________________
Soil Profile ______________

(Section 45 of this Manual should be referred to for guidance in providing this information.)

8. Borings

a) Indicates location of borings.
Log No.

9. Foundation Design Criteria

(Summary on Project to Project basis)

In addition, for those construction projects that include pile foundations, and use of the Wave Equation Analysis Program (WEAP) or a CAPWAP Analysis is required, the following, but not limited to, information shall be provided under the Foundation Design General Notes criteria. For such projects, the Geotechnical Engineering Unit should be contacted for verification of required plan notes. Reference to Subsection 1.16.3.2.e. of this Manual for additional guidance is directed.

- Ultimate Pile Capacity
- Friction Driving Resistance
- If warranted, maximum soil resistance

10. Estimated Cost $ __________ Based on (Insert Year) prices.

1.3A.3 WALLS AND ABUTMENTS, DESIGN CRITERIA

1. Equivalent Fluid Pressure .... 35 Lbs. per Cu. Ft.

2. Weight of Soil .... 120 Lbs. per Cu. Ft.

3. Weight of Concrete .... 150 Lbs. per Cu. Ft.

4. f'c .... 3,000 psi

5. fc .... 1,200 psi

6. fs .... 24,000 psi

7. Surcharge for Level Backfill .... 2 Feet

8. Sloping Surcharge .... Variable – Use acceptable method such as Coulomb or Rankine's method.

9. Sliding Factor of Safety 1.5

10. Overturning Factor of Safety .... 2 for footings on soil
.... 1.5 for footings on rock

11. Vertical Load Per Foot of Approach Slab Reacting on Abutment Backwall:

    Treat Approach Slab as a 25 foot simple span beam.

12. Horizontal Thrust Force for Approach Slab Resting on Abutment Backwall: None

13. Surcharge due to Temporary Construction Equipment and any temporary overstress permitted (this is used for extraordinary conditions but shall not exceed the following):

    Variable: 50% maximum overstress for structural components; 25% overstress for foundations.

14. Lateral Loads on Piles

    The lateral load design capacity of piles is a function of the flexural stiffness of the shaft, the stiffness of the bearing soil in the upper portion of the pile and the degree of fixity in the pile head. It is also related to the amount of lateral deflection permitted, method of placement and pile group action.

    (a) The following allowable forces should be used for determining the lateral resistance of piles, if minimal site specific information exists regarding the foundation soil parameters in accordance with AASHTO Subsection 4.3. However, if more extensive subsurface exploration is to be performed, then analytical design methods may be used, as stated in part (b) below.

Pile Type	Lateral Resistance
12" Nominal Steel-H	8 kips
12" Timber	4 kips
12" Cast-in-Place Concrete	6 kips
12" Precast Concrete	6 kips

The values above are applicable only for the pile types specified and if the upper limit of the pile is in compact, granular material.

(b) In lieu of the above values, a detailed analytical analysis will be permitted under the following conditions:

1) The chosen analytical method shall conform to those accepted and approved by the FHWA (refer to the FHWA Manual on Design and Construction of Driven Pile Foundations).

2) Analytical methods can only be used in cases where extensive soil investigation has been performed within the footing area.

3) Tolerable movement criteria for footings is in accordance with AASHTO Subsections 4.4.7.2.5 and 4.5.12. Special consideration shall be given to footing movements for continuous bridges.

(c) When piles are battered, the horizontal component due to the batter of the pile is added to the lateral resistance.

15. Horizontal load taken by pile in lieu of or in addition to use of batter:

Same as lateral loads on piles 14 (a).

16. Temperature and Distribution Reinforcement:

No. 4's at 12″ spaced horizontally in the exposed face of walls.
No. 4's at 18″ spaced vertically in the exposed face of walls.
No. 4's at 18″ (minimum) spaced horizontally in the rear face of walls.

17. Top heel steel is designed to support the entire weight of superimposed material plus dead load of footing without reduction from minimum upward soil pressure acting beneath heel.

18. Passive forces are to be disregarded for all factors of footing and wall design.

19. Minimum footing thickness shall be 2 feet (add one foot if piles are used).

20. The designer shall verify the need for batter in walls under 10′-0″. Walls over 10′-0″ shall have a minimum batter of 1″ per foot. The wall height shall be measured from the top of the footing at the rear face of the stem to the top of the wall.

21. Rear face of abutments shall be plumb, 0″ on 12″.

22. Reference AASHTO Table 5.5.2B for guidance in selecting friction factor coefficients for various soil types. These vales should be utilized unless otherwise established by laboratory tests.

Adhesion values for cohesive soils shall range from 100 psf to 1200 psf and shall be verified by laboratory or field tests.

23. Resultant Center of Pressure

(a) When the foundation is on soil, the resultant shall be within the middle third of the footing.

(b) When footings are founded on rock, the resultant may fall within the middle half, provided the factor of safety against overturning is adhered to.

24. Toe design based upon cantilever design with earth pressure acting up and weight of concrete acting down.

25. Refer to Section 16 of this Manual for material for steel H-piles.

26. Pile Capacities:

(a) Timber Piles – For round timber piles, the maximum allowable working stress shall not exceed the values listed in AASHTO Table 4.5.7.3A.

1) Bearing Piles – Structural capacity shall be equal to the allowable working stress multiplied by the pile tip area.

2) Friction Piles – Structural capacity shall be based on the allowable working stress multiplied by the critical pile section area.

Timber piles should not be used where seismic design considerations are critical.

(b) Cast-in-Place Concrete Filled Steel Pipe Piles – The maximum allowable stress shall not exceed 0.25Fy + 0.40 f'c applied over the cross sectional area of the steel pipe and on the gross cross sectional area of the concrete respectively.

(c) Precast Concrete Piles – The maximum allowable stress shall not exceed 0.33 f'c over the cross sectional area of the concrete. For tapered piles, the tip area should be used in determining the allowable stress for bearing piles, and the critical section should be used in determining the allowable stress for friction piles.

(d) Prestressed Concrete Piles – For piles fully embedded in soils providing lateral support, the maximum allowable stress shall not exceed 0.33 f'c – 0.27f_{pe} on the cross-sectional area of the concrete, where f_{pe} represents the extreme fiber concrete compressive stress due to prestressing after all losses.

(e) Steel H-Pile and Unfilled Steel Pipe Piles – The maximum allowable stress in all cases shall not exceed 0.25 Fy over the cross-sectional area of the pile, not including the area of any tip reinforcement.

Where pile damage or deterioration could occur for any of the above stated pile types, the designer shall utilize a lower stress level than the maximum permitted in AASHTO in accordance with AASHTO Subsections 4.5.7 and 4.5.14.

27. Additional conditions to consider for stability of the structure should be checked in terms of:

    (a) Maximum acceptable post construction settlement.

    (b) Foundation soil's stabilization for minimum residual settlement.

    (c) Overall earth mass stability of the foundation soils and/or embankment supporting the structure.

    (d) Consideration of the foundation soils in the selection of the pile type and size.

    (e) Consideration of soil characteristics on the post construction effect on pile foundations (drag and additional lateral pressure).

28. The foregoing design criteria is intended for "typical" reinforced concrete walls with conventional heights and wall sections, in which the designer has an unrestricted ability to proportion the toe and heel dimensions of the footing.

    It is recognized that justification for exceptions to these criteria may be offered where certain combinations of conditions are present.

SECTION 4

RAILROADS

1.4.1 DESIGN CRITERIA

a. Railroad bridges shall be designed in accordance with the AREMA Manual for Railway Engineering.

b. All rail-carrying bridges and structures shall be designed for the AREMA E-80 loading with diesel impact instead of the AREMA E-72 loading.

1.4.2 VERTICAL UNDERCLEARANCES

Vertical underclearances shall conform to the table shown in Subsection 1.3.1 of this Manual.

1.4.3 LATERAL CLEARANCES

Lateral clearances shall conform to Guide Sheet PLATE 3.14-1.

1.4.4 PROTECTIVE SHIELD

A protective shield is required during the construction of spans over electrified tracks. Details shall be shown on plans and shall be subject to the approval of the appropriate Railroad Company. See Guide Sheet PLATE 3.14-2.

1.4.5 RAILROAD UTILITY AGREEMENT PLANS

Procedures to be followed by the Design units concerning Bridge sketches, preliminary plans, agreements and final plans shall conform to Department guidelines.

SECTION 5

BRIDGE TYPE SELECTION AND GEOMETRICS

1.5.1. BRIDGE TYPE SELECTION

a. Engineering, architectural (when warranted), and cost studies shall be prepared for each structure or group of structures. Where several structures are in close proximity with each other, studies may be prepared to show possible interaction with each other.

In the consideration of the need for a movable bridge structure, the long term investment associated with machinery maintenance, liabilities associated with navigation hazards and staffing the structure with operators should be considered. Also, the impact of traffic congestion due to openings should be considered. These issues should be addressed in assessing the cost and practicality of a movable bridge versus a fixed bridge.

b. These initial studies should be developed from a careful appraisal of the site, foundation, drainage conditions, highway limitations, and environmental impact, both present and future. The structural types proposed as a result of these studies must be based on the highest standards of creativity and engineering technique.

c. For a group of bridges in a contract, structure types should be similar so that similarity of construction details may result in economy of costs.

d. New materials and developments may be incorporated in the design of the proposed structures. This is provided that approval has been given by the Manager, Bureau of Structural Engineering.

e. Economy, aesthetics, maximum safety and infrastructure security are not incompatible in the design of structures. For grade separation structures, in urban as well as rural areas, the absence of shoulder piers allows for possible future widening of the lower roadway while removing sight line restrictions and minimizing safety hazards. The resultant "open" structure usually results in a more pleasing appearance.

f. In planning new bridges, the list of available structure materials and types of construction should be considered. The use of High Perforance Steel and High Performance Concrete is encouraged. At any given location, the ultimate selection should be based on suitability and aesthetics. This is with consideration of the bridge and its site as an entity and also as part of the surrounding environment.

The character and coloration of the terrain and the form of nearby structures should all be influences on the aesthetics proposed for the structure.

g. Superstructures of shallow proportion shall be strived for; however, stiffness requirements and other design considerations must be balanced against those of aesthetic appeal. Ordinarily, the superstructure should be of uniform depth from end to end. Unsightly details, which present abrupt discontinuities in the bridge profile, should be avoided.

h. In arriving at span proportions, substructure elements should be positioned well clear of travelled roadways. For lateral clearances to substructure elements, refer to the NJDOT Roadway Design Manual. Minimum lateral clearances are illustrated therein. Where considerations of economy permit, abutment faces should be at least 30 feet from roadways. Planning along these lines should result in proportions which are economical, aesthetic, and that provide maximum safety for the travelling public.

i. Abutments and wingwalls should be made as inconspicuous as possible by limiting the exposed height of the abutment (preferably stub to semi-stub). An appropriately aesthetic type treatment shall be proposed for all large exposed surfaces.

j. Concrete piers which are built near roadways should generally be of open-type construction (i.e. column bent piers). When supporting a multitude of closely spaced stringers, a common and simple frame consisting of a uniform depth cap beam on circular columns may be suitable. Often times, frame proportions are enhanced by allowing the cap beam to cantilever over the exterior columns with a variable depth that tapers to a minimum beyond the fascia stringer bearing. The slender tee-pier should not be overlooked for the support of high crossings or narrow structures.

k. New designs, as well as major rehabilitation work for high level or complex structures, should include permanent provisions for inspection, such as catwalks, in order to make bridge members accessible. Bridge design engineers should ensure that easy and adequate access can be achieved, especially to pin-hanger assemblies, fatigue prone details and fracture critical members.

1.5.2 GEOMETRICS ON BRIDGES

a. It is generally accepted that the use of machine finishing for deck slab construction produces more durable and better quality bridge decks. Adverse geometrics, however, sometimes preclude the use of machine finishers. Highway and bridge designers shall make every effort to eliminate or minimize adverse geometrics on bridge decks during the design phases.

b. The magnitude and complexity of modern highway bridges are often characterized by the introduction of certain features; such as, horizontal curves, vertical curves, variable bridge widths for on and off ramps, variable cross-slopes and many others. These features are often incorporated in bridge designs without a rational analysis during the initial design stages of the project and evolve as an outgrowth of the adjacent approaches. Justification for the inclusion of adverse conditions should be prepared by the highway designers. Such justification should be included in the Design Appraisal. These features should be avoided where possible.

c. The number of curved bridges is increasing. If properly planned for at the project inception, horizontal curves could frequently be included in the contiguous approach roadways, especially in rural areas where the right-of-way might not be a determining cost factor. Curved bridges are generally more costly than straight bridges. For steel girder superstructures, heat curving the girders or cutting flange plates to meet the curvature will add to the steel cost. Superelevation and additional labor could increase the overall project cost by about 10 to 15 percent.

d. Wherever possible, vertical curves, both crest and sag, should be located away from the bridge. It is economically advantageous to place a bridge on a tangent grade rather than on the vertical curve. Cambering girders for vertical curvature is more costly than tangent girders since excessive camber may entail cutting the web to the required curvature, thus wasting steel and increasing fabrication costs. Increased construction costs will result from forming a bridge deck on a curve in view of the additional labor required to achieve the plan precision in forming the deck.

e. Except for major interchanges, it may not be necessary to include the geometrics for the on and off ramps on the bridge. These could be designed to clear the bridge in the interest of economy. When an off ramp is made part of a bridge, the gore area including its supports should include crash cushions. This will also increase costs.

f. A comprehensive and diligent analysis should be made of the entire project at the preliminary design stage. This should be the basis for designing curves and ramps away from the structures to the maximum extent feasible since they generally increase the bridge cost. Locating curves and ramps on the approach highways rather than on bridges results in simpler construction, is more economical, and reduces future maintenance requirements. Although it is more desirable to avoid curves and ramps on bridges, their absolute elimination is not proposed. Rather, it is believed that there are locations where alignment of bridges on curves is unable to provide the much sought highway geometry. Determination of the final design of straight versus curved bridges, constant or variable width, should be based on comparative cost estimates of the alternatives.

g. If site conditions permit, in order to avoid the design and construction of skewed bridges, abutments that are ninety degrees to the upper roadway shall be developed. This may be accomplished by increasing one side of the span and not placing the abutments parallel to the lower roadway.

1.5.3 ALTERNATE DESIGNS

Studies during the Preliminary Design may conclude that alternate designs may be warranted for major bridges. The decision as to whether or not to proceed with an alternate design will be made, as recommended by the Manager, Bureau of Structural Engineering, by the Assistant Commissioner, Capital Program Management. On Federal Aid Full Oversight projects, this decision will be made in conjunction with FHWA. The decision will be made on a project to project basis at the scoping phase of the project.

1.5.4 LIFE CYCLE COST ANALYSIS

A Life Cycle Cost Analysis (LCCA) is defined as the total cost of an item's ownership over a specified period of time. This includes, as applicable, initial acquisition costs (right-of-way, planning, design, construction), operation, maintenance, modification, replacement, demolition, financing, taxes, disposal, and salvage value.

A LCCA to compare the benefits and costs that arise at different times in a bridge structure's life span shall be made in studying alternate design concepts. Future benefits and costs over the proposed time span of each alternative should be considered. A long term perspective should be considered in programming improvements and selecting among alternative design, maintenance, rehabilitation and reconstruction strategies in designing bridge structures.

In New Jersey, an important factor to consider in this process, especially in urban areas, is highway congestion. Investment decisions must consider the impact that is imposed on the traveling public in constructing bridge structures on congested highways. LCCA's will help the Department to identify and explain the real costs that it must bear in maintaining its bridge structures. Also, the LCCA will assist the Department in making the best use of available funds. The FHWA recognizes that a LCCA may result in proposals that call for potential allocation of significant funds.

The following paragraphs provide guidance in developing the principals for a good LCCA. These principals will allow the Department to identify its investment alternatives.

a. Design Life. Generally a longer design life should be considered for bridge structures. This is due to the realization that future Department and user costs, that are associated with maintenance of a bridge structure, will be high. For a bridge structure on the National Highway System (NHS) a design life of 100 years should be considered. This will require a longer analysis period. All project alternatives should consider this length.

b. User Costs. The costs and lost productivity to the public because of traffic delays should account for a high cost range consideration. Increased vehicle operating costs, accident costs and delay related costs should be considered in the LCCA.

c. Discount Rate. Future agency and user costs should be discounted to net present value or converted to equivalent uniform annual costs using appropriate discount rates. The selected discount rate should be based on guidance that is provided in the Office of Management and Budget (OMB) Circular A-94, "Guidelines and Discount Rate for Benefit Cost Analysis of Federal Programs".

d. Other Factors. Budgetary, environmental and safety considerations will influence the investment decision. These factors should be considered along with the results of the LCCA in evaluating the investment alternative.

e. Department Costs. Traffic control costs, during a maintenance or rehabilitation project, should be considered in the LCCA.

1.5.5 VALUE ENGINEERING

The use of Value Engineering (VE) in the planning, design and/or construction of structural work is encouraged. Consideration of life cycle cost shall be the primary purpose in applying VE to structural work.

a. Value Engineering is an effective tool for both product improvement and cost reduction. It should not be confused with the typical design review process nor should it be applied in a routine manner without warrant. Value Engineering should be employed when there is potential for a significant ratio of savings to the cost of the VE study or substantial improvements in program effectiveness. Value Engineering should be considered on all major structural projects, and on obviously high cost projects as well as standard details that are used repetitively on many projects.

b. For maximum benefit, VE should be employed as early as possible in the project development process so that valid VE recommendations can be implemented without delaying the progress of the project.

c. The NJDOT Standard Specifications for Road and Bridge Construction includes a VE specification which encourages the Contractor to propose changes in contract requirements which will accomplish the project's functional requirements at less cost. The net savings of each proposal should be shared with the contractor, or through the Contractor with subcontractors and suppliers, at a stated reasonable rate. Reimbursement for such share is eligible for pro-rata reimbursement of Federal-aid funds. The Department retains the right to accept or reject all proposals and acquire all rights to use the accepted VE proposals in current and future projects without restriction.

1.5.6 RETAINING WALLS

a. For projects in which alternate retaining wall structures are deemed feasible, the Department requires alternate retaining wall designs. The methodology provided under, Subsection 1.7.2 – Retaining Walls, of this Manual will be followed. The Designer will analyze site conditions during preliminary engineering and make recommendations regarding which wall system may be used.

   As per the guidance provided in Subsection 1.17.3 of this Manual, Mechanically Stabilized Earth Walls (MSE), Prefabricated Modular Walls or Crib Wall systems are permitted.

b. Conceptual wall plans, hereafter referred to as CONTROL PLANS, shall be provided in the final Contract Plans. The Control Plans shall be prepared by the Designer and shall include project specific details. Complete detailed proprietary wall drawings will not be included in the contract documents. After the award of the contract, complete proprietary wall plans for the selected wall will be prepared by the proprietor and submitted by the Contractor as shop drawings in accordance with Subsection 105.04 of the NJDOT Standard Specifications for Road and Bridge Construction. A set of original drawings will be added to the record set of the contract documents after approval of the shop drawings.

c. When special site conditions only permit construction of certain type proprietary walls, design and preparation of detailed proprietary drawings for the permitted wall types shall be done and included as part of the contract documents. Special site conditions shall include, but not be limited to, the following:

   - excessive height of wall (more than 30 feet)
   - poor foundation conditions (low allowable bearing pressure)
   - constructability
   - noise barriers mounted to wall
   - longitudinal drainage in the common structure volume
   - obstructions such as sign structures

1.5.7 ACCIDENT ANALYSIS FOR BRIDGE GEOMETRICS

Designers shall analyze the geometrics of a bridge; such as, bridge width, based on the following guidance and according to the following Table:

- Increase the difference between the width of the bridge and the width of the approach lanes from 0 to 3 feet. This will decrease accidents by about 40 percent, with the first 12 inches of widening accounting for nearly one-third of this reduction.

The incremental safety gains of widening bridges decrease as the clear bridge width increases (i.e. the first 12 inches of bridge width beyond the travel lanes has three time the effect on accident rates as the tenth 12 inches).

PROBABILITY TABLE OF BRIDGE ACCIDENT PER MILLION VEHICULAR PASSAGES

Bridge Relative Width in Feet and Inches	Approach Roadway Width in Feet							
	16 Feet to 18 Feet	18 Feet to 20 Feet	20 Feet to 22 Feet	22 Feet to 24 Feet	24 Feet to 26 Feet	26 Feet to 28 Feet	28 Feet to 30 Feet	Over 30 Feet
Over 6 Feet Narrower	1.200	0.767	0.436	0.135	0.060	0.030	0.200	0.163
4 Feet to 6 Feet Narrower	1.200	1.171	0.757	0.686	0.604	0.533	0.472	0.150
2 Feet to 4 Feet Narrower	1.194	0.476	0.490	0.503	0.500	0.400	0.300	0.140
0.0 to 2 Feet Narrower	0.611	0.649	0.553	0.695	0.479	0.500	0.400	0.130
0.0 to 2 Feet Wider	0.344	0.496	0.330	0.529	0.319	0.497	0.677	0.120
2 Feet to 4 Feet Wider	0.641	0.319	0.319	0.308	0.477	0.448	0.420	0.105
4 Feet to 6 Feet Wider	0.217	0.200	0.193	0.256	0.224	0.176	0.128	0.080
6 Feet to 8 Feet Wider	0.254	0.170	0.234	0.061	0.162	0.113	0.064	0.056
8 Feet to 10 Feet Wider	0.165	0.000	0.170	0.145	0.333	0.331	0.200	0.120
10 Feet to 14 Feet Wider	0.140	0.123	0.120	0.083	0.148	0.171	0.068	0.176
Over 14 Feet Wider	0.113	0.110	0.066	0.090	0.098	0.102	0.299	0.248

1.5.8 CONTEXT SENSITIVE DESIGN

Context Sensitive Design is a comprehensive and balanced approach that considers social, natural and physical aspects, for all transportation actions. It fully assesses impacts of an improvement on the community, exploits design flexibility and involves all stake holders in developing solutions to project concerns. This design approach should be followed for all bridge structure work.

SECTION 6

BRIDGE SKETCH PLANS

1.6.1 GENERAL

Sample Typical Bridge Sketch Plans are shown on Pages 1.6-2 through 1.6-6.

Subsection 17.2 - Structure Sketch Procedures of the NJDOT Procedures Manual may be referred to for guidance in submitting Bridge Sketch Plans.

NEW JERSEY DEPARTMENT OF TRANSPORTATION

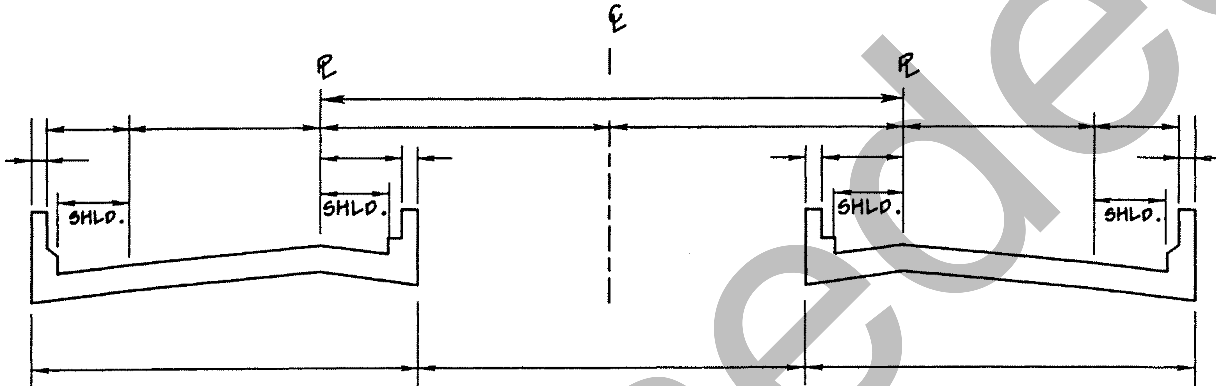
SHEET NO. 1 OF 5

ROUTE ______ SECTION ______ FEDERAL PROJECT NO. ______

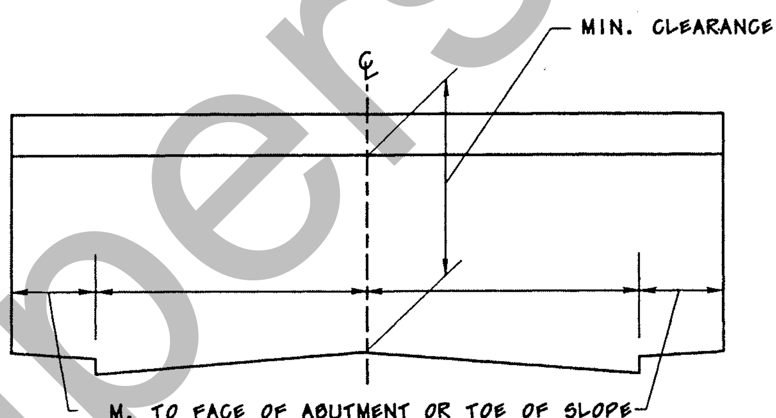
OTHER DESCRIPTION ______

ITEM NO. ______ ITEM DESCRIPTION ______

MADE BY ______ DATE ______ CHECKED BY ______ DATE ______



ROUTE ______ OVER ______
VIEW LOOKING ______



ROADWAY UNDER
VIEW LOOKING ______

THIS SKETCH FOR GEOMETRIC PURPOSES ONLY
BRIDGE TYPE SELECTION WILL BE DEVELOPED
DURING THE PRELIMINARY SUBMISSION

NEW JERSEY DEPARTMENT OF TRANSPORTATION

SHEET NO. 2 OF 5

ROUTE ________ SECTION ________ FEDERAL PROJECT NO. ________

OTHER DESCRIPTION ________

ITEM NO. ________ ITEM DESCRIPTION ________

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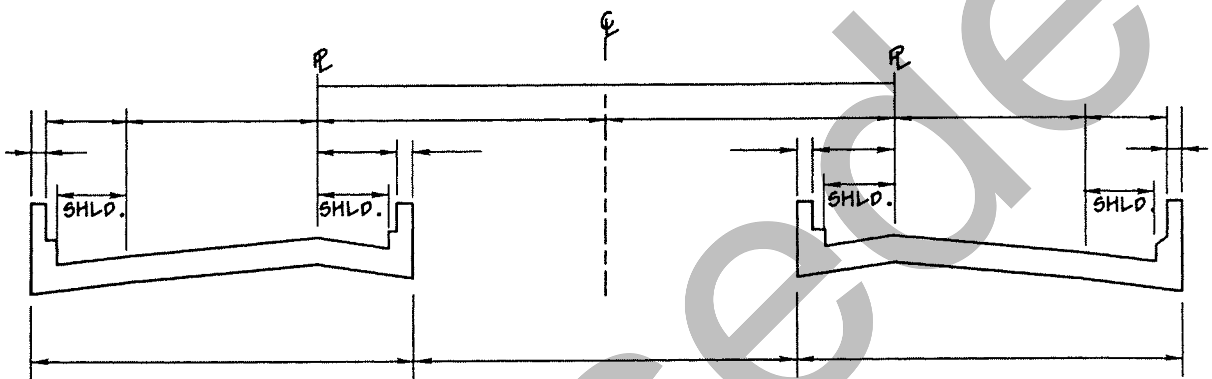

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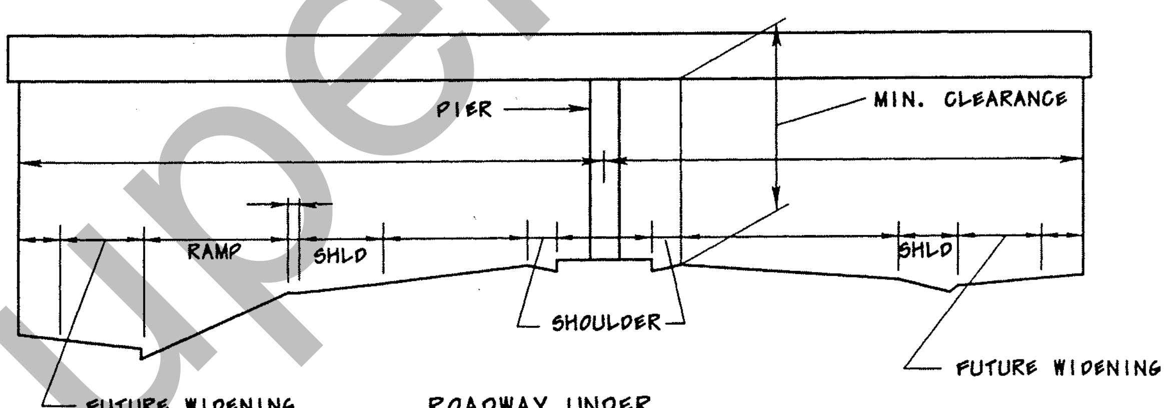

ROADWAY UNDER
VIEW LOOKING ________

THIS SKETCH FOR GEOMETRIC PURPOSES ONLY
BRIDGE TYPE SELECTION WILL BE
DEVELOPED DURING THE PRELIMINARY
SUBMISSION

NEW JERSEY DEPARTMENT OF TRANSPORTATION

SHEET NO. 3 OF 5

ROUTE ____________ SECTION __________ FEDERAL PROJECT NO. ____________

OTHER DESCRIPTION ______________________________

ITEM NO. __________ ITEM DESCRIPTION ______________________________

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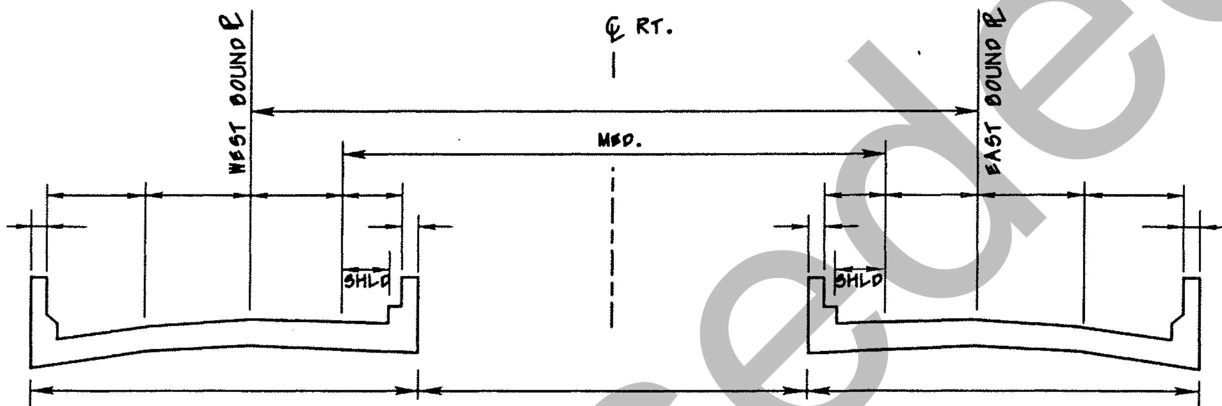

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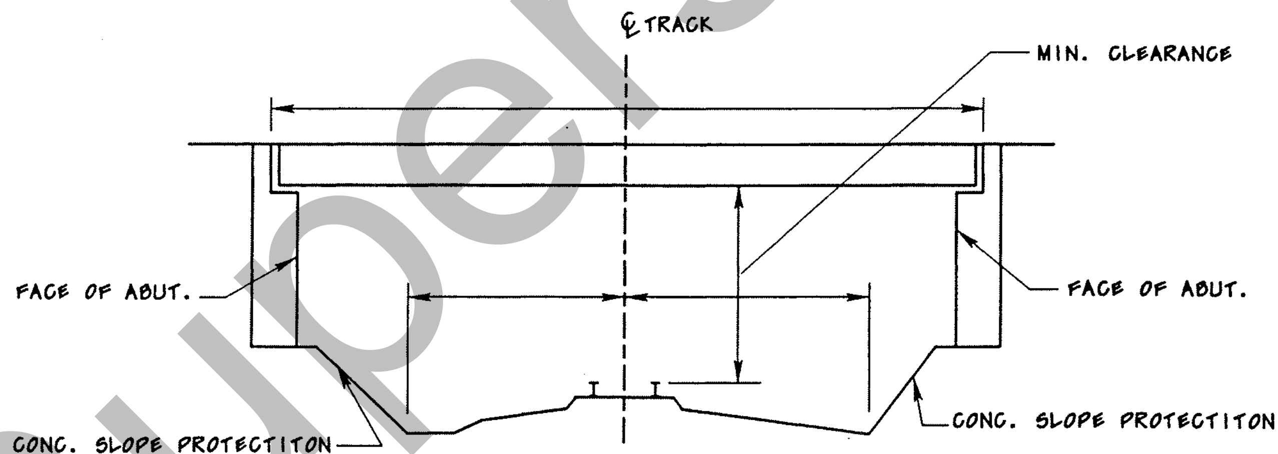
VIEW LOOKING ______



RAILROAD UNDER ______
VIEW LOOKING ______

THIS SKETCH FOR GEOMETRIC PURPOSES ONLY
BRIDGE TYPE SELECTION WILL BE DEVELOPED
DURING THE PRELIMINARY SUBMISSION

NEW JERSEY DEPARTMENT OF TRANSPORTATION

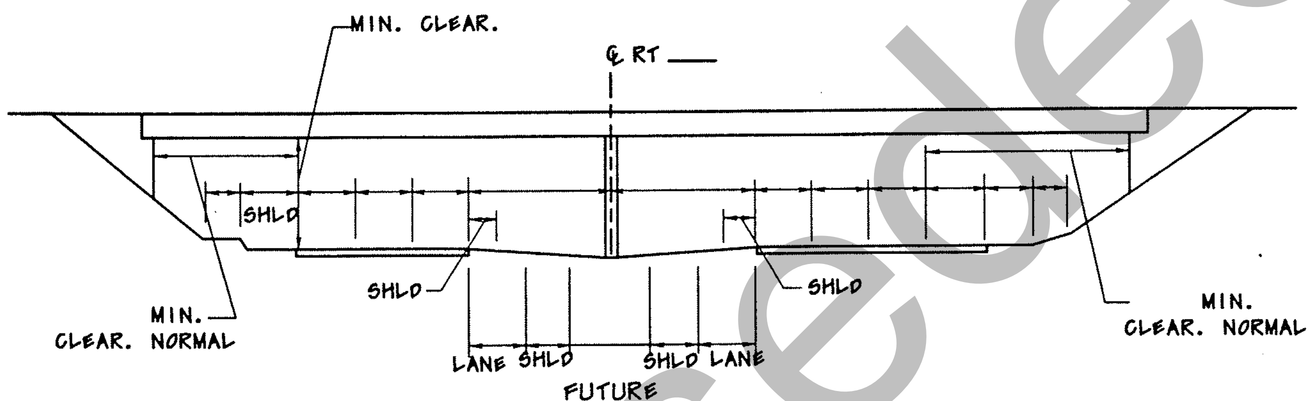
SHEET NO. 4 OF 5

ROUTE________ SECTION________ FEDERAL PROJECT NO.________

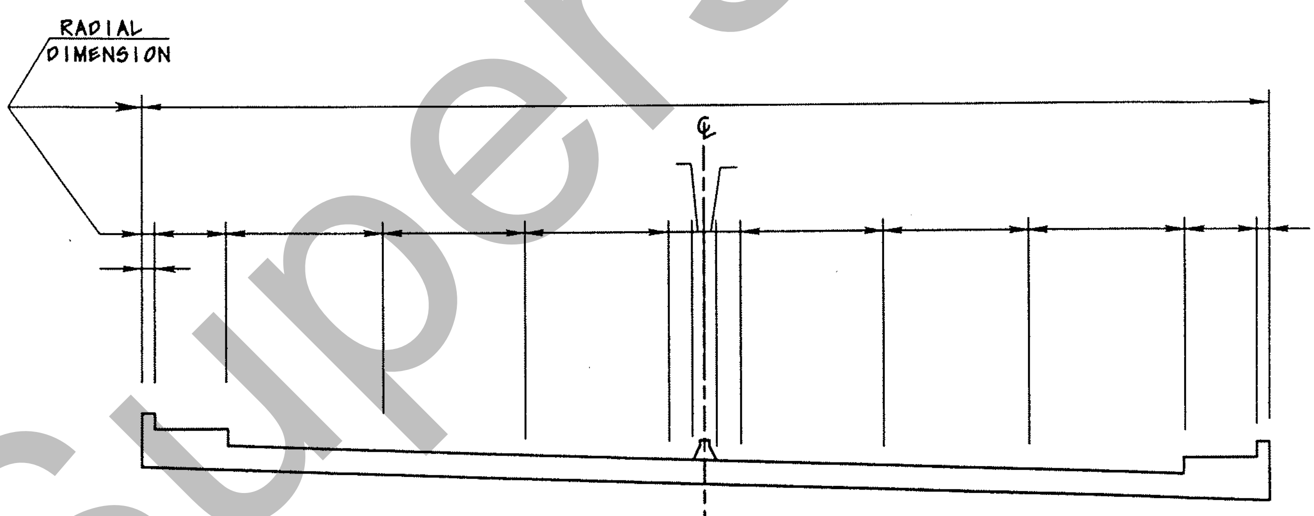
OTHER DESCRIPTION________

ITEM NO.________ ITEM DESCRIPTION________

MADE BY________ DATE________ CHECKED BY________ DATE________



RT. ___ UNDER ______ RD.
LOOKING ____



____ RD OVER RT. ___
LOOKING ____

THIS SKETCH FOR GEOMETRIC PURPOSES ONLY BRIDGE TYPE SELECTION WILL BE DEVELOPED DURING THE PRELIMINARY SUBMISSION

NEW JERSEY DEPARTMENT OF TRANSPORTATION

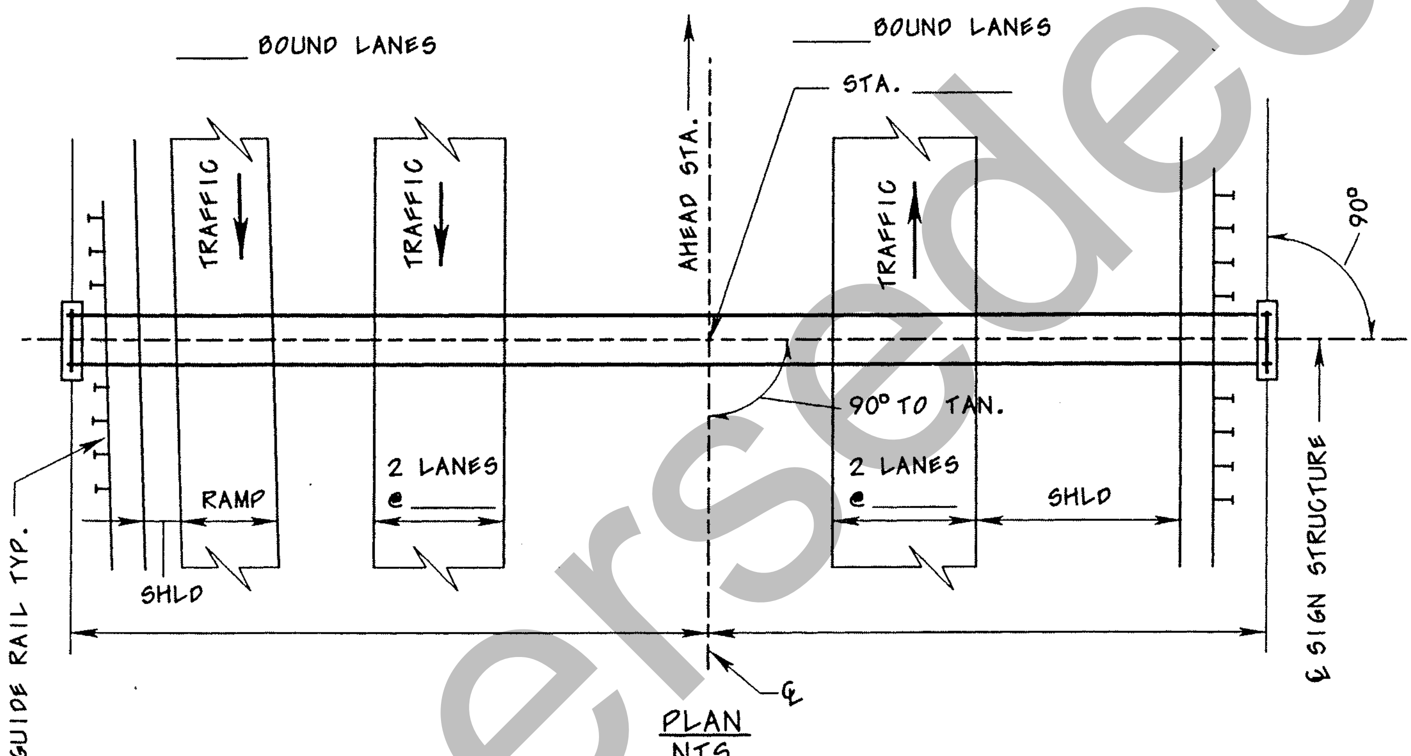
SHEET NO. 5 OF

ROUTE ________ SECTION ________ FEDERAL PROJECT NO. ________

OTHER DESCRIPTION OVERHEAD SIGN SUPPORT NO. ___

ITEM NO. ________ ITEM DESCRIPTION ________

MADE BY ________ DATE ________ CHECKED BY ________ DATE ________



PLAN
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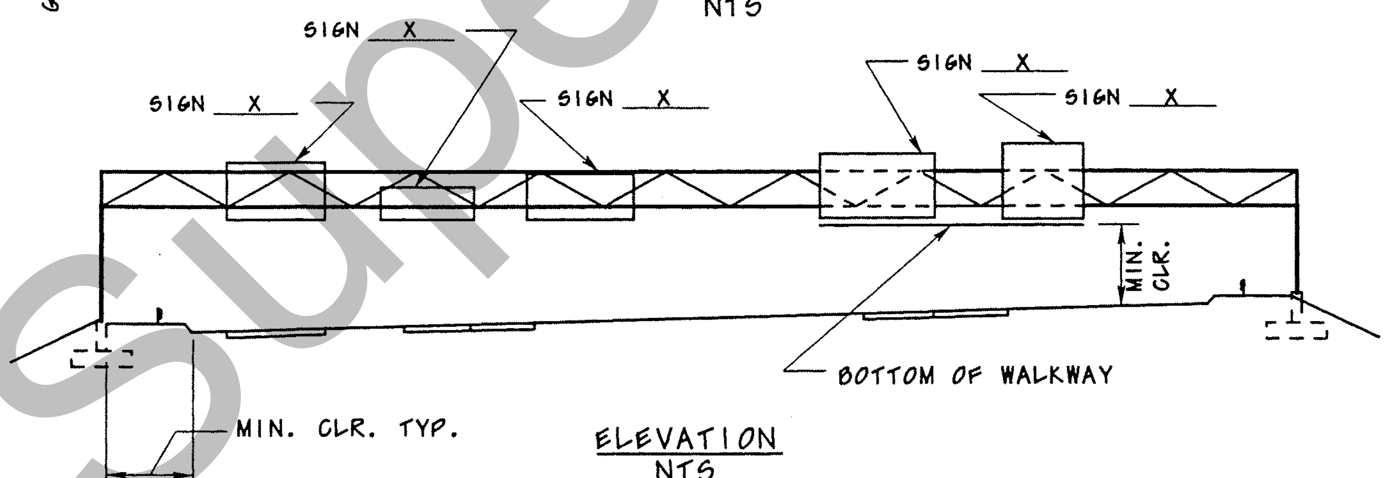


ELEVATION
NTS

THIS SKETCH FOR GEOMETRIC PURPOSE ONLY
BRIDGE TYPE SELECTION WILL BE DEVELOPED
DURING THE PRELIMINARY SUBMISSION

SECTION 7

PRELIMINARY BRIDGE PLANS

Refer to Section 17 of the NJDOT Procedures Manual for provisions governing submissions for new bridges and structures. Also, see Sections 9A and 9B of this Design Manual for provisions governing submissions for Reconstruction and Rehabilitation Contracts.

1.7.1 GENERAL

a. In the submission of Preliminary Plans, the submission should, as applicable, contain the following information:

1) Plan and elevation of a structure showing the following:

   - elevation grades of the structure and immediate approaches
   - span lengths
   - skew
   - controlling minimum horizontal and vertical clearances (also show the actual vertical clearance obtained)
   - type of superstructure
   - location of expansion and fixed bearings
   - proposed elevations of bottom of footing shall be indicated together with the original ground line, finished ground line, and assumed rock line (if any)

2) Typical section of bridge showing the following:

   - type, spacing and arrangement of beams
   - widths of median
   - traveled roadway
   - shoulder (or curb offset) and curb or sidewalk
   - type of railing or chain link fence
   - type of parapet
   - cross-slopes or superelevation

   A preliminary drainage design and layout arrived at through accepted means, as described in Section 22 - Deck Drainage, shall be included in these documents.

3) Typical section of approach roadway showing median, roadway and shoulder dimensions, and location of guide rail, if any.

4) The plan sheet should include Notes about design loading, design allowable stresses, etc. and the specifications under which the structure is to be designed (see Subsection 1.7.3).

5) The plan sheet should show the location of borings and log identification number.

6) Foundation pile design loadings shall be noted on the preliminary plan.

7) Profiles of roadway on the bridge and lower roadway should be shown.

8) Location of bridge mounted signs shall be shown if information is available at the time of submission.

9) Location of subsurface utilities and proposed utilities in the superstructure should be shown.

10) Hydraulic and hydrologic data shall be noted on plans for waterway structures.

11) If a railroad crossing, show existing tracks, profile on tracks, proposed horizontal and vertical clearances and topography along the railroad. (A separate Railroad Agreement Plan is to be prepared in accordance with Subsection 1.4.5).

12) Where water crossings are involved, horizontal and vertical clearances selected should be covered in the submission. Any special inlet-outlet treatment should be shown. A copy of required permits should be included.

13) Any design project which involves any bridge with substandard clearance and/or rating shall be brought to the attention of the Manager, Bureau of Structural Engineering. If it is possible to improve the deficiency, a determination will be made as to the proper improvement.

    A request for approval of the proposed improvement shall be formally submitted to the Manager, Bureau of Structural Engineering. If a Design Exception for any structural aspect is to be recommended, the criteria of Subsection 3.8 of the NJDOT Procedures Manual should be followed.

b. The Preliminary Submission shall include an evaluation of the proposed superstructure to determine if the structure warrants provision of an access mechanism whereby maintenance activities or inspections may be performed. If deemed warranted, the Designer shall recommend for approval to the Manager, Structural Engineering, installation of an underbridge access mechanism.

c. The Preliminary Submission shall consist of the following items:

- Preliminary Bridge Plans
- Design Recommendation Summary
- Foundation Report and Recommendation
- Construction Cost Estimate
- Seismic Retrofit Report (if applicable) (Refer to Section 45 of this Manual)
- Hydraulic and Scour Report (if applicable) (Refer to Section 46 of this Manual)
- Vessel Collision Report (if applicable) (Refer to Subsection 1.19.9 of this Manual)

d. Preliminary bridge plans shall be on 22 inch by 36 inch sheets and be in bound sets.

e. For all structural submissions, the Bureau of Structural Engineering will review and approve Preliminary bridge submissions. On full Federal oversight projects, concurrence by FHWA on the Preliminary submission is required. For other processes, the Bureau of Structural Engineering will provide approval of Preliminary bridge submissions to the Project Manager.

1.7.2 ALTERNATE RETAINING WALL SYSTEMS

The following methodology shall be followed in presenting a Preliminary Submission in which construction of alternate retaining walls is planned. Also, refer to Sections 3 and 17 of this Manual for design guidance.

a. Based on his preliminary engineering study of a project, the Designer shall recommend at the Preliminary submission if either Mechanically Stabilized Earth (MSE) or Prefabricated Modular Wall proprietary wall types; such as, Doublewal, or the T-Wall system or Crib Wall systems can be included in the contract preparation or if site conditions limit the type of alternate wall that can be utilized. This information should be provided in the Design Appraisal Statement. Approved proprietary wall systems shall be listed in the Project Special Provisions. The Designer shall prepare a Control Plan, that provides sufficient information to the proprietary wall supplier, for the design of the wall system. Refer to d. below for information that is to be provided in the Control Plan.

Refer to Section 1.5.6 of this Manual for governing site conditions that may limit the wall type selection.

b. Section 519 - Prefabricated Modular Walls and Section 520 - Mechanically Stabilized Earth (MSE) Walls of the Special Provisions to the Standard Specifications should be referred to for fabrication and construction requirements of approved proprietary wall systems.

Refer to Section 31 of this Manual for guidance in the presentation of a Crib Wall system.

c. If it is determined that only one type alternate wall system is suitable for a specific site, then the Control Plans may be developed with the intent that only that wall system is to be constructed. However, if it is somehow determined that only one particular MSE wall system or modular wall system is suitable for a project site, then a waiver must be obtained for use of the identified sole proprietary wall system.

d. Refer to Standard Drawings 2.10-1 and 2.10-2 for an example of a Control Plan presentation. The guidance provided in Subsection 1.17.3 of this Manual shall also be followed in completing the Control Plan. The Control Plans shall include, but not be limited to, the following information:

1.) Plan and elevation views of the wall(s)

The Elevation view of wall(s) shall show existing and proposed ground lines, elevations at 25 foot intervals at the top of wall and proposed ground line (used to compute quantities), wall embedment (maximum elevation at top of levelling pad) and beginning and end of wall stations.

2.) Control data for horizontal and vertical alignment

3.) Specific/nominal limits of the wall(s)

4.) Locations of existing and proposed utilities

5.) Boring locations

6.) General Notes

7.) Right of Way limits / construction easements

8.) If warranted, construction sequence requirements, traffic control, access, and stage construction sequence

9.) Work Item Quantities table

10.) Estimate of Quantities Table

11.) Limits of Common Structure Volume

12.) Limits and requirements for drainage features within the Common Structure Volume, limits and requirements which will affect the construction or stability of the wall beneath, on top of, and behind the retaining wall.

13.) At stream location, high water and normal water levels and scour protection

14.) Design parameters to establish External Stability factors, which shall include, but not be limited to, the following:

- Allowable Bearing Capacity
- Soil Unit Weight of Porous Fill
- Angle of Internal Friction for the Foundation Subgrade, Retained Soils, and the Soils within the Wall System
- Anticipated settlement
- If required, Foundation Subgrade Treatment
- Soil Unit Weight of Broken Stone
- Friction Factor of Broken Stone

15.) Magnitude, location and direction of external loads due to bridges, sign structures, traffic surcharge, etc.

16.) Seismic criteria

17.) Sections through wall showing offset control point, pay area, ditches, sidewalks, superelevation and any unusual features

18.) General details showing:

- End of wall interfaces
- Wall/coping/barrier or barrier interfaces
- Drainage pipe and inlet details, slip joint details
- Compatibility with roadway plans
- Excavation, temporary sheeting, cofferdam requirements
- Architectural details (such as dimensional requirements, special wall features; such as facing finish, texture, color or planting)
- Location and size of any existing or proposed structures
- Location of overhead signs or roadway lighting
- Location and height of noise barrier, if applicable

Guide Plates 3.4-7 through 3.4-12 may be used in presenting this information.

e. Foundation Report and Recommendation

1.) When alternate retaining walls are to be included in a project, the Foundation Report shall provide complete detailed information as to the reason for recommendation of alternate type retaining wall systems. The Designer shall evaluate global external stability, sliding, overturning, slope stability, bearing pressure, settlement.

2.) The Report shall indicate the maximum elevation at the top of leveling pads or footings and the design foundation pressures at those elevations.

3.) If soil subgrade treatment, soil enhancements and/or unsuitable material removal is required, the Report shall clarify such recommendations along with potential effects that the recommendations may have on the various alternates.

4.) In order to permit the availability of the Report to the Contractor, the Designer shall assure that the most current Report is provided to the Project Manager.

1.7.3 GENERAL NOTES

The following notes (when applicable) shall be used as design criteria and shown in the right hand corner of the General Plan and Elevation Sheet for each structure. Note 10 shall be deleted from the plan sheet at the time of the final submission.

1. <u>Design Specifications</u>

   The AASHTO LRFD Bridge Design Specifications, with current interims, as modified by Section 3 of the NJDOT Design Manual for Bridges and Structures.

   (The year of the current AASHTO LRFD Bridge Design Specifications should be inserted.)

2. <u>Construction Specifications</u>

   The NJDOT Standard Specifications for Road and Bridge Construction with current Supplemental Specifications, as modified by the Special Provisions.

   (This note may be modified to insert the current year and to refer to any updated specifications.)

3. <u>Live Load</u>

   AASHTO LRFD HL-93 Vehicular Live Loading or NJDOT Permit Vehicle, whichever governs.

4. <u>Concrete Compressive Stresses</u>

   (a) Design Compressive Strength - f'_c

Class A............................ 4,000 psi
Class B............................ 3,000 psi

(b) Class Mix Design Strengths

(In accordance with Table 914-3 of the NJDOT Standard Specifications)

Class A............................ 4,600 psi
Class B............................ 3,700 psi

5. Reinforcement Steel

ASTM A615M (Grade 60)

6. Superstructure

* (a) Dead load includes a 25 lbs/sq.ft. provision for a future 2 inch thick concrete overlay protective system on the bridge deck.

(b) Structural Steel: AASHTO M 270M/M 270, Grade ___________ (ASTM A 709/A 709M, Grade _________) with Supplementary Requirements for Notch Toughness for all member components marked (T).

(Also, refer to Section 24 of this Manual for permitted structural steel designations.)

(c) See Structural Steel Plans for Cleaning and Painting Systems, and Finish Coat Color.

(d) See Structural Steel Plans for any member or member components designated FCM's under the Fracture Control Plan.

(e) See Prestressed Concrete Beam Plan Sheets for details and notes.

* This note is applicable only for bridges which utilize one-course deck slab construction in accordance with Subsection 3, "Loads and Load Factors" and Subsection 1.20.2(d), "Deck Slabs, Design Criteria", of this Manual.

7. Seismic Design Notes

Seismic Performance Zone 2
Acceleration Coefficient "A" = ___________
Soil Profile _____________

(Section 45 of this Manual should be referred to for guidance in providing this information.)

8. Borings

a) Indicates location of borings.

Log No.

9. Foundation Design Criteria

(Summary on Project to Project basis)

For those construction projects with pile foundations, the following information shall be provided. For such projects, the Geotechnical Engineering Unit should be contacted for verification of required plan notes or to verify if any additional notes should be provided. **Reference to Subsection 1.16.3.2.e of this Manual is directed for additional guidance.**

- Pile Design Capacity
- Ultimate Pile Design Capacity
- Ultimate Pile Capacity During Driving
- Percentage of skin friction and the shape distribution associated with Ultimate Pile Capacity During Driving
- The required soil parameters of Skin Damping, Toe Damping, Skin Quake, and Toe Quake to be used in the WEAP.

10. Estimated Cost $ __________ Based on (Insert Year) prices.

SECTION 8

FINAL BRIDGE PLANS

Refer to Section 17 "Structures" of the NJDOT Procedures Manual for provisions governing final plan submissions of Bridges and Structures.

1.8.1 GENERAL

1. Contract drawings shall be on 22 inch by 36 inch sheets.

2. Preferably, plans, sections, and elevations should be drawn to a scale not less than ¼"= 1'-0" and details to a scale not less than 3/8" = 1'-0" except on the General Plan and Elevation Sheet.

3. Two (2) sets of the Design and Quantity Calculations shall be submitted as part of this submission.

1.8.2 SUBMISSION CRITERIA

The above referenced Section of the NJDOT Procedures Manual details the requirements that are to be provided on each structural plan sheet.

As defined in Subsection 1.3.2 of this Manual, under an addition to Subsection 5.10.8.3 of the AASHTO LRFD Bridge Design Specifications, the Designer shall indicate on the plans any concrete element that qualifies as a Mass Concrete placement.

1.8.3 ALTERNATE RETAINING WALL SUBMISSIONS

1. When the allowance of alternate type proprietary walls is permitted, **CONTROL PLANS** are required in the final contract documents. Refer to Subsection 1.7.2 for Control Plan requirements. Also, refer to Sections 3 and 17 of this Manual for controlling criteria.

   a. The Contractor shall be responsible for providing the design calculations and construction plans for the alternate retaining wall systems. The calculations shall include internal stability verification of the wall system. Sections 519, 520 and 521 of the NJDOT Standard Specifications should be referred to for guidance in providing such submissions.

   b. In accordance with Subsection 105.04 of the Standard Specifications, drawings and design calculations shall be submitted for review. Once the submission is found to be acceptable, the Contractor shall submit final signed and sealed design calculations, one (1) set of mylars and the required number of signed and sealed prints as per Subsection 105.04.

c. The Designer will sign and seal these mylars noting that the walls are checked for external stability and for conformance with the design concept of the project. Also, he will modify the Index of Drawings on the Contract set of plans.

d. The Designer will submit the final design calculations and the number of prints of approved wall plans to the Project Manager. Also, an additional set shall be furnished if Railroad structures are involved.

e. A note on the Control Plan shall be provided specifying which type of proprietary wall is to be constructed at each wall location.

2. When project site conditions limit the wall type system selection (refer to Subsection 1.5.6 of this Manual) complete proprietary wall designs shall be provided in the Contract set of plans.

a. All calculations, including the internal stability analysis as generated by the supplier of the wall system, shall be provided. Appropriate information shall be stated on the contract plans.

b. Complete information as to the proposed method of fabrication and erection of precast units and related components shall be provided. Shop drawings shall be prepared and submitted in accordance with the requirements specified under Subsection 105.04 of the Standard Specifications and as modified herein.

3. As per Subsection 1.7.2 of this Manual, when only one type proprietary wall system manufacturer can be used, a waiver must be obtained from FHWA.

4. The Department reserves the right to reject any alternate wall system or details which do not conform to the control plans, pre-approved details, NJDOT Design Manuals or AASHTO Specifications.

SECTION 9A

RECONSTRUCTION AND REHABILITATION PROJECTS

1.9A.1 CONCRETE BRIDGE DECKS

In the processes that are involved in construction, rehabilitation, and reconstruction of concrete bridge decks, with special emphasis on overlay protective systems, the following terminology shall apply:

(a) Construction means the initial construction of any specific bridge deck.

(b) Maintenance means routine or incidental work necessary to keep a bridge deck functioning in a safe and efficient manner.

(c) Overlay Protective System means a system used to protect bridge decks from deterioration induced by highway deicing chemicals, salt water, or other hostile environments.

(d) Reconstruction means the restoration of the structural integrity of a concrete bridge deck by complete removal and replacement of the existing deteriorated bridge deck.

(e) Rehabilitation means the work necessary to restore the structural integrity of portions of the original bridge deck as well as the installation of a deck protective system.

The following policies are established for all bridge decks to be constructed, rehabilitated or reconstructed with Federal-aid funds.

(a) Standard Specifications. Criteria that is included in the NJDOT Specifications for Road and Bridge Construction shall be adhered to.

(b) Full depth High Performance Concrete deck slabs that are designed for reliability and durability shall be the primary protective system for bridge deck construction.

(c) Overlay Protective System. When permitted, if a bridge deck is likely to be exposed to potentially damaging applications of deicing chemicals, salt water, or other hostile environment, a cost effective overlay protective system should be considered.

(1) The type of overlay protective system shall be based on the criteria established in the NJDOT Standard Specifications.

(2) The installation of an overlay protective system shall be governed by criteria stated in Section 20 of this Manual.

(d) Eligible Work. Reconstruction and rehabilitation procedures necessary to assure acceptable performance of existing structures are set forth below and are eligible for Federal-aid participation from the appropriate category. Reconstruction and rehabilitation shall include all work required to assure satisfactory performance of the concrete deck, as well as supporting superstructure and substructure units.

(1) This may include items such as the removal of existing overlays, removal and replacement of all deteriorated components or the complete removal and replacement of the entire bridge deck if necessary.

(2) This work may also include repair or removal and replacement of deteriorated concrete curbs, sidewalks, parapets, as well as rail, deck joints, bearings, or similar incidental items which are associated with proper functional restoration of the structure.

(3) Safety improvements should be undertaken with the above described work when such improvements eliminate an established hazardous condition. Such safety improvements may include widening, elimination of hazardous walks and substandard safety hardware, removal of hazardous fixed objects or the installation of energy absorbing barrier system, and any other features that are consistent with current safety standards.

Projects that include the replacement of a bridge deck or complete superstructure replacement shall utilize the AASHTO LRFD Bridge Design Specifications to design the deck slab or entire superstructure. Also, refer to 1.9A.6, herein, for additional guidance.

1.9A.2 FIELD CONDITION AND APPRAISAL SURVEY

(a) Where an existing bridge or structure is to be widened, altered, reconstructed or rehabilitated, reference shall be made to the Evaluation Survey Report for the bridge. This report may be obtained on a loan basis upon written request to the Manager, Structural Evaluation/Bridge Management Unit.

(b) In conjunction with the review of the Report, a limited Field Condition Survey shall be made to update the original inspection report. The supplementary report shall include recommendations for remedial work together with the preliminary cost estimate. The Field Condition and Appraisal Survey shall be submitted prior to submission of the Preliminary Plans.

The Department will determine and authorize the extent of the work to be included in the Contract Plans.

(c) Consistent with the policies and procedures established in Subsection 1.9A.1, safety improvements shall be considered for all reconstruction and rehabilitation projects. Recommendations shall be included in the Field Condition and Appraisal Survey (See Paragraph b). If not already included in the Scope of Work, the Department will determine and authorize the extent of work to be included in the Contract Plans.

(d) The minimum vertical underclearance shall be measured and noted, together with its location, in the Field Condition and Appraisal Survey (See Paragraph b). If the underclearance is substandard, a commentary about the extent of work that is needed to improve the situation, together with a preliminary cost estimate, shall be included. The Department will determine if a detailed retrofit study is warranted.

1.9A.3 DECK SLAB RECONSTRUCTION (REPLACEMENT)

Deck slab replacements shall be designed in accordance with the AASHTO LRFD Bridge Design Specifications and Sections 3 and 20 and other applicable provisions of this Manual. Existing stringers and/or beams must be analyzed to determine if additional Dead Load stresses may be introduced. Secondary Dead Load design requirements may also be a factor.

If the deck slab reconstruction work should impact bridge approach areas, the Design Engineer should refer to Subsection 1.20.11 of this Manual for guidance concerning provision of approach slabs.

All of these factors shall be considered in the design phase. If calculations indicate that the existing stringers and/or beams may become significantly overstressed, the matter, together with recommendations, should be brought to the attention of the Manager, Bureau of Structural Engineering.

Special measures such as requiring the use of removable deck forms, retrofitting stringers with shear connectors, design criteria exceptions, etc. may be required.

Additionally, the height of shear connector studs on the existing stringers should be considered. Additional studs may have to be added in order to conform to the design criteria under Subsection 1.24.6.

1.9A.4 SPECIAL CONDITIONS

(a) Any changes in the condition of the bridge superstructure, current at the time of the Final Plan Processing for the receipt of construction bids, which influence previous design decisions, should be considered. Special Provisions may be required in the Plans and Special Provisions for the following (if not already included in the contract documents):

- Construction Staging.
- Traffic controls and diversions.
- Authorized detours.
- Restricted working hours or days.
- Load restrictions for construction equipment.
- Posting for reduced speeds, substandard vertical underclearances and/or load capacities.

1.9A.5 CLOSURE OF DRAWBRIDGES

Contracts involving reconstruction or rehabilitation of drawbridges, where closures are expected, shall have suitable provisions written into the Special Provisions to conform to the regulations of the U.S. Coast Guard.

Requests for U.S. Coast Guard approval of proposed closures shall be channeled through the Manager, Bureau of Structural Engineering. Approval shall be received prior to advertising the contract for bids.

1.9A.6 SUPERSTRUCTURE REPLACEMENTS OR BRIDGE WIDENING PROJECTS

1. Superstructure replacements shall be designed in accordance with applicable criteria of the AASHTO LRFD Bridge Design Specifications and as may be amended within this Manual. Bridge widenings that will exceed 30% of the deck slab area will similarly be designed according to the AASHTO LRFD Bridge Design Specifications.

2. The substructure of a bridge that meets the above replacement or widening criteria shall be analyzed for its Strength I Limit State as per the guidance

provided in Section 6.4.3 of the AASHTO Manual for Condition Evaluation and Load and Resistance Factor Rating (LRFR) of Highway Bridges.

SECTION 9B

BRIDGE DECK REHABILITATION

1.9B.1 REQUIREMENTS

In addition to applicable construction plan requirements that are presented in Section 17 of the NJDOT Procedures Manual, the following shall apply:

1. Prior to the Preliminary Plan Submission, the following shall be performed:

   a. Review the Bridge Evaluation Survey Report or any prior Deck Evaluation Survey.

   b. Perform an on-the-site observation to determine if a Bridge Deck Evaluation Survey is warranted.

   c. Perform, if authorized, a Deck Evaluation Survey.

   d. Perform a Field Survey to determine existing/as-built geometrics and deck profile elevations at 10 foot intervals (if warranted).

   e. Contact the Bureau of Structural Engineering if it is found that the superstructure is substandard in load capacity or vertical underclearance. A determination as to whether a retrofit study is warranted shall be made.

2 The area of deck that is to be rehabilitated shall be designated as the area that is actually realized from the Deck Condition Survey or, as a minimum, fifteen (15) percent of the entire deck area.

3. Also, reference is directed to Section 12 of this Manual, "Bridge Deck Repair, Design Guidelines", for additional guidance concerning bridge deck repair contracts.

1.9B.2 CONTRACT PAY ITEMS AND QUANTITIES

The following contract pay items and Standard Specifications references shall apply in preparing bridge deck rehabilitation projects:

Standard Specifications Subsection	Contract Pay Item	Unit	Notes
----	Pavement Surface Removal	Square Yard	1
202.14 202.15	Removal of Hot Mix Asphalt Overlay	Square Yard	1
518.08 518.09	Repair of Concrete Deck, Type A	Square Foot	2
518.08 518.09	Repair of Concrete Deck, Type B	Square Foot	2
518.08 518.09	Repair of Concrete Deck, Type C	Square Foot	2
501.25 501.26	Reinforcement Steel in Structures	Pound	3
518.08 518.09	Membrane Waterproofing	Square Yard	1
404.25 404.26	Hot Mix Asphalt Surface Course, Mix _______	Ton	4
518.08 518.09	Concrete Overlay Protective System	Cubic Yard	5
518.08 518.09	Scarification	Square Yard	6
----	Modify Deck Drainage Inlets	Unit	
----	Reconstruct Concrete Headers	Linear Foot	
----	Repack Joints	Linear Foot	
----	Modify Steel Deck Joints	Linear Foot	

Standard Specifications Subsection	Contract Pay Item	Unit	Notes
503.17 503.18	Structural Steel Deck Joints (lbs)	Lump Sum	7
----	Remove ___ " by___ " Elastomeric Joint Sealer	Linear Foot	7
501.25 501.26	___ " by ___ " Reinforced Elastomeric Expansion Dam	Linear Foot	7
501.25 501.26	___ " by ___ " Preformed Elastomeric Expansion Dam	Linear Foot	7

Notes

1. Pavement surface removal is scheduled for existing bridges with Hot Mix Asphalt Overlay. Determine if waterproofing was also included and detail plans accordingly. Specifications in the Special Provisions should require that the waterproofing be removed.

2. Plans should outline Repair Areas, Repair Material, etc. when a bare concrete deck is scheduled for an overlay.

3. Reinforcement steel in structures for deck repair should be scheduled if it is determined that a reasonably large amount of Rebars will be required. If not scheduled, the Special Provisions should be modified accordingly.

4. Hot Mix Asphalt Surface Course is scheduled for resurfacing projects when approved prior to the Preliminary Plan Submission. Calculations must be submitted determining the influence of dead load on the existing superstructure caused by any additional thickness of Hot Mix Asphalt overlay that is proposed.

   Thickness of Hot Mix Asphalt Surface Course shall be noted on the Plans. Prescribed thickness for Hot Mix Asphalt Surface Course Mix I-4 or I-4 HD is 2 inches and for Hot Mix Asphalt Base Course Mix I-2, the minimum thickness is 2 inches. Design of an overlay in excess of this thickness and for use of a different mix shall be submitted for review and recommendations.

5. The standard minimum thickness adopted for concrete overlay protective systems is 1¼ inches. This thickness shall be noted on the Plans.

An additional 10% to 20% (depending on the concrete overlay area) should be added to the estimated quantity that is based on the 1 ¼ inches minimum thickness. This is based on the Designer's anticipation that additional thickness may be required at some locations to achieve the proposed plan profile elevations and cross-slopes.

In areas where additional thickness of a concrete overlay protective system is anticipated, the total overlay thickness should be clearly prescribed on the plans. In this case, the total concrete overlay thickness should be limited to 2 inches maximum. If the area of additional thickness is significant (compared to total overlay area), changes in the specifications for the overlay mix design and curing time should be considered in the Special Provisions for the Project.

Situations which would produce a concrete overlay thickness in excess of 2 inches require special solutions. For example, if substructure settlements have resulted in significant lowering of the original plan/as-built profile elevations, jacking of the superstructure at selected locations may be considered and scheduled as a contract pay item when warranted.

Specifications provide that when a concrete overlay protective system is used as the repair material in Type B Repairs, the volume of the overlay material that is used in the repair is not to be included in the volume of the overlay measured for payment, but is measured for payment in square feet under the item "Repair of Concrete Deck, Type ________", whichever applies.

6. Scarification is always scheduled for reconstruction projects using Concrete Overlay Protective Systems. The standard depth adopted for scarification is ¼ inch. This depth shall be noted on the plans. Where additional depth is required, the areas and depths should be clearly prescribed on the plans.

   In the case of a newly constructed bridge deck which has not been opened to traffic or, subjected to traffic and deicing chemicals for a relatively short time, and a concrete overlay protective system is to be added, scarification may not be necessary. Cleaning of the surface by sandblasting may suffice. Provisions should be included in the Special Provisions accordingly.

7. If new preformed elastomeric joint sealer and/or reinforced elastomeric expansion dams are proposed and approved for scheduling as a contract pay item, the ideal plan would be to provide a continuous sealer across the full width of the deck slab. If this is impractical, the Structural Design Engineer shall prescribe the location of splices on the plans depending on construction traffic staging.

   Concrete overlay protective systems will not bond properly to oil, epoxy, other contaminants, and rubber (neoprene). Use of reinforced elastomeric expansion dams exclusively as the "headers" is not recommended. Other details should be considered as part of the installation.

1.9B.3 MACHINE FINISHING FOR CONCRETE DECK OVERLAY PROTECTIVE SYSTEMS

(a) At this time, concrete overlay protective systems shall include Latex Modified Concrete and Silica Fume Concrete.

(b) Specifications under Article 518.03(A) require the use of a finishing machine for placing overlays. However, the Specifications also provide that "... Hand operated vibrators and screeds may be used to place and finish small areas of work...".

In some instances small "tight" areas, unusual transitions, or other geometric constraints may preclude machine finishing. Structural Engineers should recognize adverse criteria and provisions should be made on the Plans and in the Special Provisions (Stage Construction etc.) during the design phases to minimize bridge deck areas that could preclude use of machine finishing.

(c) See Subsection 1.20.10 a. for criteria which could preclude use of machine finishing for bridge deck slab construction. These provisions shall also apply to concrete overlay protective system construction.

(d) It shall be the responsibility of the Structural Design Engineer to show the following note on the plans in bridge deck areas where adverse conditions could conceivably preclude the use of machine finishing:

NOTE:

Machine Finishing of Overlay not required, See Special Provisions.

Or...

NOTE:

Machine Finishing of Overlay not required in areas designated.
See Special Provisions.

.... Whichever is applicable.

Unique specifications should be included in a project's Special Provisions.

SECTION 9C

BRIDGE DECK EVALUATION SURVEY AND GUIDELINES FOR RESTORATION WORK

1.9C.1 DECK EVALUATION SURVEY

A. Description of Survey and Testing

Testing and evaluation of concrete bridge decks consists of visual observations, delamination or debonding detection, concrete sampling for chloride analysis, and electrical potential measurement (half-cell testing). All of these bridge deck evaluation techniques are used to detect existing defects and actively deteriorating conditions of the deck. The following description is intended to provide information and procedures for these bridge deck evaluation techniques. These techniques should be used in sequence and, if warranted, in combination. By using the combined results, engineers can better evaluate the condition of any bridge deck.

1. Visual Survey

   The first step for deck evaluation is a visual observation to determine the extent of spalling, cracking and scaling. Visual observation, however, does not reveal hidden structural deterioration such as delaminations or corrosion of rebars. The information from visual surveys is used to determine further deck condition survey needs. Visual surveys are generally expressed in terms of the amount of spalling and patching as a percent of the total deck area.

2. Concrete Delamination Detection (Chain Drag)

   A delamination survey provides information on the subsurface condition of concrete bridge decks. A chain drag can be used to survey concrete bridge decks for delaminations.

   Chain Drag: The chain drag consists of four or five segments of 1 inch link chain about 18 inches long, attached to a 2 foot piece of aluminum or copper tube, to which a 2 to 3 foot piece of tubing is attached at the midpoint, forming a "T". The chain is dragged along the surface of the concrete in a swinging motion, resulting in a ringing sound. When delaminated concrete is encountered, a noticeable "dull" sound is produced. The delaminated concrete area is outlined on the deck with chalk, crayon, or paint and can be plotted to give an overall picture of delaminated areas.

   The results of the Chain Drag are not reliable when the bridge deck has been overlayed with bituminous concrete; therefore, its use is not recommended for bridge decks with bituminous concrete overlays.

3. Chloride Analysis

Chloride analysis provides a quantitative measure of the chloride ion contamination of concrete at selected levels in the deck. Concrete samples for chloride analysis are usually taken by a rotary hammer drill. The concrete is pulverized in the hole from the combined hammering and rotating actions of the drill, thus facilitating removal and analysis. The sampling is done at or above the level of the top reinforcing bars, and the powdered concrete is collected and sent to the Department's Laboratory for analysis. The percentage of chloride ion is then calculated from the lab results. The "threshold" chloride content, or amount of chloride needed to initiate corrosion, is approximately 2.0 lbs. of chloride per cubic yard of concrete.

4. Half-Cell Test

The purpose of half-cell testing is to determine the areas in the deck in which active corrosion is present. Corrosion of the reinforcing bars in concrete decks is detected by electric current flowing from the rebar at one point (the anode) to another point (the cathode). During active corrosion, an electrical potential difference exists between the anode and cathode which can be measured by copper/copper sulfate half-cells (CSE). The CSE is pure copper rod suspended in a saturated solution of its own ions. Corrosion of the reinforcing steel can be detected by grounding the CSE to the deck slab reinforcing steel, placing the CSE in contact with the Bridge Deck Electrolyte (i.e., touching it to a small section of deck wetted with water) and measuring the electrical potential from a volt meter attached to the CSE.

Research tests have demonstrated that potential differences more negative than -0.35 volts indicates a high degree of probability of active corrosion of the reinforcing steel. Potential readings not greater than -0.20 volts indicate the probability of inactive or no corrosion, while potential readings between -0.20 volts and -0.35 volts indicate the possibility of active corrosion. The potential readings collected are then used to plot an equipotential map of the deck and to estimate the percent area of the deck with actively corroding reinforcing steel. Surveys are temperature sensitive and should only be performed if the ambient air temperature has been above 40° F for a minimum of 72 hours immediately prior to the date of the survey.

5. Pachometer Test

In order to properly establish the deck condition, establishing the depth of cover over the top reinforcement is necessary. This will provide the evaluator with needed information to properly judge the existing condition versus what is the required minimum depth of cover.

B. Procedures to Perform Deck Evaluation Survey

1. Visual Observations

a. Make comments on the deficiencies of either the asphalt overlay or the concrete deck wearing surface (e.g. spalling, cracking, scaling, warping, asphalt creep, alligator cracks, etc.). Include the location and size of deficiencies, if any.

b. Observe the underside of the deck and record the approximate size and location of all areas exhibiting cracks with or without efflorescence. Also, record all areas having concrete spalled from the bottom reinforcing.

c. If the structure does not have an asphalt overlay over the concrete deck, determine the percentage of spalls and/or patches in the exposed concrete deck wearing surface. Decks covered with asphalt should be similarly inspected, with a general condition statement made about the asphalt surface.

d. Record this percentage for use in the final deck condition determination.

2. Concrete Delamination Detection

Chain Drag

a. Drag the chain in a swinging motion, while walking along the concrete surface of the deck.

b. Outline, with crayon, the areas of the deck over which the chain produces a distinctive "dull" sound. These areas indicate delamination of concrete.

c. Transfer the delineated areas on the deck by plotting on a scaled map of the bridge deck.

3. Chloride Analysis

a. Select random sample locations for chloride testing using statistical methods and plot the locations on a plan view of the deck. As a minimum requirement, 10 locations per every 6000 square yard area should be tested.

b. Locate the depth of the top reinforcing steel with a pachometer to determine the chloride sampling depth.

c. Cut out an approximate square foot section of bituminous concrete overlay, if any exists, to expose the concrete deck surface. Record the depth of overlay removed, if any.

d. Obtain each of the random samples with a rotary hammer drill.

Pulverize the concrete down to within ½ inch of the rebar location, vacuum the hole, pulverize approximately 1 inch of concrete, then collect the powdered concrete sample in an uncontaminated container. All of the samples should be properly labeled and sent to the Department's Laboratory for chloride analysis.

e. After all of the holes have been drilled, and all the samples collected, refill the holes with materials similar to the material that was there prior to drilling, (i.e. concrete slabs with a fast curing "concrete compound" and asphalt overlays with asphaltic materials).

f. After the lab has analyzed the samples taken, calculate the percentage of the samples with a higher chloride content than 2 lbs/cu.yd. from:

$$\frac{\text{No. of Samples with Cl. greater or equal to 2 lbs/cu.yd.}}{\text{Total No. of Samples}} \times 100 = \_\_\%$$

4. Half-Cell Test

a. Test all equipment before proceeding to the field site. Check the Voltmeter battery for satisfactory charge.

b. Measure and mark a 5 foot grid pattern on the surface of the deck in accordance with Contract Plans. If a grid pattern is not shown on Contract Plans, the grid pattern should be recorded on a plan view of the deck for simplicity and speed in data recording. Start the grid with a 1 foot offset from curb to keep the equipment out of the dirt and debris, and an offset from the first deck joint that will allow convenient placing of the grid pattern on the deck.

c. Uncoil an ample length of wire to reach all the grid points to be tested and connect the copper sulfate half-cell (CSE) to the positive jack of the Voltmeter.

d. Pre-wet the deck at the grid points with water, saturate a sponge with water, and attach it to the bottom of the half-cell.

e. Begin to take readings of the electrical potentials at every other grid point with the half-cell and continue the testing until the whole grid pattern has been completed. The time it takes to get a stable reading will indicate the proper "soak" time for the deck. The Voltmeter needle should make an immediate response and settle down when good connections have been made. Note: If the deck is too wet or frozen, reliable readings cannot be taken.

f. After the field work is completed, the data can be recorded on graph paper and the equipotential lines plotted to produce an equipotential contour map.

g. The percentage of possible corrosion affected deck area is then calculated from the results by counting the number of tests points equal to or more negative than -0.35 volts.

$$\frac{\text{No. of Samples More Negative than -0.35 volts x 100}}{\text{Total No. of Samples}} = \_\_\%$$

5. Pachometer Survey

a. A Pachometer Survey to determine the depth of the concrete cover over the reinforcement steel. The equipment shall be calibrated according to the equipment manufacturer's specifications.

b. Locate and expose a reinforcing bar in the deck using a jackhammer. Connect the negative lead of the Voltmeter to the reinforcing steel. Connection can also be made to other metallic objects on the bridge (e.g. drainage scupper, light standards, bridge railing, expansion joints, etc.), if they are physically connected to the reinforcing steel. Connections should be made in each span if the reinforcing steel is not continuous through the expansion devices.

C. Summary - Sample Calculations and Statements

The summary calculations show a composite result of the previously described tests as follows:

1. Visual: The percentage of visual spalls over the top of the deck is 10%.

2. Concrete Delamination Detection: The analysis of the data revealed that 65% of the tested area is delaminated.

3. Chloride Analysis: The results of the chloride analysis (shown below) revealed that 60% of the samples tested were above the 2 pounds per cubic yard threshold.

$$\frac{\text{Unacceptable Samples}}{\text{Total Samples}} = \frac{(6)}{(10)} = 60\%$$

4. Half-Cell Test: The results of the half-cell testing (shown below) revealed that 13.5% of the tests taken were more negative than -0.35 volts.

$$\frac{\text{Unacceptable Samples}}{\text{Total Samples}} = \frac{(13)}{(96)} = 13.5\%$$

D. Composite Results - Starting with 100% of the deck and deducting non- duplicative contaminated areas from the tests above:

Visual	100.0 - (100.0 x 0.10) = 90.0%	Remaining uncontaminated
Delaminations	90.0 - (90.0 x 0.65) = 31.5%	Remaining uncontaminated
Chloride	31.5 - (31.5 x 0.60) = 12.6%	Remaining uncontaminated
Half-Cell	12.6 - (12.6 x 0.135) = 10.9%	Remaining uncontaminated

Composite Result Final = 100.0 - 10.9 = 89.1% of the bridge deck tested had contaminated concrete.

E. CONCLUSIONS AND RECOMMENDATIONS:

The final category classification, using the percentage of bridge deck contamination shown in the summary, should be made in accordance with Subsection 1.9C.2. The classification and evaluation of the deck should also incorporate engineering judgment in addition to the test results to provide a meaningful and complete recommendation for deck rehabilitation or reconstruction.

1.9C.2 GUIDELINES FOR DETERMINING DECK CONDITION AND EXTENT OF WORK

Experience, judgment, and research have shown that deterioration often continues in partially rehabilitated decks when only the obviously deteriorated portion of the deck is removed and replaced. To minimize this effect, procedures are required that will determine the extent and type of rehabilitation or reconstruction that should be provided.

The following guidelines present procedures that should be considered in determining existing bridge deck conditions and the extent of work required for adequate rehabilitations. They also represent the current state-of-the-art on this subject and therefore will be updated as necessary when technology improves.

Although these are guidelines and are intended to be flexible, a great deal of care should be exercised in any significant deviation. In all cases, the rationale for any significant deviation should be explained in the project records or correspondence.

A. Field Condition Survey - A limited field condition survey should be made to identify bridge decks that may be structurally inadequate or possibly contaminated with de-icing chemicals such that normal maintenance is not expected to provide reasonable service. Some examples of deck slab conditions which may warrant rehabilitation and/or protective measures, are as follows:

    1. Visible concrete spalls which have occurred in the deck riding surface and/or evidence of unsound concrete in the bottom exposed surface of the deck slab (which may indicate structural failure).
    2. Extensive deterioration of the asphaltic overlay logically due to underlying concrete deterioration.

3. Evidence of delaminations (horizontal fracture planes) in the concrete deck.

4. Evidence of reinforcing steel corrosion.

5. Evidence of inadequate concrete cover over the reinforcing steel.

B. Structural Adequacy - When the structural adequacy of a bridge deck to carry current traffic loads is questioned, an in-depth field survey and analysis must be performed. This review should determine the extent of deficiencies as well as the feasibility of rehabilitation. Economics, traffic maintenance, etc., need to be evaluated when balancing the feasibility of structural restoration against complete replacement.

C. Detailed Field Appraisal - Where the field condition survey has indicated that rehabilitation and/or reconstruction may be warranted, a detailed Evaluation Survey (See Subsection 1.9C.1) should be performed to further define the inadequacies of the existing deck.

This appraisal should, to the extent appropriate, consider the following as recommended components of an evaluation system:

1. Delamination detection with appropriate equipment to determine extent of internal fractures of the concrete.

2. Determination of the extent of reinforcing steel corrosion by the use of a half-cell corrosion detection device.

3. Determination of areas with inadequate concrete cover over the reinforcing steel by the use of appropriate equipment.

4. Chemical analysis to determine extent of chloride contamination.

D. Evaluation of Field Survey Results - Research reports have explained the interaction of all current detection methods and emphasized the need to use each method only for its designed purpose. The following data have been developed by research and experience:

1. Delaminations - The use of a chain drag will readily define the areas of loss of structural performance in the form of delaminations or cleavage planes within the concrete. This normally indicates active corrosion of the rebars within these areas and probable chloride contamination of the entire deck. A visible spall is the end result of delaminations at the level of the rebar.

2. Electrical Potential - Laboratory corrosion tests and field experience have shown that there is a 95 percent probability that an electrical potential in excess of -0.35 volts (CSE) to the copper-copper sulfate

electrode corresponds to active corrosion in the reinforcing steel. However, this does not necessarily provide any positive relationship to the destructive nature of the corrosion that is occurring.

3. Concrete Cover - Chloride concentrations are significantly greater near the surface of a concrete bridge deck. When rebars have less than specified concrete cover they become appreciably more susceptible to damaging rebar corrosion.

4. Chloride Content - Test results have generally established that the corrosion threshold is approximately 2.0 pounds of chloride per cubic yard of concrete at the level of the rebars for typical bridge deck concrete.

E. Category Classification - The limits describing three categories of condition as described below are based on the best judgment available nationally.

The user will note that Category 2 will in many cases overlap Category 1. In such cases the State will exercise its best judgment based on engineering, economics and other factors to properly categorize a given bridge deck.

Category 1 - Extensive Active Corrosion

5% or more of the deck area spalled

OR

40% or more of the deck area deteriorated or contaminated as indicated by any nonduplicating combination of the following:

(1) spalls, (2) delamination, and (3) corrosion potentials more negative than -0.35 volts (CSE)

OR

40% of the area of the bridge deck indicated by random chloride sampling to contain greater than 2.0 pounds of chloride per cubic yard of concrete at the level of the top rebars.

Category 2 - Moderate Active Corrosion

0 to 5% of the deck area spalled,

OR

5 to 40% of the deck area deteriorated or contaminated as indicated by any nonduplicating combination of the following: (1) spalls, (2) delaminations, and (3) corrosion potential more negative than -0.35 volts (CSE),

<u>**OR**</u>

5 to 40% of the area of the bridge deck indicated by random chloride sampling to contain greater than 2.0 pounds of chloride per cubic yard of concrete at the level of the top rebars.

<u>**Category 3 - Light to No Active Corrosion**</u>

No spalls,

<u>**OR**</u>

0 to 5% of the deck area deteriorated or contaminated as indicated by any nonduplicating combination of the following: (1) delaminations, (2) corrosion potentials more negative than -0.35 volts (CSE),

<u>**OR**</u>

0 to 5% of the area of the bridge deck indicated by random chloride sampling to contain greater than 2.0 pounds of chloride per cubic yard of concrete at the level of the top rebars.

1.9C.3 RECOMMENDED RESTORATION PROCEDURES

Based on the foregoing categorization of the condition of the bridge deck, the table below, which details rehabilitation and reconstruction alternates, has been developed.

Testing Steps:

1. Visual
2. Delamination
3. Electrical Potential
4. Pachometer Survey
5. Chloride Content

RECOMMENDED RESTORATION PROCEDURES

CATEGORY	PROCEDURES	RESTORATION (Considered Permanent)	RESTORATION (Estimated extended life 10 to 15 yrs)
Structurally Inadequate		Complete Deck Replacement (Unless restorable)	
Extensive Active Corrosion (1)	Required Restoration Work	Complete Deck Replacement	Removal of all deteriorated concrete. Follow the repair procedure approved for the protective system selected.
	Testing	Steps 1 through 5 as necessary. (Probably only steps 1 & 2)	Steps 1 & 2 only, except all the testing steps on the first five (5) bridge decks (spans) plus 10% of the remaining bridge decks.
	Suggested Protective Systems	Membrane with bituminous concrete overlay*; Concrete Overlay Protective System. *	Concrete Overlay Protective System.*
Moderate Active Corrosion (2)		Same as Category 1 above OR Same as Category 3 below, as determined by the State.	Same as Category 1
Light To No Active (3)	Required Restoration Work	Removal and Replacement of all areas of deterioration and chloride contaminated concrete as determined by corrosion potentials and/or chloride sampling. (Less than 5% of the deck area is bad).	Same as Category 1 Note: For this category of condition, permanent restoration is recommended.
	Testing	Steps 1 through 5.	Same as Category 1
	Suggested Protective System	Membrane with bituminous concrete overlay*; Concrete Overlay Protective System.*	Concrete Overlay Protective System.*

* When approved prior to Preliminary Plan * Submission on a project to project basis.

SECTION 10A

ESTIMATED QUANTITIES

1.10A.1 PLANS

a) Estimated quantity tabulations shall be shown on plans. All appropriate contract "pay items" listed in Subsection 1.10A.3 shall be included.

(b) Each bridge plan detail sheet shall have the following type of tabulation, which represents the quantity of contract pay items shown on that sheet:

QUANTITIES				
PAY ITEM NO.	STANDARD ITEM NO.	DESCRIPTION	UNIT	CONTRACT QUANTITY

(c) The General Plan and Elevation sheet shall have the following type of tabulation which represents the total quantities of the individual plan sheets and, consequently, the total quantities for the bridge or structure.

SUMMARY OF QUANTITIES				
PAY ITEM NO.	STANDARD ITEM NO.	DESCRIPTION	UNIT	CONTRACT QUANTITY

(d) Each bridge design unit shall obtain from the roadway design unit the last roadway pay item number to facilitate the bridge pay item numbering.

(e) Quantities on these sheets shall be listed on an individual bridge or structure basis. Retaining walls shall be summarized on a total quantity for all walls in the contract. However, the quantities for the individual walls shall be included in a separate tabulation.

(f) Overhead and Cantilever Sign Structures shall be listed on an individual lump sum basis, however, the items for clearing site, foundation excavation, concrete for footings, temporary sheeting and reinforcement steel shall be listed as the total summary for all sign support structures in the contract.

1.10A.2 CALCULATIONS

(a) Estimated quantity calculations are required as part of the Final Plan Submission. They shall be on 8½ inch by 11 inch sheets bound in a separate folder (from the design calculations). Each sheet shall be initialed by the estimator and the checker.

(b) The required submission of bridge quantity calculation at the Final Plan shall also include schematic drawings of all concrete structures. (See Paragraph c).

(c) The volume of concrete in each individual unit shall be noted on the schematic drawings (paragraph b). The sheets shall be bound into the folder following the index. Pages 1.10A-3 to 1.10A-5 illustrate the concept desired. This will facilitate pinpointing any mistakes or errors during construction when Quantity calculations are made for purposes of monthly payments.

Ref. Subsection 1.10A.2 Paragraph (b) and (c).

NEW JERSEY DEPARTMENT OF TRANSPORTATION

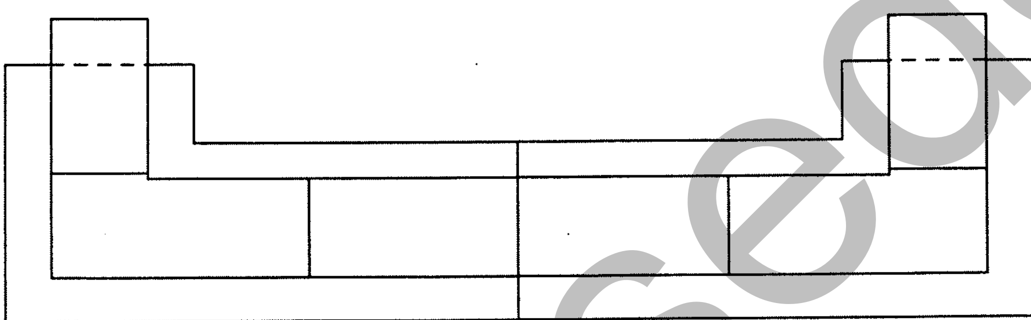
SHEET NO.___ OF ___

ROUTE __________ SECTION __________ FEDERAL PROJECT NO. __________

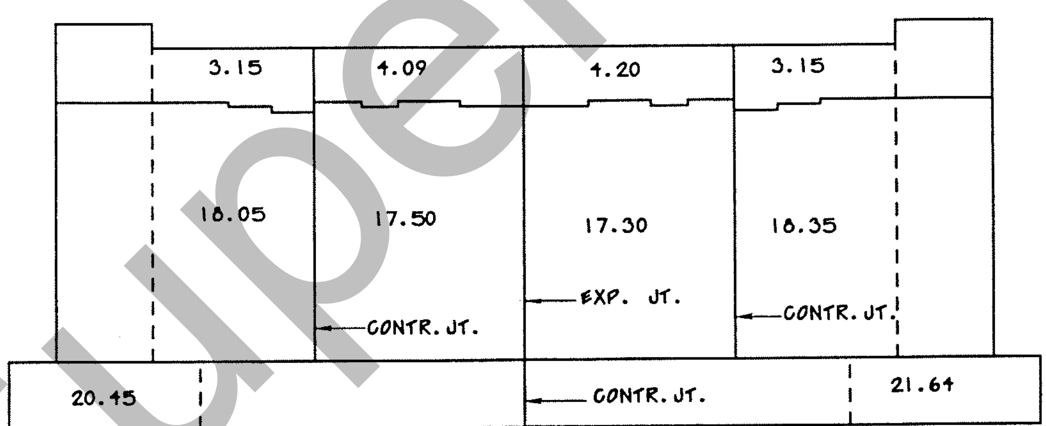
OTHER DESCRIPTION __________

ITEM NO. __________ ITEM DESCRIPTION __________

MADE BY __________ DATE __________ CHECKED BY __________ DATE __________



ABUTMENT #1
PLAN
NTS



ABUTMENT #1
ELEVATION
NTS

NOTE: ALL VOLUMES SHOWN IN CUBIC YARDS

Ref. Subsection 1.10A.2 Paragraph (b) and (c).

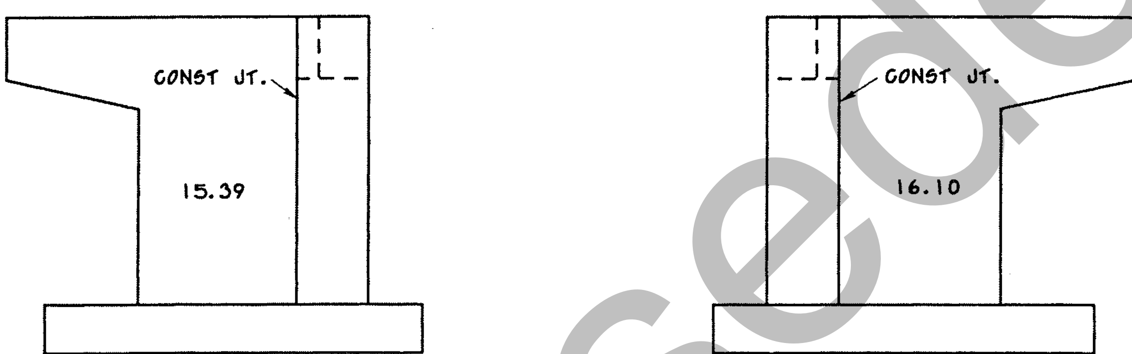
NEW JERSEY DEPARTMENT OF TRANSPORTATION SHEET NO.___ OF___

ROUTE_____________ SECTION__________ FEDERAL PROJECT NO.______________________

OTHER DESCRIPTION____

ITEM NO.__________ ITEM DESCRIPTION____________________________________

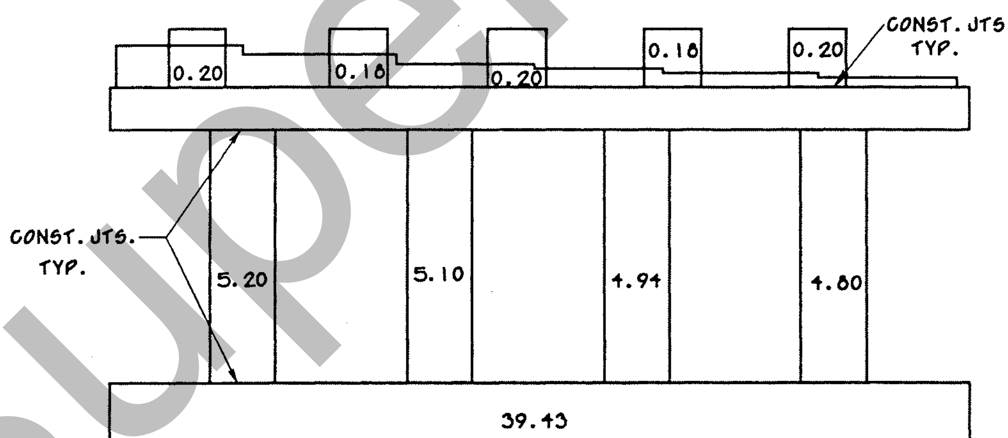
MADE BY____________ DATE____________ CHECKED BY____________ DATE____________



ABUTMENT #1
N.E. WALL

ABUTMENT #1
N.W. WALL

ELEVATION
NTS



PIER #1
NTS

NOTE: ALL VOLUMES SHOWN IN CUBIC YARDS

Ref. Subsection 1.10A.2 Paragraph (b) and (c).

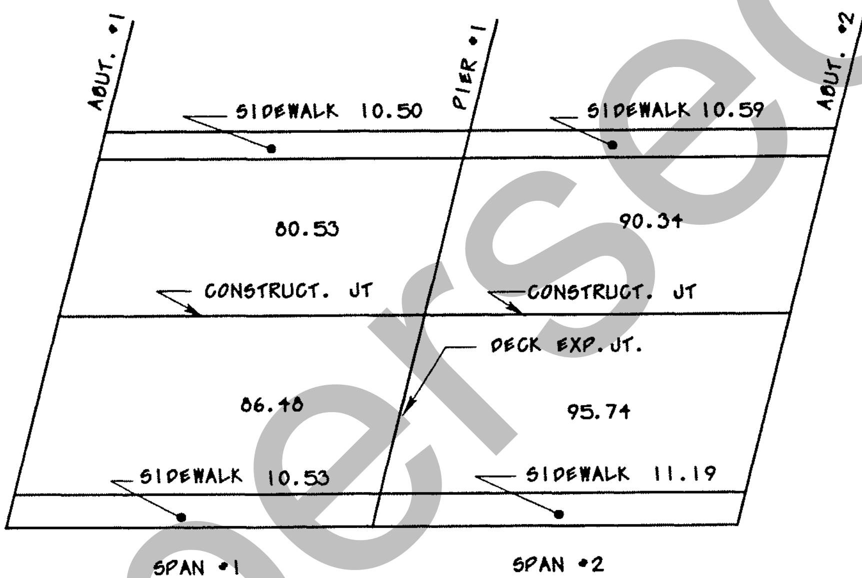
NEW JERSEY DEPARTMENT OF TRANSPORTATION SHEET NO.___OF___

ROUTE________________SECTION__________FEDERAL PROJECT NO.________________________

OTHER DESCRIPTION____

ITEM NO.____________ITEM DESCRIPTION____

MADE BY______________DATE____________CHECKED BY_____________DATE_____________



DECK PLAN

N.T.S

NOTE: ALL VOLUMES SHOWN IN CUBIC YARDS

1.10A.3 LIST OF BRIDGE PAY ITEMS (STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION)

The Standard Specifications for Road and Bridge Construction with current Supplemental Specifications provide the following Pay Items for work on bridges and structures.

SECTION	PAY ITEM	NOTES	PAY UNIT
201	CLEARING SITE, BRIDGE	(1)	LUMP SUM
	CLEARING SITE, STRUCTURE	(1)	LUMP SUM
	TEMPORARY SHIELDING		LUMP SUM
	BONDING AND GROUNDING	(22)	LUMP SUM
202	REMOVAL OF HOT MIX ASPHALT OVERLAY	(2)	SQUARE YARD
203	POROUS FILL	(3)	CUBIC YARD
204	BORROW EXCAVATION, ZONE	(3)	CUBIC YARD
	BORROW EXCAVATION, BRIDGE FOUNDATION	(3)	CUBIC YARD
205	CHANNEL EXCAVATION,	(3)	CUBIC YARD
206	FOUNDATION EXCAVATION	(4)	CUBIC YARD
	BRIDGE EXCAVATION	(4)	CUBIC YARD
	COARSE AGGREGATE LAYER	(4)	CUBIC YARD
	COFFERDAMS	(5)	LUMP SUM
404	HOT MIX ASPHALT SURFACE COURSE MIX	(6)	TON
405	BRIDGE APPROACH SLABS, ____ " THICK	(3)	SQUARE YARD

SECTION	PAY ITEM	NOTES	PAY UNIT
	BRIDGE APPROACH TRANSITION SLABS, ____ " AVERAGE THICKNESS	(3)	SQUARE YARD
501	CONCRETE IN STRUCTURES, CULVERTS	(7)	CUBIC YARD
	CONCRETE IN STRUCTURES, FOOTINGS	(7)	CUBIC YARD
	CONCRETE IN STRUCTURES, RETAINING WALLS	(7)	CUBIC YARD
	CONCRETE IN SUBSTRUCTURES, ABUTMENT WALLS	(7)	CUBIC YARD
	CONCRETE IN SUBSTRUCTURES, PIER COLUMNS AND CAPS	(7)	CUBIC YARD
	CONCRETE IN SUBSTRUCTURES, PIER SHAFTS	(7)	CUBIC YARD
	CONCRETE IN SUPERSTRUCTURE, DECK SLABS	(7)	CUBIC YARD
	CONCRETE IN SUPERSTRUCTURE, RELIEF SLAB INTEGRAL ABUTMENT	(7)	CUBIC YARD
	CONCRETE IN SUPERSTRUCTURE, SLEEPER SLAB INTEGRAL ABUTMENT	(7)	CUBIC YARD
	CONCRETE IN SUPERSTRUCTURE, DECK SLABS WITH CORROSION INHIBITOR ADMIXTURE	(7)	CUBIC YARD
	CONCRETE IN SUPERSTRUCTURE, SIDEWALKS	(7)	CUBIC YARD
	CONCRETE IN, SUPERSTRUCTURE, PARAPETS	(7)	LINEAR FOOT
	CONCRETE SEAL IN COFFERDAMS	(5)(7)	CUBIC YARD

SECTION	PAY ITEM	NOTES	PAY UNIT
	REINFORCEMENT STEEL IN STRUCTURES	---	POUND
	REINFORCEMENT STEEL IN STRUCTURES, EPOXY COATED	---	POUND
	REINFORCEMENT STEEL IN STRUCTURES, GALVANIZED	---	POUND
	WATERPROOFING	---	SQUARE YARD
	EPOXY WATERPROOFING SEAL COAT	---	SQUARE YARD
	1¾" X 2¼" PREFORMED ELASTOMERIC JOINT SEALER	---	LINEAR FOOT
	2½" x 2¼" PREFORMED ELASTOMERIC JOINT SEALER	---	LINEAR FOOT
	4" x 4" PREFORMED ELASTOMERIC JOINT SEALER	---	LINEAR FOOT
	6" X 5¾" PREFORMED ELASTOMERIC JOINT SEALER	---	LINEAR FOOT
	4" X 3¾" REINFORCED ELASTOMERIC EXPANSION DAM	---	LINEAR FOOT
	ROCK ANCHORS	---	LINEAR FOOT
	STRIP SEAL EXPANSION DAM	---	LINEAR FOOT
	SAWCUT GROOVED DECK SURFACE	---	SQUARE FOOT
	REINFORCED CONCRETE BOX CULVERT, PRECAST	---	LINEAR FOOT
	PRESSURE INJECTION, CONCRETE CRACKS	---	LINEAR FOOT

SECTION	PAY ITEM	NOTES	PAY UNIT
502	PRETENSIONED PRESTRESSED CONCRETE BEAMS, 45"	---	LINEAR FOOT
	PRETENSIONED PRESTRESSED CONCRETE BEAMS, 54"	---	LINEAR FOOT
	PRETENSIONED PRESTRESSED CONCRETE BEAMS, 63"	---	LINEAR FOOT
	PRETENSIONED PRESTRESSED CONCRETE BEAMS, 72"	---	LINEAR FOOT
	PRESTRESSED CONCRETE BOX BEAMS (TYPE BI-36), 36" X 27"	---	LINEAR FOOT
	PRESTRESSED CONCRETE BOX BEAMS TYPE B1-36), 36" X 33"	---	LINEAR FOOT
	PRESTRESSED CONCRETE BOX BEAMS (TYPE B1-36), 36" X 39"	---	LINEAR FOOT
	PRESTRESSED CONCRETE BOX BEAMS (TYPE B1V-36), 36" X 42"	---	LINEAR FOOT
	PRESTRESSED CONCRETE BOX BEAMS (TYPE BI-48) 48" X 27"	---	LINEAR FOOT
	PRESTRESSED CONCRETE BOX BEAMS (TYPE BII-48), 48" X 33"	---	LINEAR FOOT
	PRESTRESSED CONCRETE BOX BEAMS (TYPE BIII-48), 48" X 39"	---	LINEAR FOOT
	PRESTRESSED CONCRETE BOX BEAMS (TYPE BIV-48), 48"X 42"	---	LINEAR FOOT

SECTION	PAY ITEM	NOTES	PAY UNIT
	PRESTRESSED CONCRETE SLAB BEAMS (TYPE SII-36), 36" X 15"	---	LINEAR FOOT
	PRESTRESSED CONCRETE SLAB BEAMS (TYPE SIII-36), 36" X 18"	---	LINEAR FOOT
	PRESTRESSED CONCRETE SLAB BEAMS (TYPE SIV-36), 36" X 21"	---	LINEAR FOOT
	PRESTRESSED CONCRETE SLAB BEAMS (TYPE SII-48), 48" X 15"	---	LINEAR FOOT
	PRESTRESSED CONCRETE SLAB BEAMS (TYPE SIII-48), 48" X 18"	---	LINEAR FOOT
	PRESTRESSED CONCRETE SLAB BEAMS (TYPE SIV-48), 48" X 21"	---	LINEAR FOOT
503	STRUCTURAL STEEL	(8)	LUMP SUM
	STRUCTURAL STEEL	(8)	POUND
	STRUCTURAL STEEL DECK JOINTS	---	LUMP SUM
	STEEL GRID FLOORING	---	SQUARE FOOT
	FORMED STEEL FLOORING FOR PEDESTRIAN BRIDGES	---	SQUARE FOOT
	SHEAR CONNECTORS	---	UNIT
	SHEAR CONNECTORS, GALVANIZED	---	UNIT
	STRUCTURAL BEARING ASSEMBLY	-	UNIT

SECTION	PAY ITEM	NOTES	PAY UNIT
504	TREATED TIMBER STRUCTURES	---	MBM
	TREATED TIMBER STRUCTURES, BRIDGE DECKING	---	MBM
	UNTREATED TIMBER STRUCTURES	---	MBM
	TREATED TIMBER STRUCTURES, WALES	---	MBM
	TREATED TIMBER STRUCTURES, SHEETING	---	MBM
505	PREBORED HOLES	(9)	LINEAR FOOT
	TEST PILES, FURNISHED		LINEAR FOOT
	TEST PILES, DRIVEN		LINEAR FOOT
	CAST-IN-PLACE CONCRETE PILES, FURNISHED, _____ " DIAMETER		LINEAR FOOT
	CAST-IN-PLACE CONCRETE PILES, DRIVEN, _____ " DIAMETER		LINEAR FOOT
	PRECAST CONCRETE PILES, FURNISHED, ____ " BY ____ "		LINEAR FOOT
	PRECAST CONCRETE PILES, DRIVEN, ______ " BY ____ "		LINEAR FOOT
	PRESTRESSED CONCRETE PILES, FURNISHED		LINEAR FOOT
	PRESTRESSED CONCRETE PILES, DRIVEN		LINEAR FOOT
	STEEL H-PILES, FURNISHED, HP ____ X ____		LINEAR FOOT
	STEEL H-PILES, DRIVEN, HP ____ X ____		LINEAR FOOT
	UNTREATED TIMBER PILES, FURNISHED, ____ " DIAMETER		LINEAR FOOT

SECTION	PAY ITEM	NOTES	PAY UNIT
	UNTREATED TIMBER PILES, DRIVEN, ____ " DIAMETER		LINEAR FOOT
	TREATED TIMBER PILES, FURNISHED, ____ " DIAMETER		LINEAR FOOT
	TREATED TIMBER PILES, DRIVEN, ____ " DIAMETER		LINEAR FOOT
	SPLICES FOR STEEL H - PILES	---	UNIT
	PILE LOAD TESTS (STATIC)	(10)	UNIT
	PILE SHOES	---	UNIT
	PILE LOAD TESTS (DYNAMIC)	(10)	UNIT
	FURNISHING EQUIPMENT FOR DRIVING PILES	---	LUMP SUM
506	CONCRETE SHEET PILING	---	SQUARE FOOT
	STEEL SHEET PILING	---	SQUARE FOOT
	TREATED TIMBER SHEET PILING	---	SQUARE FOOT
	TIE RODS	---	POUND
507	PNEUMATICALLY APPLIED MORTAR	(11)	SQUARE FOOT
508	CHAIN - LINK FENCE, ALUMINUM-COATED STEEL, BRIDGE ____ ' - ____" HIGH	---	LINEAR FOOT
	CHAIN - LINK FENCE, PVC COATED STEEL, BRIDGE, ____' - ____" HIGH	---	LINEAR FOOT
	CHAIN - LINK FENCE, BRIDGE, ____ ' - ____" HIGH	---	LINEAR FOOT
	CHAIN - LINK FENCE, ALUMINUM COATED STEEL, BRIDGE, ____' - _____" HIGH CURVED TOP	---	LINEAR FOOT

SECTION	PAY ITEM	NOTES	PAY UNIT
	CHAIN - LINK FENCE, PVC COATED STEEL, BRIDGE, ____' - ____ " HIGH, CURVED TOP	---	LINEAR FOOT
	CHAIN - LINK FENCE, BRIDGE, ____' - ____ " HIGH, CURVED TOP	---	LINEAR FOOT
	METAL RAILING (__ RAIL, ALUMINUM)	---	LINEAR FOOT
	METAL RAILING (__ RAIL, STEEL)	---	LINEAR FOOT
	4 - BAR OPEN STEEL RAILING	---	LINEAR FOOT
509	CANTILEVER SIGN SUPPORT, STRUCTURE NO.	(12)	UNIT
	BRIDGE MOUNTED SIGN SUPPORT STRUCTURE NO. __________	(12)	UNIT
	BUTTERFLY SIGN SUPPORT, STRUCTURE NO. ______	(12)	UNIT
	OVERHEAD SIGN SUPPORT, STRUCTURE NO. _____	(12)	UNIT
510	ELECTRIC CONDUITS	(13)	LINEAR FOOT
	TELEPHONE CONDUITS	(13)	LINEAR FOOT
	____ " GAS MAINS	---	LINEAR FOOT
	____ " WATER MAINS	---	LINEAR FOOT
512	TEMPORARY STRUCTURE, ONE-WAY	(14)	LUMP SUM
	TEMPORARY STRUCTURE, TWO-WAY	(14)	LUMP SUM
	TEMPORARY STRUCTURE, PEDESTRIAN BRIDGE	(14)	LUMP SUM

SECTION	PAY ITEM	NOTES	PAY UNIT
513	TEMPORARY SHEETING	(15)	SQUARE FOOT
	SHEETING LEFT IN PLACE	(23)	SQUARE FOOT
514	PAINTING BRIDGES - EXISTING STEEL	---	TON
	PAINTING BRIDGES - EXISTING STEEL	---	LUMP SUM
	HAND/POWER TOOL CLEANING	(24)	SQUARE FOOT
	HAND/POWER TOOL CLEANING	---	LUMP SUM
	PAINTING AND NEAR - WHITE BLAST CLEANING - BEARINGS	---	UNIT
	PAINTING AND NEAR-WHITE BLAST CLEANING - MISCELLANEOUS APPURTENANCES	---	LUMP SUM
	CONTAINMENT PLAN	---	LUMP SUM
	WASTE DISPOSAL PLAN	---	LUMP SUM
	LEAD HEALTH AND SAFETY PLAN	---	LUMP SUM
	COMMERCIAL BLAST CLEANING	---	SQUARE FOOT
	NEAR-WHITE BLAST CLEANING	---	TON
	TESTING, IF AND WHERE DIRECTED	---	LUMP SUM
515	GRANITE MASONRY	---	SQUARE FOOT
516	CONCRETE CRIBBING	---	CUBIC YARD
	BROKEN STONE FILL FOR CRIB WALL	---	CUBIC YARD
517	INLET FRAMES AND GRATES	---	UNIT
	SCUPPERS	---	UNIT

SECTION	PAY ITEM	NOTES	PAY UNIT
	__ " STEEL ALLOY PIPE	---	LINEAR FOOT
518	REPAIR OF CONCRETE DECK, TYPE _______	(16)	SQUARE FOOT
	MEMBRANE WATERPROOFING	(16)	SQUARE YARD
	CONCRETE DECK OVERLAY PROTECTIVE SYSTEM, TYPE _________	(16)	CUBIC YARD
	SCARIFICATION	(16)	SQUARE YARD
521	RETAINING WALL, LOCATION NO. ___________	---	SQUARE FOOT
522	NOISE BARRIER, ROADWAY	---	SQUARE FOOT
	NOISE BARRIER, BRIDGE	---	SQUARE FOOT
	NOISE BARRIER TEST POSTS AND PANELS	---	LUMP SUM
	NOISE BARRIER, FOUNDATIONS	---	UNIT
601	__ " CORRUGATED STEEL UNDERDRAIN PIPE	---	LINEAR FOOT
605	___ " X ___ " WHITE CONCRETE BARRIER CURB, BRIDGE	---	LINEAR FOOT
	REINFORCEMENT STEEL	---	POUND
612	BEAM GUIDE RAIL, BRIDGE	---	LINEAR FOOT
	RUB RAIL	---	LINEAR FOOT
615	METAL RAILING	---	LINEAR FOOT
616	CONCRETE SLOPE PROTECTION, ____ " THICK	---	SQUARE YARD
	CONCRETE SLOPE PROTECTION, REINFORCED, ____ " THICK	---	SQUARE YARD

SECTION	PAY ITEM	NOTES	PAY UNIT
701	__ " RIGID METALLIC CONDUIT, TYPE _______	(18)	LINEAR FOOT
	____ " X _____ " JUNCTION BOXES	(19)	UNIT
	____" X _____ " JUNCTION BOXES	(20)	UNIT
	____ " JUNCTION BOXES	---	UNIT
	JUNCTION BOX FRAMES AND COVERS	---	UNIT
703	UNDERDECK LIGHTING ASSEMBLIES, TYPE ________	(21)	UNIT
(OTHER ITEMS)			
511	___ " STRUCTURAL PLATE PIPE , ___ THICK	---	LINEAR FOOT
	___ " X ____ " STRUCTURAL PLATE PIPE ARCH, __ THICK	---	LINEAR FOOT
	___ " X ___ " STRUCTURAL PLATE ARCH, ___THICK	---	LINEAR FOOT
602	____ " CORRUGATED STEEL CULVERT PIPE	---	LINEAR FOOT

NOTES:

(1) The first item is used when a "bridge" is involved, either partial or total removal.

The second item is used when a "structure" such as culverts, walls, etc. is involved, either partial or total removal. Also see Subsection 201.04 of the Standard Specifications and Section 17 of the NJDOT Procedures Manual for requirements that are to be shown on Plans. In addition, when it is determined that certain components are to be salvaged and remain the property of the State, provisions in the Plans and/or the Supplementary Specifications are required.

(2) This item is scheduled in bridge deck rehabilitation projects. See Subsection 1.9B.2 of this Manual.

(3) This item is listed with the roadway items of work.

(4) Payment line limits shall be shown on the Plans in accordance with Guide Sheet PLATES 3.15-1 to 3.15-5 of this Manual.

(5) See Section 35 of this Manual for guidance concerning Cofferdams and Sheeting Left in Place.

For major waterway bridges, separate Pay Items for COFFERDAMS and CONCRETE SEAL IN COFFERDAMS shall be scheduled at each pier (and abutment, if applicable) location.

(6) This item used with membrane waterproofing for resurfacing and bridge deck rehabilitation projects. See Section 9A and 9B of this Manual.

(7) Concrete Classes and Pay Items shall be illustrated on Contract Plans.

(8) Use the lump sum method of payment. The per pound pay unit method should be considered for the occasional project where there is a possibility that significant changes can occur during construction, such as on repair or rehabilitation projects.

(9) See Subsection 1.36.3 of this Manual for guidelines as to when this item should be scheduled.

(10) Load tests scheduled on a project to project basis only if required in the Foundation Report.

(11) Usually scheduled under the square foot pay unit method. Per bag pay unit method should be considered for rehabilitation projects where there is the possibility of significant changes in extent of repair areas.

(12) See Subsection 1.32.8 d. of this Manual.

(13) The estimated quantity shall be the total length of all conduits in the bank.

(14) See Section 17 of the NJDOT Procedures Manual.

(15) See Subsection 1.35.2 of this Manual.

(16) See Subsection 1.9B.2 of this manual for listing of other possible contract items (not included in the Standard Specifications) for bridge deck rehabilitation projects.

(17) The bridge items are listed (for <u>each</u> bridge and/or structure in the Contract) in the order in which the items of work appear in the Standard Item listing of the Contractor Payment Listing. Any additional bridge items which may be required (but which are not included in the provisions of the Standard Specifications) shall be included in the listing by the same criteria.

(18) See Standard Drawing PLATE 2.6-1 for details of RMC Expansion Sleeves.

(19) For use on barrier type bridge parapets. See Standard Drawing PLATE 2.6-2 for details.

(20) For use on bridge sidewalks. See Standard Drawing PLATE 2.6-1 and 2.6-2 for details.

(21) This item is listed with electrical items of work.

(22) Non-standard items shall be assigned a 5-digit number by the design unit. Item numbers shall start with the letter "N".

(23) See Subsection 1.35.3 of this Manual.

(24) For those projects where Epoxy Mastic surface preparation with Hand/Power Tool Cleaning is warranted and the effective steel is confined to limited areas.

SECTION 10B

DESIGN CALCULATIONS

1.10B.1 GENERAL

(a) Design calculations shall be on 8 ½" x 11" sheets with a heading similar to that shown on Page 1.10A-4.

(b) For both Consultant and In-House design projects, a single set of calculations will be included with the Project Files. Checker's corrections shall be made directly on the original set of calculations. Each sheet shall be signed by the designer and the checker.

(c) Computer interpretation information shall be included in the design calculations in accordance with Subsection 1.14.1.

(d) If changes are necessary in the Standard Contract Plan PLATES for Overhead Sign Support Structures, half-size copies of the PLATES shall be included in accordance with Subsection 1.32.5 c.

(e) The design calculations shall be bound in separate folders by individual bridges and structures. The front cover shall identify the contents with the following minimum information:

Route ______________ Section _______ County _________________

Design Calculations For ____________________________________

Design Unit ____

Structure No. ____

(f) All pages shall be numbered and dated and an index sheet shall be included.

(g) Calculations shall be included in the Final Plan Submission in accordance with Subsection 1.11.2.

SECTION 11

SUBMISSION GUIDELINES FOR PLAN REVIEWS

1.11.1 DESIGN DEVELOPMENT (Preliminary Structural Documents)

This submission provides for a review of the preliminary plans of an entire project. During this review, interested parties look at all aspects of preliminary development of a project to develop the Department's final scope of work.

Of significance for structural submissions is, that the Preliminary Submission Date for a project, be the latest date that structural preliminary plans can be submitted for approval without prior coordination with the Department's Project Manager.

This is critical since a Preliminary Submission will not be considered complete by the Department until Preliminary Plans for all structures in the contract have been approved. If the structural plans are submitted for Preliminary Bridge Plan approval as part of the Preliminary Submission, the NJDOT Project Manager should be contacted just prior to the scheduled submission to determine the exact number of documents to be submitted. For planning purposes, the designer can expect to provide the following:

- Required number of General Plan and Elevation sheets
- Design Appraisal Statements
- Foundation Reports
- Cost Estimates for use in obtaining Preliminary Plan approval
- Seismic Design and Analyses (Refer to Section 45 of this Manual)
- Seismic Retrofit Report (if applicable) (Refer to Section 45 of this Manual)
- Hydraulic and Scour Report

This submission is in addition to the copies of the General Plan and Elevation sheets and Structure Location Plans that are included in the roadway plans. Additional sets of plans are required for each Railroad affected by the structure.

It is preferred that all bridges and structures in the contract be submitted at the same time; however, it is recognized in large contracts that interchanges and sections of roads are sometimes approved in a "piecemeal" fashion. Consequently, preliminary bridge plans will be accepted on an individual basis.

1.11.2 DESIGN DEVELOPEMENT (Final Structural Documents)

This submission, in effect, is the submission of 100% complete contract documents. Submission of all bridge documents shall be included in the total contract documents.

SECTION 12

BRIDGE DECK REPAIR DESIGN GUIDELINES

The following guidelines shall be common to most deck repair projects. These guidelines should be used to avoid common problems during plan preparation and construction. All items in these guidelines may not be applicable or appropriate for every project. However, any deviations from these guidelines should be discussed with the NJDOT Project Manager in charge of the project.

The purpose of Bridge Deck Repair projects is to construct interim repairs which can provide a smooth riding surface and improve the bridge deck surface and bridge deck joints so as to extend the useful life of the structure in a cost efficient manner.

1.12.1 FIELD RECONNAISSANCE

All field work shall be conducted with safety as a first priority. All field personnel are to wear safety vests. Lane closures are not permitted without proper approval of the Department's Project Manager. Designer's vehicles shall not be parked in the shoulder unless proper cones and signs are placed.

A. Plan Preparation For Field Audit

1. As-built plans of the bridge should first be obtained from the Department.

2. Prior to field reconnaissance, a plan view of the deck should be drawn at a scale of ¼" = 1'-0". A grid system at 5 feet intervals should be drawn on the plan to enable easy recording of deck defects.

3. Accident data within the vicinity of the structure and approaches should be obtained and reviewed for safety upgrades.

B. Traffic Patterns

1. Traffic patterns should be reviewed in the field. Sketch and make a note of all warning and regulatory and guide signs within the vicinity of the structure in question. Indicate posted speed limit.

2. The number of lanes and shoulders at each bridge approach and on the bridge itself should be noted. Make notations and measurements of all striping transitions especially where lanes are dropped or added or where shoulders are dropped or added. All existing lane widths shall be measured.

3. Show all ramps within the vicinity of the bridge structure whether they are immediately adjacent to or located within 1500 feet of the bridge structure in question. Measure the distance to the ramp from the structure.

4. Concrete barrier curb widths should be measured to determine if signs could be mounted. Caution should be exercised and traffic approval is required when requiring signs to be mounted on concrete barrier curb. Possible insufficient shoulder width and resulting traffic interference problems should be evaluated.

C. Deck

1. Verify Base plans to insure that no changes have been made to the deck since the as-built plans were prepared. Any changes made should be measured and incorporated into the plans.

2. A baseline which follows the grid sequence on the deck plan should be placed in the field with stations marked at 10 feet intervals. Photos and/or video of the deck should be taken for future reference. A dry marker board of paper medium can be used as a photograph location reference.

3. The defects should be recorded by sketching the defects. Areas of previous repair as well as existing spalls should be sketched. A proper legend should be developed to symbolize each defect.

4. The concrete decks should be tested to determine the deteriorated areas as follows:

Tier I	Sounding (chain drag and hammer methods)
Tier II	Deck condition survey & evaluate the latest bridge inspection report

Refer to 1.12.2(B) for the definition of Tier I and Tier II.

- Evaluate the bridge inspection report to verify the appropriate Tier ranking.

- Perform a full deck condition survey with criteria as specified in Section 9C of this Manual.

Before proceeding with the Tier II measures, the following guidelines should be evaluated.

- The current Bridge Evaluation report should be evaluated by the Designer since a Federal Funded Tier II repaired bridge can not be repaired again using Federal Funds for a period of 10 years.

- A full deck condition survey, following the criteria as specified in Section 9C of this Manual, should be performed.

5. To avoid underestimation of quantities, the sounding of the deck to detect areas of delamination should occur close to the time of the actual project construction. A typical probable time line for advancing Bridge Deck Repair Contracts should be as follows:

   - July to November - Bridges selection
   - September to February - Deck condition surveys
   - November to March - Complete all plan sheets
   - March to April - Advertising
   - April to May - Award
   - Completion in no more than one construction season

   Deck condition surveys will be performed by trained construction personnel or vendors prior to advertisement of the Project.

6. To categorize asphalt overlaid decks into Tiers I and II, visual inspection, study of past Bridge Evaluation reports and of maintenance history and use of Department approved delamination detection devices shall all be utilized to determine the deteriorated areas. Existing Tier I asphalt overlaid decks will not be included in the Deck Repair Program as they are not cost effective.

7. Traffic control by Maintenance staff should be arranged with the Director of Operation's Office. If manpower is not available, a consultant agreement to perform deck soundings, including the traffic control, must be entered into.

8. The Designer shall evaluate the underside of the deck slab for potential full depth repairs, or to check the condition of stay-in-place forms.

D. Joints

1. Deck joint type, size and locations should first be confirmed against as-built drawings. Joint spalls should all be recorded. The joint filler material should be observed for any deterioration. The existing width of the joints shall be noted. The ambient temperature and general weather conditions during these observations should also be noted.

2. The joints shall be observed under the structure to determine if there are any water stains, efflorescence or spalls on the substructure due to joint leakage.

1.12.2 PLAN PREPARATION FOR DESIGN

A. Key Sheet

1. The Key Sheet shall be submitted prior to Final Design so that the proposed titles, control section number, and highway types can be reviewed. The title to appear on the Key Sheet shall be:

   Bridge Deck Repair
   at Various Locations
   Contract No. # VAR970199
   Route # ______
   From The Vicinity of Route # _______ to Route # _______

2. Counties where each bridge is located shall be shown above the Key Map. The location of each bridge shall be flagged off on the Key Map and labeled "Project Site 1", "Project Site 2", etc. The "Project Site" numbers shall correspond to the numbers on the chart labeled "Bridges in this Contract" appearing on this sheet. At locations where all bridges can not fit on the same Key Map, another Key Map shall be shown to the right of the main map with the remaining project sites flagged out.

3. The total length of the project to be shown on the Key Map shall be in feet or miles because of discontinuity between sites. Also, on the BRIDGES IN THIS CONTRACT Table, add a column for Total Bridge Length for each bridge for FHWA FMIS Reporting purpose.

4. Any utilities affected by construction shall be shown on the Key Sheet. If none are affected, then the list of utilities shall be removed from the Key Sheet.

B. Repair Percentage

1. The maximum percentage of deck patching areas that should be included in these projects and remain cost effective are as follows:

1% to 30%	deck deterioration	Deck Patching	(Tier I)
20% to 60%	deck deterioration	Deck Patching with overlay	(Tier II)
50% to 100%	deck deterioration	Deck Replacement	

   Use of overlays shall conform to the provisions of Subsection 1.20.3 of this Manual.

   The overlapping percentages are intended to provide some flexibility in the decision making process. If the deck deterioration percentage falls in the overlapping percentages, then the following factors should also be considered in order to place the bridge in the appropriate tier:

- *Adjacent Structure* - Need to look at the condition of and what repair work is proposed for the adjacent structures in the corridor.
- *Upcoming Project* - If the bridge is included in a project that is in the pipeline.
- *Traffic Volume* - ADT in the heavy traffic areas.

2. When the deck deterioration percentage indicates that the deck should be replaced, it should be programmed in the pipeline as soon as possible so that its construction can begin within 2 years. Accordingly, performing deck repairs is not economical. If warranted as a temporary measure, asphalt patching with an asphalt overlay will be utilized (if the bridge can take the additional load) until the bridge receives a new deck.

C. Estimate of Quantities

1. All roadway and bridge items shall be shown in the same estimate of quantities sheet. Bridge items shall follow all roadway items. Each bridge shall be listed by name and bridge number above it's quantities.

2. If a pay item other than those of Section 500 of the Standard Specifications is used for work on a bridge, then that item shall be listed with the roadway items and will be cross referenced on the bridge drawings.

3. Current Baseline Document Change (BDC) memorandums shall be followed for standard items and standard item numbers that are to be included in the contract. In addition, all projects shall include items for:

   - Final Cleanup
   - Construction Layout
   - Field Office
   - Telephone Service
   - Dust Control Calcium Chloride
   - Clearing Site

4. The estimated area of patching should be provided for each structure in the contract. However, these quantities will be added and included under one pay item.

D. Roadway Construction Plan

1. All roadway items shall be shown on a "Construction Plan". No bridge items shall be shown on this plan. The sheet shall contain a plan view of the bridge with predominant features of the structure shown. Multiple bridges are permitted to be detailed on the same plan sheet with the appropriate scale shown below each detail.

2. Sheets shall be prepared so that each roadway construction item is labeled with a bubble containing the "Standard Item Number" with an extension line

showing the required quantity. Label and dimension all lane widths, shoulder widths, high type channelization devices such as concrete islands, concrete medians, etc.

3. Label each plan view and route number, direction and structure number (e.g. Route 15 SB over Main Street (1404-151)).

4. Provide a "To Be Constructed" table which includes Pay Items No., Std. Item No., To Be Constructed (description) and Contract Quantity.

5. A table shall also be shown providing a cross reference to the appropriate bridge sheets.

6. Like quantities for each bridge must be flagged individually but can be summed together in the "To Be Constructed Box."

E. Staging Plans

1. Prior to developing staging plans, the Project Manager shall contact Traffic Operations to determine what are the maximum allowable lane closure hours in each direction and the maximum number of lanes that can be closed at one time. When work is to be done on local roads, local authorities should be contacted to determine if they have any restrictions regarding lane closures. A minimum ten hour window is required for the Contractor to properly complete his work. If Traffic Operations does not have allowable lane closure hours across a ten hour window, then the Project Manager shall recommend a revision to these hours to Traffic Operations based on field observations made at the beginning and end of the lane closure hour window.

2. Staging plans shall show a cross-section of the bridge for each stage of construction (two stages are preferred). In each of the planned stages, repair areas shall be distinguished from travel lane areas. Placement of traffic control drums with dimensions of temporary travel lane widths and repair area widths shall be shown. Reference notes to cross reference traffic control plan sheets and deck repair plan sheets shall also be shown. A table of allowable lane closure hours must be provided on the plan.

   A note must be placed in the specifications stating that the Contractor must pay liquidated damage costs for time spent on the construction site prior to or after the hours stated in the "Allowable Lane Closure Hours" table. In addition, minimum work area widths, overall bridge width, minimum lane widths, and existing cross slopes shall be indicated.

F. Traffic Control Plans

1. A set of applicable standard traffic control plans shall initially be obtained. These plans are only to be used as a basis for developing the final traffic control plans. These plans shall be customized to reflect site conditions such

as complex ramp striping locations and the ability of the shoulder to withstand traffic.

2. Plans must comply with NJDOT, MUTCD and AASHTO LRFD regulations.

3. All nonstandard signs shall be sized according to the MUTCD with letter heights and alphabet size given for each line.

4. All traffic control schemes and detour plans on local roads, if applicable, must be approved by local authorities. It is important that early in the design a set of applicable traffic control and staging plans be sent to them for their approval. A letter of approval from any of the affected local authorities must be included in the final design submission.

G. Construction Details

Bridge Construction Detail (BCD) sheets 1A, 1B, 1C and 1D can be referred to for typical details that shall be used in contract plan development.

H. General Plan and Section

1. This sheet shall include a plan view of the bridge, a key plan, a typical cross section, a baseline, an existing profile (if surveyed for Tier II project), a proposed profile if it is different from the existing profile, general notes, an index of drawings, and a summary of quantities. If no new design survey was performed for a Tier II project, the Contractor must be required to do the survey prior to scarification.

2. The plan view shall be developed from as-built plans and modified as per the field reconnaissance. All roadways should be labeled with the lanes dimensioned. The deck joints, parapets, utilities, sidewalks and curbs shall be shown.

3. The bridge section shall show a typical cross section of the superstructure with the existing lane and shoulder configuration, the cross slopes, deck slab thickness, rebar location and the typical extent of deck repairs.

4. General Notes shall list reference specifications and any other pertinent notes for the contractor.

5. The "Index of Drawings" shall contain the bridge sheet numbers of the drawings pertaining to that structure.

6. The "Summary of Quantities" shall contain only bridge quantities for that particular bridge. All other quantities shall appear on the "Construction Plan" and/or the "Estimate of Quantities" plan.

I. **Deck Repair Plan**

1. This sheet shall contain a plan view of the deck at a scale of ¼" = 1"-0". The plan view shall be drawn from As-builts and edited as per the field reconnaissance. A grid at 5 feet intervals shall be drawn over the deck to facilitate spall locations. Locations of lane lines shall also be shown.

2. All existing spalls and areas of previous spall repairs as well as other proposed repair areas shall be shown on the plan via the symbols contained in a legend. Deck joints to be repaired or reconstructed shall also be indicated with references to the Deck Repair Details. This is to calculate the percentage of deteriorated deck area and show a true As-Built condition of the deck surface.

3. The notes should contain page numbers of all the cross referenced sheets, including Traffic Control Plans, Staging Plans, Roadway Construction Plans and whether stay-in-place forms exist under the deck.

4. Decks with asphalt which are to be resurfaced shall have a quantity of "Concrete Deck Repair" based on the existing condition of the asphalt, the structure's age, the volume of traffic and deck condition survey. Deck areas 5 feet from the both gutter lines shall be assumed to be deteriorated.

J. **Deck Repair Details**

1. These sheets shall show typical repair details. The method of repair to be as per the NJDOT Standard Specifications for Road and Bridge Construction.

2. Repair procedures that the Contractor will follow should be outlined in the notes.

3. Details should be shown for a temporary cover of the repair areas that are not completed during work hours.

4. Once the quantity of deck of repair is computed, ***5%*** of this area for "if and where directed" quantities is to be included in the total quantity.

5. For small areas of repair, reinforcing bars shall be replaced "in kind". For large area (> 20 square feet), all new reinforcing bars shall be epoxy coated.

6. Deck repair details shall reflect the as-built plans. For example, special deck repairs shall be included for deck slabs which have truss reinforcment bars

7. Full depth repairs are required when any portion of the bottom layer of reinforcing bars is exposed.

K. **Deck Joint Reconstruction Details**

1. These sheets shall show typical repair details for deck joint reconstruction for specific field condition; such as, abutment headers or approach slabs as well as deck joints at the abutments and piers.

2. All as-built plans for the deck joints should be thoroughly checked and field verified prior to designing the repair.

3. It is imperative that the correct size be given for the elastomeric joint sealer in order to avoid problems during construction where the elastomeric joint sealer is to be replaced. Staging of this installation should also be specified.

4. If joint spalling is limited and marginal in width and depth, consider vertically saw cutting the deck joint and providing new wider joint filler material curb to curb.

5. The measured quantities of Deck Joint Reconstruction will be the sum of the overall length of each side of the individual joint reconstructed. Notes to call for this measure shall be shown on the plans.

6. For Tier II projects, armoring of deck joints should be considered based on deterioration of the deck slab edges and heavy truck traffic.

L. **Quality Control**

1. A cross check must be made between the Staging Plans, GP&E, Deck Plans and Roadway Construction Plans for items including but not limited to existing lane widths and any other existing features.

2. In addition, a cross check must be made between the details on the Roadway Construction Plans, and the Structural Plans to ensure constructability and prevent the overlapping of items. Areas outlined for spall repairs should be checked against the field photos to insure that the areas have been outlined properly.

M. **Bridges over Railroad Tracks**

1. All repairs over a Railroad will require Liability Insurance as specified in the Special Provisions.

2. Temporary shielding will not be required on decks having Stay in Place Forms or decks over abandoned railroad tracks. In addition, temporary shielding will not be required if the Designer decides that there is no possibility of full depth repairs over railroad tracks or other locations where there is no potential harm due to falling concrete. The Designer will verify the need for temporary shielding.

3. If temporary shielding is not anticipated, the pay item "Temporary Shielding - Working Drawing" (Lump Sum) should be included in the plans and specifications to provide for emergency conditions.

4. If temporary shielding is required, the following items should be included in the plans and specifications:

   a) Temporary Shielding - Working Drawing (Lump Sum)
   b) Temporary Shielding (SF)

5. Flagman and inspectors and other associated costs will be as provided for in the Utility Agreement.

6. The use of temporary shielding after the approval of the working drawing will be at the discretion of the Resident Engineer.

1.12.3 CONSTRUCTION TECHNIQUES

A. Approaches

1. A bridge which has an asphalt approach roadway and has an abutment deck joint that should be replaced shall have the approach milled a minimum distance of 10 feet, a tack coat applied, and a minimum of 2 inches of Bituminous Concrete Surface Course Mix I-4, Aggregate Modified, constructed on the approach. This will result in a smooth transition from the slab to the deck.

2. The length of approach to be milled and resurfaced is dependent on the pavement condition of the approach and any excessive differences between the elevations on the approach and bridge deck. A minimum length of 10 feet should be used.

B. Deck

1. Bituminous concrete overlays are not permitted on any bridge decks. In special cases where such overlays are already part of the existing deck surface, replacements of such overlays may be appropriate. Placements of these overlays will be approved on a case by case basis by the Manager, Structural Engineering. In any event, milling of asphalt overlays will not be permitted on any bridge deck unless shown on the plans. Bridges requiring resurfacing shall use the roadway item "Removal of Bituminous Concrete Overlay".

   After patching the deck, a waterproofing membrane shall be applied prior to resurfacing the bridge with "Bituminous Concrete Overlay Mix I-4, Aggregate Modified". The item "Water Proofing Membrane" shall only appear on the bridge plans. Other roadway items shall only appear on the Construction Plan.

2. In order to reduce construction costs, repair of deck deterioration of all the bridges in the contract shall go under the single non-standard item "Concrete Deck Repair". The Designer will provide specifications for this item. The item will consist of constructing a modified standard "Type B" repair for all repairs. However, if a "Full Depth" repair is encountered, it shall be repaired as a full depth repair, but still be included in the item "Concrete Deck Repair". Class A concrete or Type IA quick setting patch material is to be used for concrete deck repairs depending on available traffic windows. For depths more than 4 inches, patch materials and method of construction shall be approved by the Resident Engineer. Special attention should be made to manufacturer's recommendations regarding application thickness and curing time.

3. All spall areas to be repaired must be clearly outlined on the plans. All previous spall repairs containing epoxy shall be removed if an LMC overlay is planned. It has been determined that it is more practical and efficient to group together small spalls and outline it as one large spall repair. Engineering judgment should be used to determine if small isolated spalls in the deck should be included as part of an adjacent larger repair. The larger the repair patch, the easier it is for workers to remove the defective concrete and replace it with patch material.

4. All deck repair shall be finished utilizing a coarse broom finish unless the existing deck is already sawcut. This item is to be included in the price bid for the item "Concrete Deck Repair". Large repair areas such as overall lane widths or decks already sawcut shall be finished with the item "Sawcut Grooved Deck Surface".

5. Construction joints are often used to limit the size of the repair due to lane closing restrictions. They may also be placed at the contractor's option to provide a working edge for concrete finishing, to provide for a continuous joint replacement, or at the end of the work day. Extreme care must be made to remove all loose materials (new or old) along these construction joints prior to placing any new concrete.

   There is a tendency to have irregular shapes at the interface between deck patches and joint reconstruction. This is due to the skew angle between the direction of the traffic lane and the joint. This results in acute angles. The newly placed concrete can crack in these areas. The designer should avoid these problems by outlining repair areas that do not form acute angles with the deck joints or other repair areas. There may be cases where new construction joints must be sawcut into the new concrete to provide the proper edge. Notes on the plans should instruct the contractor to plan his work to avoid placing a construction joint at odd angles.

6. Notes on the plans should outline repair procedures. All existing reinforcing steel must be sandblasted or hydroblast cleaned prior to placement of patch material. The minimum depth of repair should not be less than 2 inches with a minimum of 1 inch removal of concrete below the bottom of the top mat of the existing reinforcement. In all cases, there should be enough space available for the maximum size of concrete aggregate to "fit" in any location within the volume of the repaired concrete deck.

   The plans must be specific about the concrete removal. Hydrodemolition is acceptable as a removal technique. The Contractor must provide necessary sediment control measures so as not to impact any surrounding areas or drainage systems and meet all environmental requirements.

   In removing deteriorated concrete, caution must be exercised so that the removal does not progress to sound concrete, or is limited to 1 inch below the top reinforcement in conformance with the BCD. The Engineer shall develop his plans so that this guidance is provided.

7. Details must be shown for treatment of repair areas which can not be completed during work hours due to unforeseen conditions. The most widely utilized method is to fill the spall with cold patch. In addition, a detail utilizing a steel cover plate should also be shown. The contractor should have the option of what method to use. A time limit of 2 days should be placed on the duration the temporary cover can remain in place. The price for placement, maintenance, and removal of the temporary cover and cold patch during repairs shall be included in the bid cost of "Concrete Deck Repairs".

8. An LMC or Silica Fume concrete overlay should be constructed where feasible. Due to the curing time of 7 days, a lane or bridge closure is required. When specifying an overlay, it is important for the designer to recognize that the deck joints and approaches may have to be reconstructed due to the elevation change.

C. Joints

1. Deck joints which exhibit leakage and/or edge spalling shall be repaired by replacing the Deck Joint Sealer and/or reconstructing the header and/or deck side of the joint utilizing the non-standard items "Deck Joint Reconstruction", "Sawcut Joint Reconstruction" or "Deck Joint Repairs". These items shall be measured in linear meters with the area to be repaired outlined in the plan view. Generally, it has been found that it is more practical to repair the entire length of joint thereby creating a better seal of the preformed elastomeric joint sealer rather than only repairing a portion of the joint. All labor and materials shall be included in this item except for preformed elastomeric joint sealer which shall be itemized separately.

2. Where applicable, hot poured rubber asphalt joint sealer should be used to seal joints. Where possible, bituminized fiber joint filler should be placed below the hot poured rubber asphalt joint sealer.

3. Where defects due to spalling at joint sealers occur, the joint should be repaired according to appropriate details.

4. Where abutment deck joints are reconstructed, hot poured sealant should be placed between the abutment header and approach slab.

1.12.4 SAFETY UPGRADES

Safety upgrades will not be included as part of the deck repair project but will be included in a subsequent contract. This contract will be authorized and advertised no later than 12 months following the completion of the deck repair work so work can begin promptly ***after*** the deck repair contract work is completed. Safety upgrades guidelines will be as follows:

A. For decks receiving a concrete overlay:

1. All geometric standards will be met, or a design exception will be prepared.

2. Upgraded safety features that will be incorporated on NHS bridges receiving a concrete overlay will include crashworthy attachments and transitions of approach beam guide rail to the bridges, installation of guide rail or other crashworthy retrofit barrier system across the structure, or installation of replacement of parapets. For non-NHS roadways, if full safety upgrades are not practical, as determined by the Bureau of Structural Engineering, and there is no accident history, then attachments and transitions which consist of at least reduced post spacings and connections with a history of satisfactory performance will be considered acceptable.

B. For decks that are to be patched between **20%** and **30%** of the total deck areas:

1. In addition to approach guide rail being attached to the bridge using a crashworthy attachment and transition, the need to upgrade or retrofit the existing bridge rails will be evaluated on NHS bridges. Factors such as accident data, loading, geometry, cost and impact of the improvement will be evaluated, and any decision not to upgrade or retrofit the existing bridge rails will be justified and documented in the bridge design project files.

2. For non-NHS roadways, if full safety upgrades are not practical, as determined by the Bureau of Structural Engineering, and there is no accident history, then attachments and transitions which consist of at least reduced post spacings and connections with a history of satisfactory performance will be considered acceptable.

C. For decks that are to be patched to less than **20%** of the total deck area:

1. If there is no accident history, attachments and transitions which consist of at least reduced post spacings and connections with a history of satisfactory performance will be considered acceptable.

2. Attachments and transitions not meeting this criteria will require upgrading to current standards. Existing approach beam guide rail will be attached to the bridge using an acceptable attachment.

D. Bridges with aluminum 3-rail bridge railings with an adjacent brush curb of 9 inches or less, will not be retrofitted, unless there is a history on unsatisfactory performance.

E. A brief statement addressing resolution of safety deficiencies will be provided with authorization requests for projects.

1.12.5 NBI CODING

A. For decks receiving a concrete overlay, item 106 (year constructed) of the Structural Inventory and Appraisal will be updated to the year of reconstruction. The highest code that is used for a reconstructed deck is an "8". The coding of Item 58 (bridge deck condition) will be based on the actual condition of the deck in the field, but in no case less than a rating of "7".

B. For decks receiving patching, item 106 will not be revised and the coding of Item 58 will be updated based on the actual condition of the deck in the field.

SECTION 13

BRIDGE ATTACHMENT PERMITS

1.13.1 GENERAL

The Department allows utility attachments to crossframes of an existing bridge. This is if the proposed addition is "a practical arrangement and considered to be in the public interest". Bridges, overhead sign support structures or other highway structures should not be used to support utilities where their support will impede the Department's ability to perform future work on the structure without relocation of the utility.

The following information has been established as a guide for the preparation of plans and for the review of plans for the proposed attachment.

1.13.2 LOCATION

a. The location of a utility crossing in a structure should be selected to avoid conflict with existing utilities or future utilities for which provisions have been made. Adequate access for maintenance and inspection of the planned installation and of the structure itself must be kept in mind.

b. Placement of utilities on bridge decks or sidewalk areas, or attachments to railings or parapets, are not permitted. Also prohibited are exposed installations at the outside faces of the structure.

c. Existing underclearances must be preserved. Section 34 of this Manual may be referred to for policy regulations concerning utility installations. Familiarity with the structural framework is necessary to avoid conflicts with bearing seats, crossframes, intermediate and end diaphragms and lateral bracing.

d. Structural integrity of the bridge components shall be preserved. The dead load of the proposed utility attachment shall not cause undue stresses.

1.13.3 INSTALLATION AND PLAN REQUIREMENTS

a. Joints in bridge decks usually define locations where differential movements can occur between adjacent spans resulting from temperature changes and traffic loads. Appropriate devices must be provided at these locations to accommodate similar movements in bridge attachments.

b. Galvanized structural steel should be utilized for supports where existing structural elements cannot be used to carry loads. Sizes of proposed structural shapes should be provided.

c. Specify the type, size and location of connections. High strength bolts (7/8 inch diameter preferred) shall be used. For new structures, welding to existing structural appurtenances is prohibited. Welding to bottom flanges or lower one third of web of simply supported stringers is not permitted. Welding will also be prohibited in areas of negative moment area for continuous beams. Placement of anchor bolts or other inserts into deck slabs is also prohibited.

d. Pipes installed through abutment backwalls should be placed in galvanized steel sleeves set in non-shrink grout with the opening between the pipe and sleeve packed with jute or similar material to prevent leakage through the backwall.

e. Provide ducts for electrical and communication cables.

f. Pipes carrying liquids under pressure in trenches should be sleeved within 10 feet of abutments, walls and piers.

g. All pipelines carrying liquids or gasses under pressure shall extend through the supporting structure without changes in alignment. Changes in alignment shall be outside the structure limits. Reactions developed at these locations should be carried by thrust blocks or other means completely independent of the bridge's structural elements.

h. The project location should be defined on a small scale location map on which the site can be seen in relationship to major points of reference; such as, highways, municipalities, bodies of water, county lines, etc.

i. Identification of the route, municipality, county, applicant, and proposed bridge attachment should be placed in the title block located in the lower right hand corner.

j. Provide a plan view with a North reference arrow, an elevation and a cross section of the structure and detailing and necessary dimensions to identify and locate existing and proposed structural members that are in relationship to the bridge attachment and to verify clearances. Additional sections should be shown, as required, to completely convey the extent of the work and/or modifications proposed.

k. The outside diameters and thickness of pipes, and weights of pipe or conduit and materials carried should be shown on the plans. If manufactured fittings, connectors, supports, etc. are used, their identity and spacing should be indicated on the plans and catalog cuts with dimensions should be traced on to the plans.

SECTION 14

COMPUTER PROGRAMS

1.14.1 CONSULTANTS (DESIGN CALCULATIONS)

1. The use of computers as a tool in the performance of design computations and other applications such as determination of dimensions and grades is acceptable provided:

   - All computer work is under the direct supervision of an experienced structural engineer familiar with computer techniques.
   - The Consultant assumes responsibility for the logic and results of the program.

2. Documentation of all computer programs written by individual consulting Engineering firms or obtained from other sources (including computer services) shall be submitted to the Manager, Bureau of Structural Engineering for approval before the programs are used.

   This submission shall include such information as would be required by an Engineer to determine what methods were used in the solution of the problem and what types of decisions were made by the computer.

3. The above submission should include, as a minimum:

   a. A description of the program, explaining exactly what the program does, what options are available, what methods are used and AASHTO conformance. Submission of a Flow Diagram is also recommended.

   b. The input required by the program, including a description of each value, an input form (if one is used), and sample input.

   c. The output given by the program, including a complete description of each value, any keys used in interpreting the output, and sample output from the given input.

   d. Any constants or parameters used in the program.

   e. An explanation of how the program was checked, including a copy of computations relative to test.

4. The approval only allows the Consultant to include computer input and output in the design calculations. It does not relieve the Consultant of the responsibility of ascertaining that the program is satisfactory for the use intended and performing properly. No further approval is required for any program unless modifications are made to the logic of the program.

5. When computer output is included in a set of computations for submission, a copy of the input forms necessary to interpret the data should also be included.

6. Documentation of programs submitted to the Bureau of Structural Engineering will be safeguarded and will not be released for use by any other sources unless authorized by the author in writing.

7. Documentation for previously approved programs need not be submitted for each new project. However, the Consultant shall include a letter indicating which version of each program was used in the project, together with the date of the prior approval.

1.14.2 COMPUTER-AIDED DRAFTING (CONSULTANTS)

1. Contract Plans prepared with the use of computer aided drafting systems will be acceptable provided that they are consistent with the provisions of this Manual. Guidance provided in the NJDOT CADD Standards Manual should be followed.

2. Samples of drawings produced by any particular system shall be submitted for review and general approval at the time of Proposal negotiations or prior to, but well in advance of, the Preliminary Plan Submission.

3. Changes required on drawings as a result of the Final design review must be made by the computer drafting system.

4. Changes required on drawings after award of the construction contract shall be made by the computer drafting system and shall conform to Subsection 1.39.1. If supplementary drawings are required, the type of drawing(s) to be furnished will be determined.

5. Samples of drawings for previously approved systems need not be submitted for each new project. However, the consultant shall submit a letter (with the Proposal) indicating which system will be used in the Project together with the date of the prior approval.

SECTION 15

INTEGRAL ABUTMENT JOINTLESS BRIDGES

1.15.1 CHARACTERISTICS OF INTEGRAL BRIDGES

Integral abutment jointless type bridge structures are single or multiple span continuous bridge structures that have their superstructure cast integrally with their substructure. Due to the elimination of deck joints, construction and maintenance cost are lowered and fewer foundation piles are required. Research has indicated that this type bridge structure will perform better than a conventional bridge structure in a seismic event.

Integral abutment jointless bridges accommodate superstructure movements without conventional expansion joints. With the superstructure rigidly connected to the substructure and with flexible substructure piling, the superstructure is permitted to expand and contract. Relief slabs, connected to the abutment and deck slab with reinforcement, move with the superstructure. At its junction to the approach pavement, the relief slab may be supported by a sleeper slab. If a sleeper slab is not utilized, the superstructure movement is accommodated using flexible pavement joints.

The integral abutment jointless bridge concept is based on the theory that due to the flexibility of the piling, thermal stresses are transferred to the substructure by way of a rigid connection between the superstructure and substructure. The concrete abutment contains sufficient bulk to be considered a rigid mass. A positive connection with the ends of the beams or girders is provided by rigidly connecting the beams or girders and by encasing them in reinforced concrete. This provides for full transfer of temperature variation and live load rotational displacement to the abutment piling.

The connection between the abutments and the superstructure shall be assumed to be pinned for the superstructure's design and analysis. The superstructure design shall include a check for the adverse effects of fixity.

1.15.2 CRITERIA FOR INTEGRAL ABUTMENT BRIDGE DESIGN

The movement associated with integral abutment jointless bridge design can be largely associated with thermal expansion and contraction of the superstructure. By definition, the length of an integral abutment jointless structure shall be equal to the abutment center line of bearing to abutment center line of bearing dimension. This also applies to continuous span structure lengths with expansion bearings at the piers. This length of expansion mobilizes the horizontal passive soil pressure.

Where rock or glacial till is within a distance to the surface that would stipulate the use of piles with an effective length that is less than 15 feet in length, the suitability of the site shall be carefully studied for integral abutment jointless bridge construction. This is based on the understanding that piles with an effective length less than 15 feet may not permit the flexibility that is required to withstand the expected superstructure movement. The Designer shall assure that the effective length of piles is adequate.

Also, soil strata should be studied to access any potential of soil instability. If existing soils have any potential of instability, the Geotechnical Engineering Unit should be consulted for concurrence with proceeding with development of the Integral Abutment concept.

A. Relief Slab.

1. Relief slabs will always be required for integral abutment jointless bridge structures. Their lengths shall vary from a minimum of 10 feet to a maximum that is based on the intercept of a 1 V to 1.5 H line from the bottom of the abutment excavation to the top of the highway pavement. This length is to be measured along the centerline of roadway. Standard Drawing 2.9-5 provides conceptual details for Relief Slab construction.

   The relief slab detailing provided on Standard Drawing 2.9-5 is to be followed as the basis for its design. Of primary importance is the requirement that the relief slab shall include two complete layers of reinforcement.

2. The end of the relief slab shall be parallel to the skew. A width from face of rail to face of rail shall be provided. Special provisions shall be made to allow free movement of the relief slabs if curbs, barriers or sidewalks are present. Relief slabs shall always be a separate pour from the superstructure slab. However, they shall be joined together. The location of drainage structures in relief slabs is not permitted.

3. Where warranted, as per the Expansion Provisions stated below, to prevent the relief slab from moving excessively, it should rest on a keyed sleeper slab. The excavation for the sleeper slab shall be made after the compacted abutment backfill is placed. The sleeper slab shall be founded on undisturbed compacted material. No loose backfill may be used.

4. The relief slab shall be cast on two (2) layers of four (4) mil thick polyethylene sheets. It shall be designed as a structural slab that is supported at each end. Two layers of reinforcement shall be accounted for in the design and construction of the relief slab.

5. The provision of relief slabs for integral abutment jointless bridge construction will make the use of traditional approach slabs not necessary.

B. Expansion Provisions.

1. For bridge lengths 150 feet or less, provision for expansion at the relief slab ends may be waived if it is determined by the Designer that allowance for expansion at the relief slab end is not warranted.

2. For bridge lengths over 150 feet and up to 300 feet, provisions shall be made for expansion at the end of each relief slab by installation of a sleeper slab.

3. For bridge lengths over 300 feet and up to 450 feet, integral designs shall be approved by the Manager, Bureau of Structural Engineering, on an individual basis. Provision for expansion shall be made at the end of each relief slab by installation of a sleeper slab.

4. For bridge lengths over 450 feet, integral abutments are not recommended at this time.

5. When planning the deck slab construction, the concrete placement must be planned to be a monolithic pour. No joints other than sawcut control joints or construction joints are to be considered for the planned pour.

1.15.3 DESIGN PROCEDURE GUIDELINES

The following criteria shall be utilized in providing integral abutment jointless bridge designs:

A. Hydraulics.

Integral abutment jointless bridge structures provide fixity between the superstructure and substructure and provide greater protection against translation and uplift than conventional bridges. The NJDOT Bridge Scour Evaluation Program and Structure Inventory and Appraisal Inventory records shall be studied to verify scour potential at a project site. To address potential impact of a scour effect on proposed Integral abutment bridge sites, the following areas should be reviewed and analyzed where scour potential exists:

1. Stream Velocity.

   Any history of erosion or scour at the bridge site should be reviewed and a determination made if the new structure will alleviate any problems (alignment, restricted opening etc.) that may contribute to scour. Where a scour history is determined, the potential positive effects of an Integral abutment jointless bridge should be noted. Scour information may be obtained by researching the NJDOT Bridge Scour Evaluation Program and Structural Inventory and Appraisal coding records referred to above.

2. Bank Protection.

   Suitable slope protection construction, to provide protection against scour, should be provided. On all integral abutment jointless bridges, geotextile bedding shall be used against the front face of the abutment, under the slope protection and down the slope a minimum of 6 feet.

B. Skew Angle/Curved Girders.

The maximum skew angle for integral abutment jointless bridge designs shall be thirty (30) degrees. Skew angles greater than this shall preclude the use of integral abutment jointless bridge designs.

Superstructure configurations that require the use of horizontally curved girder schemes shall also preclude the use of integral abutment jointless bridge designs.

C. Foundation Types.

1. The abutment and pile design shall assume that the girders transfer to the piles all moments and vertical and horizontal forces that are produced by the superimposed dead load, live load plus impact, earth pressure, temperature, shrinkage, creep and seismic loads. The transfer of these forces shall be considered to be achieved after the rigid connection to the abutments is made. The rigid connection shall be detailed to resist all applied loads.

   Use of reinforced concrete abutments and pile support systems are required. Alternate or proprietary type abutments are not permitted for Integral abutment designs.

2. All abutment substructure units shall be supported on a single row of piles. Due to the nature of the integral abutment jointless bridge design, flexibility in the vicinity of the pile to pile cap connection is important to help reduce the buildup of stresses which would normally be relieved through the use of expansion bearings and joints. Therefore, pile type selection shall be based on providing this increased flexibility and in accounting for the thermal movement of the superstructure.

   Cast-in-place (C.I.P.), hollow steel pipe piles, prestressed concrete piles or steel H piles may be used for structures with span lengths of 150 feet or less.

   In the use of hollow steel pipe piles, the thickness of the pipe shall be considerate of loss of its thickness due to corrosion that may occur over the life span of the bridge structure. If deemed necessary, additional corrosion protection, such as application of a coal tar epoxy coating or galvanizing of the pipe may be stipulated. Section loss due to corrosion also applies to H piles.

   Only steel H piles should be used for structures with span lengths over 150 feet. When steel H piles are used, the web of the piles shall be perpendicular to the centerline of the beams regardless of the skew. This will facilitate the bending about the weak axis of the pile.

3. To facilitate expansion, for bridge span lengths of 100 feet or more, each pile at each substructure unit shall be inserted into a pre-bored hole that extends

a distance of 8 feet below the bottom of the footing elevation. All details and notes required by the Foundation Design Report shall be placed on the plans. For bridge lengths under 100 feet, pre-boring is not required.

The diameter of the augered hole shall be twice the size of the pile. After insertion of the pile, the hole shall be filled with cushion or uncompacted sand. The cushion or uncompacted sand shall conform, according to the provisions of Subsection 901.09 of the NJDOT Standard Specifications, to designation I-8 sand.

The cost of pre-boring the holes, use of any casings to shore up the holes and cushion sand shall be included in the Unit Price Bid of the pile item.

4. To provide adequate penetration, all piles shall then be driven to a minimum depth that accounts for a stilt type effect, provision for loss of lateral support caused by scoured material, lateral loading and provision for sufficient lateral support.

5. The Designer must determine the practical point at which the embedded pile is determined to be fixed. The following steps may be followed to perform such an analysis:

   - Calculate the thermal movement demand. For a bridge structure with equal intermediate bent stiffness, the movement demand will be equal. The atmospheric temperature range, coefficient of expansion and the structure's length should be considered.

   - The plastic moment capacity of the embedded length of the pile (embedded in the concrete cap) must be calculated. As stated earlier, the pile shall be oriented for bending about the weak axis.

   - The column capacity must then be calculated.

   - The adequacy of the backwall to resist passive pressure due to expansion must be calculated.

6. When CIP or hollow steel pipe piles are used, pipe casings conforming to ASTM A252, Grade 2 minimum with a minimum wall thickness of ¼inches shall be used. This shall be noted on the plans. Higher grades may be used if it is determined that a higher grade meets the design parameters that have been considered in the pile selection.

7. A pile bent configuration should be used for the integral abutment substructure detailing. One pile per girder shall be used. Intermediate piles, as required, may be provided.

8. Pile selection shall be based upon the recommendations that are contained in the Geotechnical Report. The axial loads shall be based upon the reactions

from the superstructure design. This shall include the superstructure dead load, live load plus impact and the substructure dead load.

9. As stated earlier, live load impact shall be included in the design of piles. The total length for single span bridges and the end span length for multiple span length bridges should be considered.

10. Steel H-piles may be socketed into a rock strata by means of drilling or boring. After drilling, the piles shall be driven to refusal. This method is permitted with the condition that the remaining effective length of pile is sufficient to permit the required bridge structure flexibility.

11. A pinned connection of the superstructure and abutments shall be assumed for the superstructure design and analysis. The superstructure design should include a check for the adverse effects of fixity.

12. Provision of pile splices shall not be planned. However, if required during construction, splices will not be permitted in the top and bottom 10 feet length of the pile.

D. Superstructure.

1. Spread prestressed box beams, prestressed concrete girders and structural steel beams may be used for integral abutment jointless bridge designs. They shall be analyzed to determine the stresses in the beams that will result from thermal movements.

   In prestressed box beams, such stresses shall be judged to be critical when the beams act by pulling an abutment with an approach slab. Mild reinforcement shall be added to the ends of prestressed box beams to resist such stresses.

2. Standard Drawings 2.9-1 and 2.9-2 provide conceptional detailing for rigidly connecting structural steel type superstructures to the abutments.

   As detailed in Standard Drawing 2.9-3, prestressed concrete box beams and girders may be connected by doweling them to the abutments. Inserts for the dowels should be planned as part of the fabrication process.

   Slotted holes should be used when doweling of prestressed concrete members to the abutments is planned. Placement of prestressed concrete members on plain elastomeric pads should be detailed.

3. As detailed in Standard Drawing 2.9-2, steel girders may also be placed on plain elastomeric pads. If utilized, anchor bolts will pass through both the pad and the bottom flange of the girder. Another method is to use a longer bolt so that nuts may be placed above and below the bottom flange. The grade of the girder may be better controlled this way. Slotted holes should be used to allow better flexibility in aligning the girder.

Painting of steel girders should be noted on the Plans.

Weathering steel, subject to the guidance provided in Subsection 1.24.19 of this Manual, may be used. The guidance provided in Subsection 503.15 of the NJDOT Standard Specifications, concerning limited painting of weathering steel, should be accounted for if use of weathering steel is planned.

According to the NJDOT Standard Specifications, when weathering steel is used in Integral Abutment construction, the ends of the girders shall be painted for a distance that extends to one foot beyond the concrete diaphragm. To facilitate the shop fabrication of the girders, a length, to meet this requirement, shall be provided on the Plans.

E. Abutments.

1. In integral abutment jointless bridges, the ends of the superstructure beams are fixed to the integral abutments. Expansion joints are thus eliminated at these supports. When the expansion joints are eliminated, forces that are induced by resistance to thermal movements must be proportioned among all substructure units. This must be considered in the design of integral abutments.

2. The integral jointless bridge concept is based on the theory that, due to the flexibility of piles, thermal stresses are transferred to the substructure by way of a rigid connection. The concrete abutment contains sufficient bulk to be considered a rigid mass. To facilitate the stress transfer, abutments shall be placed parallel to each other and ideally be of equal height.

3. The connection between the girder ends and the abutment shall provide for full transfer of temperature variation and for live load rotational displacement to the abutment piling.

4. To support the integral abutment jointless bridge, a single row of piles shall be used. The piles are driven vertically and none are battered. This arrangement of piles permits the abutment to move in a longitudinal direction under temperature effects.

F. Piers.

1. Piers for integral abutment jointless bridges have similar design requirements and share common design procedures with the piers of a more traditional bridge. The primary distinguishing features of the piers for an integral abutment bridge involve their ability to accommodate potentially large superstructure movements and the sharing of lateral and longitudinal forces among the substructure units.

2. As with integral abutments, the piers must also be designed to accommodate the movements of the superstructure. Thermal movements are usually the

major concern, although superstructure movements, due to concrete creep and drying shrinkage, will also be present to some degree. Creep and shrinkage movements may be ignored for prestressed concrete girders; however, for longer bridges, these effects must also be considered in the design of the piers.

3. As part of the overall structural system, integral abutment jointless bridge piers will typically be required to carry a portion of the externally applied longitudinal and transverse loads on the bridge. In addition, thermal movements of the superstructure will induce forces as the piers attempt to restrain those movements.

4. As the superstructure expands and contracts with seasonal temperature changes, and to a lesser extent, creep and shrinkage, the tops of the piers will be forced to undergo displacements relative to their bases. These displacements will produce curvatures in columns that can be closely estimated based on the magnitude of the movements, the fixity conditions at the top and bottom of the columns and the height of columns.

5. Once curvatures are estimated, an effective column stiffness must be considered to compute internal moments and shears. A set of equivalent external forces, in equilibrium with the computed internal moments and shears, must be computed. This set of equivalent forces is used in subsequent analysis to represent the effects of superstructure movements on the piers.

6. Forces induced by the distribution of the superstructure movements must be computed. Also, the distribution of externally applied loads to the substructure units must be estimated.

7. Similar to the design of a traditional pier, piers of integral abutment jointless bridges are designed for load combinations. Often, load combinations involving temperature, creep and shrinkage control the design of integral abutment jointless bridges, as opposed to combinations containing external loads only. A pier must be capable of undergoing the imposed superstructure movements while simultaneously resisting external forces.

8. A bearing at a pier of an integral abutment jointless bridge structure should only be fixed when the amount of expected expansion from the bearing to both abutments or adjoining pier is equal. All other cases should use expansion bearings.

9. The following guidance shall be followed in determining the type of pier selection in integral abutment jointless bridge designs:

   a. Continuity at Piers.

      1.) The concrete deck slab must be physically continuous, with joints limited to sawcut control joints or construction joints.

Distinction must be made between slab continuity and girder continuity at the piers.

2.) If, in accommodating the load transfer, girder continuity is deemed appropriate by the design, the superstructure shall be assumed continuous for live loads and superimposed dead loads only. Girders shall be erected as simple spans and made continuous by the addition of mild steel in the deck slab.

3.) Longer span integral jointless bridges; i.e., those with spans over 100 feet shall be detailed to provide a deck slab placement sequence if girder continuity is to be provided.

Where applicable, casting of concrete diaphragms over the piers should be done concurrently with placement of the slab.

4.) When slab-only continuity is provided over the piers, girders are to be designed as simply supported for all loads.

b. Types of Piers.

To design piers to accommodate potentially large superstructure movements, the following options are available:

1.) Flexible piers, rigidly connected to the superstructure;

2.) Isolated rigid piers, connected to the superstructure by means of flexible bearings;

3.) Semi-rigid piers, connected to the superstructure with dowels and neoprene bearing pads;

4.) Hinged-base piers, connected to the superstructure with dowels and neoprene bearing pads.

c. Flexible Piers.

1.) A single row of piles, with a concrete cap that may be rigidly attached to the superstructure, provides a typical example of a flexible pier. This type of pier is assumed to provide vertical support only. The moments induced in the piles due to superstructure rotation or translation are small and may be ignored.

2.) A bridge constructed with flexible piers relies entirely on the integral abutments for lateral stability and for resisting lateral forces. Passive pressures behind the backwalls, friction, and passive pressures on the abutment piles should be mobilized to resist lateral and longitudinal forces.

3.) With this type of pier use, temporary lateral bracing may be required to provide stability during construction. Designers must consider a means to account for passive soil pressures in the vicinity of the backwalls.

d. Isolated Rigid Piers.

1.) Rigid piers are defined as piers whose base is considered fixed against rotation and translation, either by large footings bearing on soil or rock, or by pile groups designed to resist moment. The connection to the superstructure is usually detailed in a way that allows free longitudinal movement of the superstructure, but restrains transverse movements. This type of detailing permits the superstructure to undergo thermal movements freely, yet allows the pier to participate in carrying transverse forces.

2.) With this class of pier, the superstructure is supported on relatively tall shimmed neoprene bearing pads. A shear block, isolated from the pier diaphragm with a compressible material such as cork, is cast on the top of the pier cap to guide the movement longitudinally, while restraining transverse movements.

3.) This type pier represents the traditional solution taken with steel girder bridges at so called expansion piers. It offers the advantage of eliminating the stresses associated with superstructure thermal movements. It also provides piers that require no temporary shoring for stability during construction.

4.) In utilizing this system, additional consideration must be given to the detailing associated with the taller bearing pads and the detailing associated with the shear key. In addition, because the pier and the superstructure are isolated longitudinally, the designer must ensure that the bearing seats are wide enough to accommodate seismic movements.

e. Semi-Rigid Piers.

1.) These piers are similar to rigid piers. Their bases are considered fixed by either large spread footings or pile groups; however, the connection of the piers to the superstructure differs significantly.

2.) In utilizing prestressed concrete girders that bear on elastomeric pads, a diaphragm is placed between the ends of the girders. Dowels, perhaps combined with a shear key between girders, connect the diaphragm to the pier cap. Compressible materials are frequently introduced along the edges of the diaphragm, and, along with the elastomeric bearing pads, allow the girders to rotate freely under live load.

3.) The dowels force the pier to move with the superstructure as it undergoes thermal expansion and contraction and, to a lesser extent, creep and shrinkage. Accommodation of these movements requires careful analysis during the design of the piers. Normally, the stiffness of the piers is assumed to be reduced due to cracking and creep.

4.) There are several advantages to this type of pier: detailing is simplified, use of thin elastomeric pads are relatively inexpensive, temporary shoring is not required during construction, all piers participate in resisting seismic forces and the girders are positively attached to the piers. In addition, with many piers active in resisting longitudinal and transverse forces, the designer need not rely on passive soil pressures at the integral abutments to resist lateral forces.

5.) Design of semi-rigid piers is slightly more complicated because careful assessment of foundation conditions, pier stiffnesses and estimated movements is required. In some situations semi-rigid piers are inappropriate. For example, short piers bearing on solid rock may not have adequate flexibility to accommodate movements without distress.

f. Hinged-Base Piers.

1.) This type of pier may be used to avoid the need for an expansion pier in a situation where semi-rigid piers have inadequate flexibility. A "hinge" is cast into the top of the footing to permit flexibility of the column.

2.) Temporary construction shoring may be required, and additional detailing requirements at the top of the footing may increase cost; however, the designer should keep this alternate in mind under special circumstances where the other pier types are not feasible.

G. Wingwall Configuration.

1. In-Line wingwalls cantilevered off the abutments are the preferred arrangement for integral abutment construction. Wingwalls in excess of 12 feet should be supported on their own foundation independent of the integral abutment system. In this case, a flexible joint must be provided between the wingwall stem and the abutment backwall.

2. Flared walls cantilevered off of the abutments may be considered by the Designer on a case by case basis. The use of flared wingwalls should generally only be considered at stream crossings where the alignment and velocity of the stream would make in-line walls vulnerable to scour. Piles shall not be placed under any flared walls that are integral with the abutment stem.

3. U-walls cantilevered off the abutment stem shall be allowed only if in-line or flared walls cannot be used because of right-of-way or wetlands encroachment. The U-walls shall preferably not measure more than 10 feet from the rear face of the abutment stem.

   If U-walls greater than 10 feet in length are required, the wingwall foundation should be separated from the abutment foundation. A flexible joint between the abutment backwall and wingwall stem should be provided. This type arrangement will maintain the abutment/pile flexibility so that the thermal movement of the superstructure is permitted.

4. The distance between the end of the relief slab and the rear face of the U-wall should preferably be a minimum of 4 feet. If the relief slab must extend to the rear face of the U-wall, they shall be separated by a 2 inch joint filled with Preformed Expansion Joint Filler material.

5. If use of a Mechanically Stabilized Earth (MSE) wall is considered, piles shall be placed in plastic sleeves while the MSE wall is constructed. After the MSE wall is constructed, the piles, as required, shall be driven to refusal or to a minimum tip elevation. The pile sleeves shall then be filled with un-compacted sand.

H. Horizontal Alignment.

Only straight beams will be allowed. Provided that the beams are straight, structures on curved alignments will be permitted.

I. Grade.

The maximum grade between abutments shall be 5%.

J. Stage Construction.

Stage Construction is permitted. Special consideration shall be given to the superstructure's rigid connection to the substructure during concrete placement when staging construction. The superstructure should be secured, free from rotation, until all concrete, up to the deck slab, is placed.

K. Seismic Modeling.

1. The general concept behind modeling the seismic response of a bridge structure is to determine a force-displacement relationship for the total

structure which is consistent with the ability of the structure to resist the predicted forces and displacements.

2. Integral abutments shall be modeled to move under seismic loading in both the longitudinal and the transverse directions, thus distributing more transverse forces to the piers.

   Designers should be aware that transverse seismic loads may overstress piles in the strong direction. To account for this, the pile tensile capacity may be increased. Otherwise, the integral wingwalls may be designed to resist transverse seismic loads. This will result in lower lateral seismic loads on a pier.

3. The bridge structure shall be modeled in three dimensions for a stiffness analysis. A multi-mode analysis shall be used.

1.15.4 CONSTRUCTION PROCEDURES

The connection scheme of a steel or concrete superstructure governs the procedure that should be followed for the construction of an integral abutment bridge structure. Standard Drawings 2.9-1 and 2.9-2 specify a sequence of steps for integral abutment construction with a steel superstructure and Standard Drawing 2.9-3 specifies a sequence of steps for integral abutment construction with a concrete superstructure.

When constructing the relief slab and sleeper slab, the following procedure should be followed:

1. To permit unhindered longitudinal movement of the relief slab, the surface of the subbase course must be accurately controlled to follow and be parallel to the roadway grade and cross slope.

2. A filter fabric or some type of bond breaker such as polyethylene sheets should be placed on the finished subbase course the full width of the roadway prior to placement of relief slab reinforcement.

3. Pour the relief slab concrete starting at the end away from the abutment, progressing toward the backwall. If it can be so controlled, relief slabs should be poured in early morning so that the superstructure is expanding. Therefore, the slab is not placed in tension.

4. As shown on Standard Drawings 2.9-1 through 2.9-3, a construction joint between the deck slabs and relief slabs should be placed.

Suitable notes should be provided on the plans to incorporate these construction procedures. Other procedural construction methods, as determined by the Designer and as suitable for the selected superstructure type, may be provided.

The following pay items should be used to account for the respective work:

Concrete in Superstructure, Relief Slab Integral Abutment
Concrete in Superstructure, Sleeper Slab Integral Abutment

1.15.5 SEMI-INTEGRAL ABUTMENT DESIGN

A. A semi-integral abutment design structure is one whose superstructure is not rigidly connected to its substructure. It may be a single or multiple span continuous structure whose integral characteristics include the following:

- jointless deck
- integral end diaphragms
- compressible backfill
- movable bearings

In this concept, the transfer of displacement due to the piles is minimized. The rotation is generally accomplished by use of a flexible bearing surface at a horizontal interface in the abutment. Horizontal displacements not eliminated in a semi-integral concept must still be considered in the design.

In lieu of conventional deck joint bridges, or where a full integral bridge is not desirable, semi-integral bridges may be considered. The foundations for this type structure shall be stable and fixed. A single row of piles should not be utilized. The foundation piles should be stiffened by inclusion of battered piles, or the foundation may be founded on bed rock.

B. The expansion and contraction movement of the superstructure should be accommodated at the roadway end of a relief slab. This type design shall only be used for symmetrical, straight beam structures. The geometry of the relief slab, design of the wingwalls and transition parapet, if any, must be compatible with the freedom required for the integral configuration (beams, deck, backwall and relief slab) to move longitudinally.

Refer to Standard Drawing Plate 2.9-6 for conceptual detailing of a Semi-Integral Abutment configuration.

SECTION 16

FOUNDATIONS DESIGN CRITERIA

Section 10 - Foundations of the AASHTO LRFD Bridge Design Specifications and the additional stipulations stated on pages 1.3-21 and 22 of this Manual shall apply for the design of foundations. Other than as stated therein, design of footings shall conform to the AASHTO LRFD provisions.

Additionally, the following guidance is provided to assist Designers in utilizing the AASHTO LRFD Specifications:

The following specific criteria shall be utilized for such designs:

1.16.1 DETERMINATION OF SOIL PROPERTIES.

Subsurface exploration and soil tests shall be performed in accordance with Subsection 10.4 the AASHTO LRFD Bridge Design Specifications (with current interims) and the criteria established in Section 36 of this Manual.

1.16.2 LOADS.

1. Mass Density (Unit Weight) of Soil ....120 lbs/cu.ft
2. Mass Density (Unit Weight) of Concrete ....150 lbs/cu.ft
3. Live Load Surcharge shall be based on the criteria that is stated in Subsection 3.11.6.2 of the LRFD Bridge Design Specifications.
4. Earth Surcharge Load shall be based on the criteria that is stated in Subsection 3.11.6.1 of the AASHTO LRFD Specifications.
5. To consider the vertical load per foot of approach slabs that react on the abutment backwall, the approach slab shall be treated as a 25 foot simple span.
6. No horizontal thrust force shall be considered from the approach slab resting on the abutment backwall.
7. Compaction induced additional earth pressures, that are due to construction equipment, shall be considered. Subsection 3.11.2 of the AASHTO LRFD Bridge Design Specifications should be referred to for guidance in estimating such earth pressures.

1.16.3 FOUNDATIONS.

In order to prevent damage from frost heave, footings shall be founded at an elevation that is a minimum of 4 feet below the existing ground line or, other than when founded on sound rock, shall be embedded a sufficient depth to provide adequate bearing, scour and frost heave protection, whichever is greater.

Also, refer to Section 46 of this Manual for guidance concerning scour considerations.

1. Spread Footings

   a. Spread footings on borrow excavation, bridge foundation shall be designed for a uniform bearing pressure of 35 lbs/sq.inch.

   b. The minimum footing thickness shall be 24 inches.

   c. Passive resistance shall be disregarded in sliding failure determination.

   d. Top heel steel shall be designed to support all superimposed loading plus the dead load of the footing. This is without reduction from minimum upward soil pressure that acts beneath the heel.

   e. Toe steel design shall be based upon a cantilever design with earth pressure acting upward and the dead load of concrete acting downward.

   f. Eccentricity of Loads

      1. When foundations are on soil, the bearing resistance shall be determined in accordance with subsection 10.6.3.1.5 of the AASHTO LRFD Bridge Design Specifications.

      2. When footings are founded on rock, the eccentricity of loading shall not exceed 3/8 of the width or length. (See Subsection 10.6.3.2.5 of the AASHTO LRFD Bridge Design Specifications.)

2. Pile Foundations

   a. As stated above, pile foundation designs shall be based on the criteria that is stated on page 1.3-21 of this Manual.

b. The minimum pile cap thickness shall be 3 feet.

c. Material for steel H-piles shall conform to AASHTO M270/M 270M, Grade 36 or Grade 50. Steel H-piles for use in marine environments shall conform to AASHTO M270/M 270M, grade 50 and shall be coated with a 16 mills application of coal tar epoxy as per SSPC Paint Specification 16.

   The minimum steel H-pile section for use in pile foundations shall be 12 inches.

d. Timber piles shall not be used where seismic design considerations are critical.

e. When soil layers are present that are unsuitable for permanent load bearing, the Ultimate Pile Capacity During Driving shall be shown on the Contract Plans. The Ultimate Pile Capacity During Driving shall include the Pile Design Capacity times a factor of safety (Ultimate Pile Design Capacity) plus the soil resistance of any layers that are unsuitable for permanent load bearing that is anticipated during driving.

   Examples of soil layers that are unsuitable for permanent load bearing would be:

   1. Layers that are subject to future scour or erosion.

   2. Layers that are subject to strength loss due to earthquakes.

   3. Layers that will settle due to placement of future loads or due to existing loads. The settlement could result from the layers' compressibility or the compressibility of underlying layers.

   The Ultimate Pile Driving Capacity During Driving should be used to develop driving criteria whereby the pile driving resistance that is contributed by the unsuitable soil layers is not included in the permanent Ultimate Pile Design Capacity.

   When a Minimum Pile Tip Elevation is specified, and the Ultimate Pile Capacity During Driving is anticipated to be greater than Ultimate Pile Design Capacity, the Ultimate Pile Capacity During Driving shall be shown on the Contract Plans and used to size the hammer.

f. Refer to Guide Plate 3.4-6 for guidance on test pile plan designations. In establishing estimated test pile lengths, the total length that is provided for bidding purposes should be considerate of potential variant lengths of each test pile location. That is, the length of each test pile should not be based on an averaging of length per test pile.

g. When use of prestressed concrete piles are planned and they are to be constructed in a marine environment, grit impregnated epoxy coated prestressing steel strands shall be used. The grit impregnated epoxy coated prestressing steel strands shall conform to the requirements of ASTM A882/A 882 M. Refer to Subsection 502.06 of the Standard Specifications for information on the use of this material.

   Low relaxation prestressing strands shall be used for all prestressed concrete pile applications.

3. High Performance Concrete (HPC) for Prestressed/Precast Concrete Piles.

   a. Prestressed or Precast concrete piles that require a compressive strength greater than Class P-2 concrete should be designed as an HPC element.

   b. Use of HPC will optimize the expected performance of the prestressed/precast concrete piles. Performance measures such as permeability and abrasion resistance will better assure the expected service life of such pile systems. When such performance is desired, HPC should be used.

   c. Designers should familiarize themselves with the following criteria that must be met to develop an HPC mix design. Specific Performance Requirements will be established in a Project's Special Provisions.

Performance Characteristic	**Standard Test Method**
Creep @ 180 days (x = microstrain/pressure unit)	ASTM C 512
Modulus of Elasticity	ASTM C 469
Chloride Permeability 56 days	AASHTO T 277
Shrinkage (x = length change in microstrain)	ASTM C 157
56 Day Compressive Strength	AASHTO T 22
Abrasion Resistance (x = average depths of wear)	ASTM C 944

Notes:

1. Acceptance of HPC pile systems shall be based on achieving the design compressive strength required in a Project.

2. Chloride permeability testing and Abrasion Resistance testing will only be required when precast or prestressed concrete piles are to be submerged in water as pier bent members.

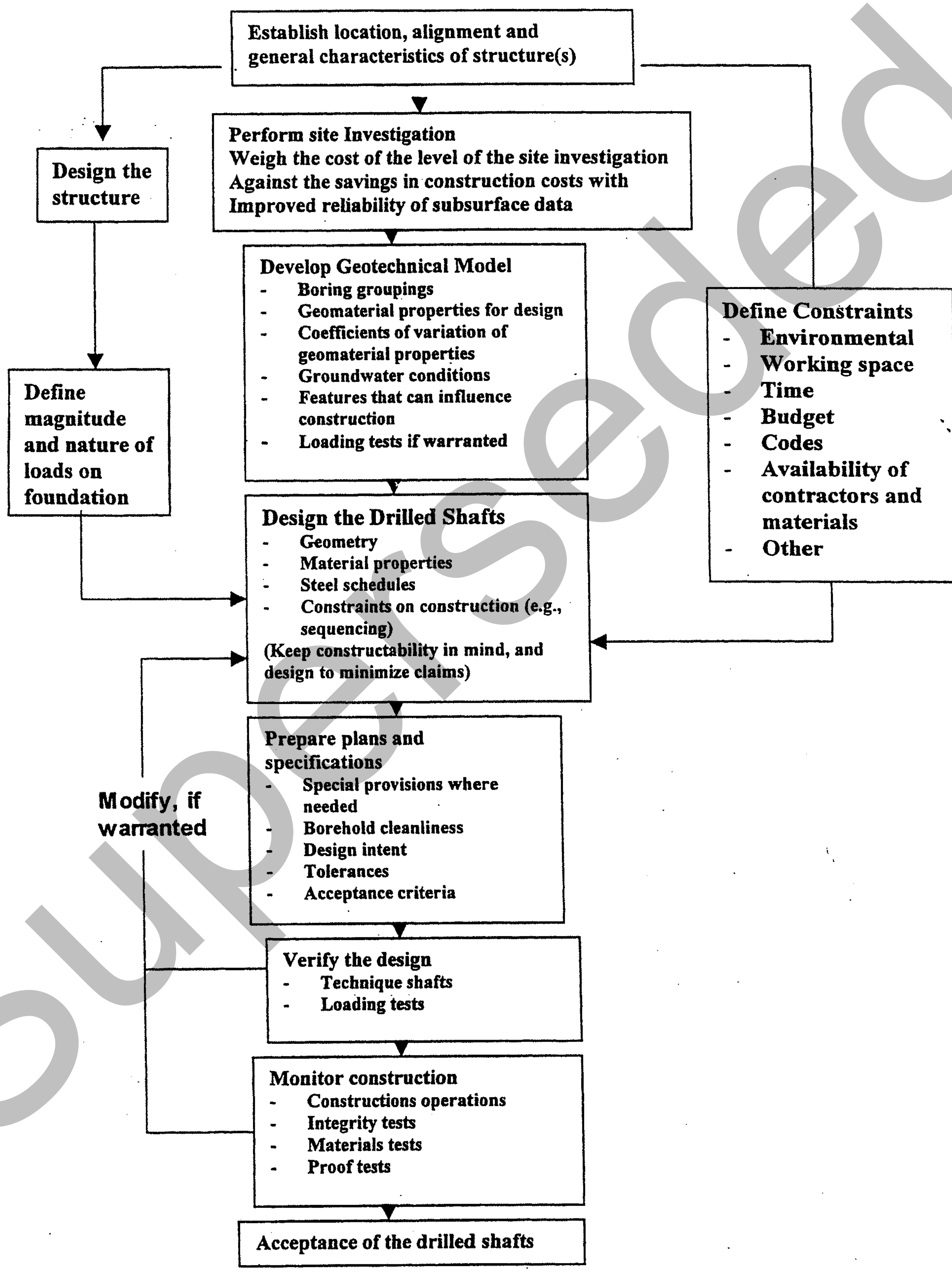
3. All tests will be performed on samples that are moist cured for 56 days.

4. Drilled Shaft Foundations

a. As stated above, drilled shaft foundation designs shall be based on the criteria that is stated on page 1.3-21 of this Manual. The obtained axial loading shall be used to design the depth and diameter of the shaft, steel reinforcement and concrete.

b. The Federal Highway Administration Publication Number FHWA-IF-99-025, titled "Drilled Shafts: Construction Procedures and Design Methods" may be studied for assistance in designing drilled shafts.

c. The following flow chart illustrates the overall process of designing and constructing drilled shafts:


Establish location, alignment and general characteristics of structure(s)
Perform site Investigation
Weigh the cost of the level of the site investigation
Against the savings in construction costs with
Improved reliability of subsurface data
Design the structure
Define magnitude and nature of loads on foundation
Develop Geotechnical Model
- Boring groupings
- Geomaterial properties for design
- Coefficients of variation of geomaterial properties
- Groundwater conditions
- Features that can influence construction
- Loading tests if warranted
Define Constraints
- Environmental
- Working space
- Time
- Budget
- Codes
- Availability of contractors and materials
- Other
Design the Drilled Shafts
- Geometry
- Material properties
- Steel schedules
- Constraints on construction (e.g., sequencing)
(Keep constructability in mind, and design to minimize claims)
Prepare plans and specifications
- Special provisions where needed
- Borehold cleanliness
- Design intent
- Tolerances
- Acceptance criteria
Modify, if warranted
Verify the design
- Technique shafts
- Loading tests
Monitor construction
- Constructions operations
- Integrity tests
- Materials tests
- Proof tests
Acceptance of the drilled shafts

Schematic of the overall design process for drilled shaft foundations.

d. The Designer shall be cognizant that the initial design may, due to conditions encountered in the field, require modifications. As such, the Designer should be prepared to respond to this requirement.

e. Subsection 4.6 of the AASHTO Standard Specifications for Highway Bridges provides provisions for the design of axial and lateral loading of drilled shafts in soil or extending through soil into rock. These provisions, as well as the guidance provided in the above FHWA publication, should be followed in designing drilled shaft foundations.

f. When drilled shafts, that are constructed in moderately or extremely aggressive environments and that extend through water, are used in bents, they shall be detailed to eliminate construction joints within the Splash Zone. Additionally, it is preferred that such shafts extend to the bottom of the bent cap without a construction joint.

1.16.4 Additional Conditions

Additional conditions to consider for stability of the structure should be checked in terms of:

1. Maximum acceptable post construction settlement.

2. Foundation soil's stabilization for minimum residual settlement.

3. Overall earth mass stability of the foundation soils and/or embankment supporting the structure.

4. Consideration of soil characteristics on the post construction effect on pile foundations (drag and additional lateral pressure).

1.16.5 Prestressed Concrete Pile Connections

1. In order to account for the potential uplift of prestressed concrete piles, details to provide for a connection between the pile and pile cap shall be developed and provided in the final plans.

2. The use of mild steel dowels shall be planned for to provide this connection. Details to indicate field drilling and grouting of inserted dowels shall be provided. The size of the dowels and their length shall be as determined by design.

SECTION 17

ABUTMENTS AND WALLS, DESIGN CRITERIA

1.17.1 DESIGN CRITERIA AND GUIDANCE

1. Design of abutments shall be in accordance with Section 11 of the AASHTO LRFD Bridge Design Specifications for Highway Bridges (With Current Interims).

   Design of cast-in-place retaining walls and proprietary wall systems shall be in accordance with the current AASHTO Standard Specifications for Highway Bridges.

2. For contracts with long walls or several walls, design and detailing information may be conveniently presented in a panel-by-panel tabulation.

   a. Panels should be identified numerically on the General Plan and Elevation and referred to in the tabulation. Similarly, various types of wall sections, reinforcement patterns, etc. should be detailed once and identified for use in the tabulation.

   b. The tabulation should also indicate footing dimensions for each panel, panel end point elevations and footing elevations.

3. Details such as the placement and arrangement of non-stress reinforcement on wall stems, key construction, porous fill placement, drainage for back of walls and joint construction are common to all panels and should be presented once in a contract set of plans.

4. When "stepped" footings are used for long walls, the step should preferably not be greater than the depth of the footings, except that when the footing is on piles, the step may be twice the depth of the footing. A 1:1 slope of the concrete should be provided at each step.

5. Expansion and Contraction Joints. For reinforced concrete walls, contraction joints shall be provided at intervals not exceeding 30 feet. Expansion joints shall be provided at intervals not exceeding 90 feet. Abutment joints shall be located approximately midway between the longitudinal superstructure members that rest on the abutment seat.

6. Keyed contraction joints shall be provided in footings. They shall be located under the wall expansion joints.

7. Back of wall drainage shall be provided for all walls including U-Type semi-stub abutments. Weep holes through walls shall not be used where they empty onto pedestrian sidewalks or onto roadways where ponding and freezing could create a safety hazard.

   Roadway drainage provisions shall be detailed so that drainage pipes do not empty directly through abutment walls.

8. Wing stems ("elephant ears") shall be shown on the plans for U-Type and flared walls in accordance with the details shown on Guide Plate 3.4-5. The stems of walls shall be designed for combined axial load (including dead load of stem and of backfill acting on stem) and bending due to vertical loads and earth pressure.

9. Designers and detailers should be aware that form work is a substantial part of the construction cost for walls and abutments. Details that permit reuse of forms on as many sections as possible produce economies in the overall construction cost.

10. When battered cross sections are used, the batter of forms should always remain constant and the width of the wall at the top of the batter should be wide enough so the form can extend beyond the top of the batter and still have enough room between the front and rear forms to easily place the concrete.

11. Batters that extend only part way up a wall should be avoided. If partial batters are used, the height of the battered portion should always be made a constant height. If the height of the battered portion is constant with respect to the top of the footing, then the variation in height shall be made up in the upper vertical portion of the wall. This will allow maximum reuse of the battered form.

12. Curved wingwalls should be avoided wherever possible and should not be battered since the shape of the form must be dish-shaped which is extremely difficult to form.

13. If it is absolutely necessary to provide a curved wingwall, it is best to place the footing and the wall on chords and curve only the top portion of the wall.

14. Subsection 11.6.3.3 – Overturning and 11.6.3.7 – Sliding of the AASHTO LRFD Specifications may be referred to for consideration of these phenomena in Abutment designs.

1.17.2 ABUTMENTS AND WALLS, DESIGN PARAMETERS

1. f'c..3000 psi

2. fc..1200 psi

3. Shrinkage and Temperature Reinforcement:

   Shrinkage and temperature reinforcement for Abutment walls shall be provided in accordance with Subsection 5.10.8 of the AASHTO LRFD Bridge Design Specifications. Minimum reinforcement shall be provided in accordance with Subsection 5.7.3.3.2 of the AASHTO LRFD Bridge Design Specifications.

   Refer to Guide Plates 3.3-1, 3.3-2, and 3.4-1 for more information.

4. The Designer shall verify the need for batter in walls under 10 feet in height. Walls over 10 feet in height shall have a minimum batter of 12:1. The wall height shall be measured from the top of the footing at the rear face of the stem to the top of the wall.

5. The rear face of abutments shall be plumb.

6. The design of sheet pile retaining walls shall be based on a permissible lateral deflection that will be equal to 1% of the exposed height of the wall but not greater than two (2) inches. This limitation shall account for the action on a wall by construction activities and equipment.

1.17.3 ALTERNATE RETAINING WALL SYSTEMS

1. Designers are encouraged to use alternate retaining wall systems at select project locations. Mechanically Stabilized Earth Wall (MSE) systems, the Doublewal system, the T-Wall system; and Crib Walls, instead of the standard cast-in-place reinforced concrete cantilever retaining wall system, should be evaluated for use in a project that involves retaining wall construction.

   The submission methodology presented in Subsection 1.7.2 of this Manual shall be followed for submission of MSE wall systems, the Doublewal system or the T-Wall system. However, the use of the methodology shall only be used for those instances where such walls are to be built to a maximum height of thirty (30) feet.

   MSE wall systems, the Doublewal system or T-Wall system in heights greater than 30 feet may be provided. However, for heights greater than 30 feet complete wall plans must be provided with the final construction plans. The wall plans must include the internal stability design and this design must be reviewed by the project Designer.

2. Designs of Alternate Retaining Wall Systems shall conform to the AASHTO Standard Specifications for Highway Bridges. The Standard Input to the current NJDOT Standard Specifications for Road and Bridge Construction provides a list of approved proprietary wall systems. Sections 519 and 520 respectively, of the Standard Input

(SI) of the Standard Specifications contain these lists.

3. When alternate retaining wall systems are identified for use in a project, unless otherwise directed, a design for the cast-in-place cantilever wall system is not required.

4. As advised in Subsection 1.7.2 of this Manual, based on the suitability of a site for an Alternate Retaining Wall System, Control Plans may be developed with the intent that only one type wall system will be constructed.

5. For those projects where use of Proprietary Walls is not feasible, a presentation for a cast-in-place reinforced concrete cantilever retaining wall system shall be provided.

6. Sections 7 and 8 of this Manual may be referred to for guidance in providing Preliminary and Final submission Control Plans for alternate retaining wall presentations. The following guidance shall also be followed:

   a. In the design of the Doublewal system when the wall is to be constructed in fills or cuts above the water table, one weep hole and a 2′ x 2′ stone pocket shall be provided behind the front face of each of the lowest exposed units. If necessary, the weep hole may be replaced with a 8 inch perforated corrugated metal pipe and a 2′ x 2′ stone pocket.

   b. For MSE Walls, Doublewal or T-Wall systems that are constructed in cuts below the water table, a 8 inch P.C.M.P. and 2′ x 2′ stone pocket shall be placed parallel to and behind the wall. The area above the stone pocket behind the wall shall be backfilled with I-9 porous fill.

   c. For MSE wall systems that are located adjacent to roadways that may be chemically deiced, to intercept any flows that may contain the deicing chemicals, an impervious membrane shall be placed below the pavement and just above the first row of reinforcements. The membrane shall be sloped to drain away from the wall facing. Refer to Subsection 520.02 of the Standard Specifications for type of material to be used.

   d. The current NJDOT Standard Specifications permit the use of select granular borrow excavation material or broken stone as backfill material. When broken stone is used, geotextile filter fabric material shall be placed at the interface of the broken stone and regular roadway materials and/or embankments.

   e. In submitting calculations, the wall supplier shall account for the use of the two type backfill materials. The soil unit weight and the frictional factor of broken stone shall be included in the design calculations.

f. With respect to the guidance provided in Subsection 5.8.12.3 – Hydrostatic Pressure of the AASHTO Standard Specifications for Highway Bridges, the minimum unbalanced hydrostatic pressure for design of MSE Wall systems shall be based on a 3 foot lag. This unbalanced hydrostatic pressure shall be considered as a permanent condition when designing MSE Wall systems.

g. In accordance with the provision of Subsection 5.8.4.1 of the 1996 AASHTO Standard Specifications for Highway Bridges (with current Interims), the Simplified Coherent Gravity approach method shall be used for the Internal Stability design of MSE walls.

h. The allowable bearing capacity for an MSE wall shall be computed using a minimum factor of safety of 2.5 for the Group 1 loading that is applied to the calculated ultimate bearing capacity.

i. When site conditions permit the construction of either the Doublewal system, the T-Wall system or a MSE Wall system, a coefficient of base friction shall not be indicated on the Control Plan. Soil parameters for the following areas, shall be specified on the Control Plan:

1.) Foundation Material
2.) Fill Material within the wall system
3.) Fill Material behind the wall system

The specified soil parameters shall be the friction angle of the soil and the unit weight of the soil.

7. As per Subsections 5.2.1.4 and 5.2.1.5 of the AASHTO Standard Specifications for Highway Bridges, the following limitations should be adhered to in the proposed use of alternate retaining wall systems:

a. MSE walls should not be used under the following conditions:

- When utilities other than highway drainage must be constructed within the reinforced zone.
- When the floodplain erosion may undermine the reinforced fill zone, or where the depth of scour cannot be reliably determined.

- When the water table is above the elevation of the top of the leveling pad.

b. The Doublewal system shall not be used under the following conditions:

- On curves with a radius of less than 800 feet, unless the curve can be substituted by a series of chords.
- Steel modular systems shall not be used where the ground water or surface runoff is acid contaminated or where de-icing spray is anticipated.

8. Use of MSE wall systems that include extensible reinforcements (polymeric reinforcement) are not permitted.

9. Section 519 for Prefabricated Modular Wall Systems and Section 520 for MSE Wall systems of the NJDOT Standard Specifications contain design and construction criteria that shall be adhered to.

10. Refer to Section 31 of this Manual for guidance on the design of Crib walls.

1.17.4 ALTERNATE OR PROPRIETARY TYPE ABUTMENTS

1. Alternate type abutments; such as, sheet pile abutments, or Mechanically Stabilized Earth (MSE), Doublewal or T-Wall type systems may be considered. Their use is subject to the approval of the Manager, Structural Engineering.

2. These type abutment systems shall be designed based on a 100 year life.

3. Corrosion protection for steel sheet piles and tie backs should consist of galvanizing, epoxy coating, additional thickness, sheathing of tie backs and/or other methods to assure the 100 year service life.

4. Sheet pile abutments should not be used under the following conditions:

   a. When tie backs are required and utilities other than highway drainage must be constructed within the reinforced zone.

   b. When metallic tie bars exposed to surface or ground water that is contaminated by acid mine damage or industrial pollutants, as indicated by low pH and low chlorides and sulfates, are required.

5. Refer to 1.17.3 above for MSE, Doublewal and T-Wall wall system requirements. Criteria stated therein shall be applied in such Abutment designs.

SECTION 18

ABUTMENT TYPES

1.18.1 DESIGN CRITERIA

The guidance provided on page 1.3-21 of this Manual shall govern abutment designs.

1.18.2 GENERAL

a. Page 1.18-2 illustrates typical abutment types that are acceptable. Spill-through abutments may be considered in certain situations; such as, when foundation conditions indicate very short pile lengths.

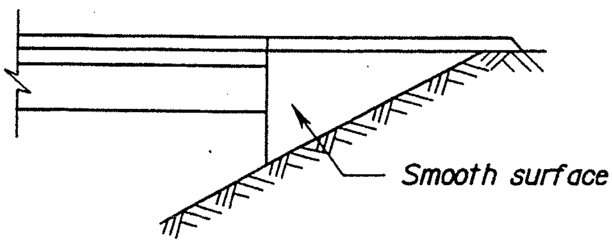
b. For abutments adjacent to waterways, even though they may not be needed for the foundation design, piles shall be considered where hydraulic or other characteristics indicate the possibility of scour

c. Reference Subsection 1.46.2 of this Manual for recommendations for scour protection.

d. For guidance as to the design of Integral Abutments, refer to Section 15 of this Manual.

e. Designers are strongly encouraged to provide enhancements to the appearance of concrete abutments. This may be accomplished through the use of form liners. As a minimum form liners will provide architectural treatment of concrete through the use of standard patterns that may be developed for specific projects. Other aesthetic treatments may be recommended.

ABUTMENT TYPES



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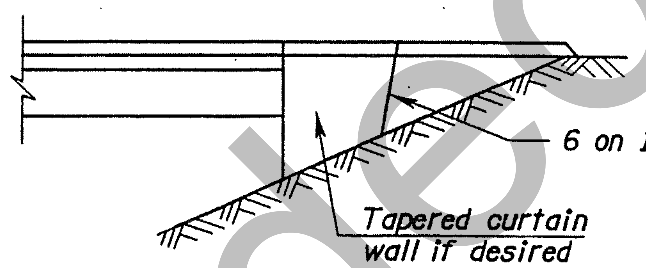
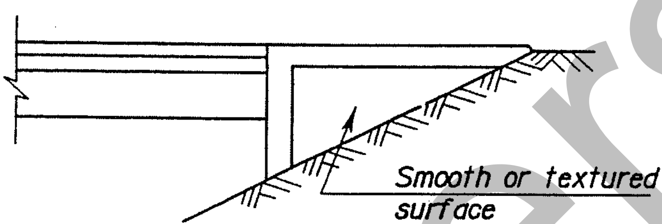
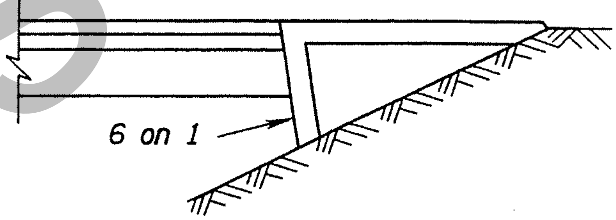


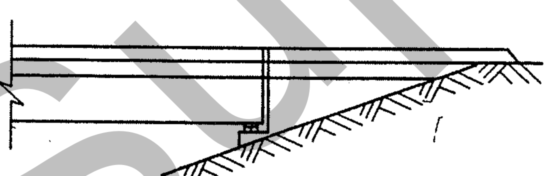
CURTAIN WALL



PICTURE FRAME



MODIFIED PICTURE FRAME



EXPOSED BEARING

The examples shown here are in no way meant to limit the engineer's creativity but only to indicate some of the variations already proposed or in use.
Acceptable combinations or modifications of these shown could be considered.

Note: Railings not shown.

SECTION 19

PIERS

1.19.1 TYPES

a. Subsection 11.7 of the AASHTO LRFD Bridge Design Specifications provides direction on the design of piers.

b. Subsection 1.5.1 j. of this Manual provides guidance on pier type selections.

c. Designers are strongly encouraged to provide enhancement to the appearance of pier members. This may be accomplished through the use of form liners. As a minimum, form liners will provide architectural treatment of concrete through the use of standard patterns or unique patterns that may be developed for a specific project. Other aesthetic treatments may be recommended.

1.19.2 WATERWAYS

a. When a pier is located in a marine environment (Zone 3A or 3B, See Subsection 1.24.18 (f)) reinforcement steel (including footing bars and dowels) shall be corrosion protected. Also, to further offset the potential of corrosion development, concrete mix designs for such pier construction shall include a corrosion inhibitor admixture. Refer to Subsection 501.12, Subpart 19. of the NJDOT Standard Specifications for Road and Bridge Construction for guidance on the usage of Corrosion Inhibitor Admixtures.

If it is determined that a pier or pier element is to be constructed with the use of High Performance Concrete, then the use of a corrosion inhibitor admixture is not warranted.

The Designer is advised that epoxy coated, galvanized, stainless steel or stainless steel clad reinforcement are equally permitted.

If galvanized reinforcement is designated, all surrounding reinforcement and miscellaneous hardware, that is to be in touch with the galvanized reinforcement, must be galvanized, plastic or PVC coated.

b. Steel sheeting below the top of the seal concrete will generally be left in place. If sheeting is left in place it shall be anchored to the top of the seal concrete. Refer to Guide Sheet PLATE 3.13-1 when sheeting is to be left in place. Also, refer to Section 35 of this Manual for guidance on the use of steel sheeting.

c. Section 46 of this Manual may be referred to for information regarding scour design, scour protection and pier protection methods.

1.19.3 RAILROADS

a. Railroad companies usually require steel sheet piling for excavations adjacent to railroad tracks. The NJDOT Bureau of Civil Engineering should be contacted for specific information regarding these requirements. This information should be obtained prior to the submission of Preliminary Bridge Plans.

b. Piers, that support bridges over railroads and that are located less than 25 feet from the centerline of track, shall either be of solid shaft construction or shall be protected by a reinforced concrete crash wall that extends not less than 7 feet above the top of rail. This will provide an allowance of 1 foot for future ballasting of the railroad tracks and for potential encroachment during construction or maintenance operations.

   The crash wall shall be at least 3'-6" thick and shall connect with all the columns. The face of the crash wall shall extend a distance of at least 6 inches beyond the face of the columns on the side adjacent to the track and it shall be anchored to the columns and footings with adequate steel reinforcement.

   For more information, reference Chapter 8, Part 2, Section 2.1.5 of the AREMA Manual For Railway Engineering.

c. Footing designs within the theoretical railroad embankment line shall provide a 8 foot minimum distance from any point on the rail to the side of the steel sheet piling used for support of tracks during construction.

1.19.4 ANCHOR BOLTS

The NJDOT Standard Specifications for Road and Bridge Construction do not permit drilling holes for anchor bolts in rigid frame and T-type piers. The following steps shall be taken to insure proper construction clearances for anchor bolts (Also see Guide Sheet PLATE 3.5-4).

a. Design drawings shall show (in a detail plan and a cross-section view) the relationships between the anchor bolts and the layers of reinforcement steel immediately under each bearing pad. Detail dimensions shall be given, locating the centers of the anchor bolts and reinforcement bars.

b. Reinforcement bars adjacent to anchor bolts shall be so spaced as to allow the free installation of 3 inches diameter sleeves for setting anchor bolts.

c. Necessary detail sketches shall be shown to a scale of not less than 1:20. The vertical rows and the horizontal layers of reinforcement steel shall be so spaced as to allow a minimum of 2 diameters clear space between bars to facilitate placing of the concrete.

1.19.5 ROUND COLUMNS

a. Spirals shall be used for reinforcement for pier columns. Generally, for the typical grade crossing, 3 foot round columns will be used with 5/8 inch diameter x 3 ½ inch pitch bar for spiral reinforcement. The spiral reinforcing shall be full height of column plus extend into the pier cap and the footing by a minimum of 1′-6″ and shall end with 1.5 turns at each end.

b. Guide Plate 3.5-2 provides reinforcement detailing for round columns. Refer to 1.19.2 above for guidance concerning the use of corrosion protected reinforcement.

1.19.6 PILE BENTS

a. For pile bent type piers, the designer shall establish the minimum pile tip elevation. This elevation <u>shall</u> be shown on the plans.

b. If the structure is located in a severe salt intrusion zone or a salt splash zone, (Zone 3A or 3B as illustrated in the Chart entitled "Zonal Areas of New Jersey Affected by Salinity" in Subsection 1.24.18 of this Manual), all spiral reinforcement for cast-in-place, precast or prestressed concrete pile bents shall be corrosion protected.

   In accordance with Table 5.12.3-1 of the AASHTO LRFD Bridge Design Specifications, the concrete clear cover for all substructure units that are located in a severe salt intrusion zone or salt splash zone shall be a minimum of 3 inches.

   Refer to 1.19.2 above for guidance concerning the use of corrosion protected reinforcement.

d. Pile bents located in a severe salt intrusion zone or a salt splash zone, as described above, may be constructed with the use of a corrosion inhibitor admixture.

   Subsection 501.12, Subpart 19 of the NJDOT Standard Specifications for Road and Bridge Construction may be referenced in the use of a corrosion inhibitor admixture.

   Refer to 1.19.2 for guidance concerning the use of High Performance Concrete.

1.19.7 ABRASION PROTECTION

a. To offset the abrasive action of water or ice against a bridge pier High Performance Concrete (HPC) shall be used.

The HPC may be placed with the use of a form liner to present the appearance of granite facing.

The HPC for pier protection shall meet the performance requirements in the following Table:

Performance Characteristic	**Standard Test Method**
Abrasion (x = avg. depth of wear in inches)	ASTM C 944
Freeze-Thaw Durability (x = relative dynamic modulus of elasticity after 300 cycles)	AASHTO T 161 ASTM C 666 Proc. A
Chloride Permeability 56 days (coulombs)	AASHTO T 277 ASTM C 1202
56 Day Compressive Strength (Design Compressive Strength)	AASHTO T 22 ASTM C 39

Note: All test to be performed on concrete samples that are moist or submersion cured for 56 days.

b. The Designer should familiarize himself with the required testing and performance requirements. He should also verify inclusion of appropriate specifications for the development of HPC mix designs for the required work in the Contract Documents.

1.19.8 FENDER PILE SYSTEMS

In lieu of constructing timber members for fender pile systems, use of FRP composite material may be used for the system components. The increased design life of the composite materials will offset the increased initial cost of the fender system.

1.19.9 VESSEL COLLISION

The design of all bridges over navigable waters in New Jersey must include consideration for possible Vessel Collision. Such collisions generally occur from barges. Designers shall conduct a vessel risk analysis to determine the most economical method for protecting the bridge. This shall include designing and constructing the bridge to withstand a Vessel Collision, or protecting it with dolphins and/or fenders. The methodology specified in Subsection 3.14 of the

AASHTO LRFD Bridge Design Specifications shall be followed for such designs. The Designer shall also comply with the guidance provided below.

1. To provide a historic basis for the design procedure discussed in Subsection 3.14 of the AASHTO LRFD Bridge Design Specifications, information and data shall be gathered as follows:

   a. Data Sources:

      1.) U.S. Army Corps of Engineers, Waterborne Commerce Statistics Center, (www.iwr.usace.army.mil/ndc/csc.htm). Commerce statistics for the subject bridge.

      2.) Port Authorities and Water Dependent Industries. Data to document use of the bridge locations by such groups.

      3.) Pilot Associations and Merchant Marine Organizations. Data to document use of the bridge locations by such groups.

      4.) National Oceanic and Atmospheric Administration (NOAA), Tidal Current Tables; Tidal Current Charts and Nautical Charts. (www.noaa.gov/charts.html)

      5.) Bridge Tender records for bascule bridge at Regional Offices.

      6.) Local tug and barge companies.

   b. Assembly of Information unless provided by the Department:

      1.) Characteristics of the waterway including the following:

         a.) Nautical chart of the waterway.

         b.) Type and geometry of bridge.

         c.) Preliminary plan and elevation drawings depicting the number, size and location of the proposed piers.

         d.) Navigation channel, width, depth and geometry.

         e.) Average current velocity across the waterway.

      2.) Characteristics of the vessels and traffic including the following:

         a.) Ship, tug and barge sizes (length, width and height).

b.) Number of passages for ships, tugs and barges per year (last five years and prediction to end of 25 years in the future).

c.) Vessel displacements.

d.) Cargo displacements (deadweight tonnage).

e.) Draft (depth below the waterline) of ships, tugs and barges.

f.) The overall length and speed of tow.

c. Accident reports.

d. Bridge Importance Classification.

2. Importance Category (IC)

Subsection 3.3 of the AASHTO Guide Specifications and Commentary for Vessel Collision Design of Highway Bridges, states that bridges crossing a navigable waterway may be classified as "Regular" or "Critical" bridges. To perform a Vessel Collision design analysis, such bridges in New Jersey shall initially be classified as "Regular". However, the Designer shall evaluate project specific conditions to determine the Social Survival and Security/Defense requirements of such bridges. If deemed appropriate, the Designer may recommend to the Manager, Structural Engineering, that the bridge be considered under an IC of "Critical".

3. Design Vessel

Subsection 3.14.1 of the AASHTO LRFD Bridge Design Specifications specifies the parameters to define the minimum design barge.

Subsection 3.14.4 of the AASHTO LRFD Specifications provides guidance for the selection of design vessels for specific bridge piers. Based on an analysis of the annual frequency of collapse, a design vessel and its associated collision loads can be determined. The AASHTO Guide Specifications and Commentary for Vessel Collision of Highway Bridges should be studied for barge categorization as well as overall guidance on the vessel collision analysis.

Section 4 of the Guide Specifications provides guidance for selection of a Design Vessel. Methods that may be used are presented therein.

4. Design Methodology

Bridge structures shall be designed to withstand loads in an inelastic manner. Therefore, the design must incorporate redundancy or other means to prevent collapse of the superstructure.

In addition to utilizing the design specifications presented in the AASHTO LRFD Specifications, the Designer shall also use the following design methodology:

a. At least one iteration of secondary effects in columns shall be included; i.e., axial load times the initial lateral deflection.

b. The analysis must include the effect on adjacent piers from the transfer of lateral forces up to the superstructure. Bearings, including neoprene pads, may transfer lateral forces to the superstructure. Analysis of forced transfer through the mechanisms at the superstructure/substructure interface shall be evaluated by use of generally accepted theory and practice.

c. The ultimate capacity of axially loaded piles shall be limited to the determined compressive and/or tensile loads. For battered pile foundations, load redistribution shall not be permitted when the axial pile capacity is reached; rather, axial capacity shall be limited to the ultimate limit as established by elastic anlaysis.

d. Lateral soil-pile response shall be determined by concepts utilizing a coefficient of subgrade modulus.

e. Load Combination "Extreme Event II" shown in Table 3.4.1-1 of the AASHTO LRFD Bridge Design Specifications shall be used for Vessel Collision. Nonlinear structural effects shall be included and can be significant, particularly for the pier components.

f. Pier protection systems shall be designed to be independent of the pier itself. That is, the pier protection system shall not rely on any apportioned load transfer to the pier foundation. It must be designed to withstand the full impact of the impact vessel.

g. For the superstructure design the main span and any approach spans shall be designed for ultimate lateral strength under a ship mast impact force in accordance with the AASHTO LRFD Bridge Design Specifications. There shall be no redistribution of the vehicle collision force between piers throughout the superstructure.

5. Pile Bents

Bridges in navigable waterways with pile bents shall be designed to remain open for traffic after a vessel collision even if any one pile is lost as a result of the collision. For this design, the load combination for Extreme Event II shall apply; however, the Load Factor for Live Load shall be increased to 1.0.

6. Movable Bridges

Movable bridges shall comply with the Vessel Collision requirements stated herein without exception.

7. Main Span Length for Barges

The length of the main span between centerlines of piers at the navigable channel shall be based upon Coast Guard requirements, the Vessel Collision risk analysis (in conjunction with a least-cost analysis) and aesthetic considerations.

8. Scour with Vessel Collision

The probability of the simultaneous occurrence of an extreme Vessel Collision load by a barge and some amount of scour being present is a valid concern. For this reason, the Substructure shall be designed to withstand the following two Load/Scour (LS) combinations:

A. <u>Load/Scour Combination 1:</u>

$LS_{(1)}$ = Vessel Collision + ½ Long-Term Scour

Where:

Vessel Collision:	Assumed to occur at normal operating speed.
Long-Term Scour:	Defined in Section 46 of this Manual.

B: Load/Scour Combination 2:

$LS_{(2)}$ **= Minimum Impact Vessel + ½ 100-Year Scour**
Where:

Min. Impact Vessel: Defined in Subsection 3.14.1 of the LRFD Specifications

100-Year Scour: Defined in Section 46 of this Manual.

When preparing the soil models for computing the Substructure strengths, and when otherwise modeling stiffness, the Designer must exercise judgment in assigning soil strength parameters to the soil depth that is subject to Local and Contraction Scour and that may have filled back in.

The soil model shall utilize strength characteristics over the depths that are compatible with the type soil that would be present after having been hydraulically redeposited. In many cases, there may be little difference between the soil strength of the natural stream bed and that of the soil that is redeposited subsequent to a scour event.

9. Application of Impact Forces

For long narrow footings in the waterway when the length to width ratio, L/W, is 2.0 or greater, the longitudinal force shall be applied within the limits of the distance that is equal to the length minus twice the width (L-2W).

10. Impact Forces on Superstructure and Piers

Vessel Impact Forces on the Superstructure and piers shall be in accordance with Subsections 3.14.10 and 3.14.11, respectively, of the AASHTO LRFD Bridge Design Specifications.

SECTION 20

DECK SLABS

1.20.1 HIGH PERFORMANCE CONCRETE (HPC) DECK SLABS

a. Construction or replacement of deck slabs of bridge structures that are on the State Highway System shall be based on the construction of a one course deck slab with HPC. HPC is defined as concrete that meets special combinations of performance and uniformity requirements that cannot always be achieved through routine use of conventional constituents and normal placing, mixing and curing practices. The Table below establishes the levels of desired performance for HPC deck slabs.

   Sidewalks, parapets and curb lines on bridges shall also be detailed to be constructed with HPC.

   An HPC element may be further defined as that which is designed to give optimized performance characteristics for a given set of loads, usage and exposure conditions consistent with the requirements of cost, service life and durability.

b. HPC for deck slabs, sidewalks, parapets and curb lines shall consist of the same properties as Class A concrete with the added stipulation that a pozzalonic material is to be included in the mix design.

c. Project Special Provisions will contain specifications for the development of HPC mix designs by the Contractor. The Designer should familiarize himself with the following performance requirements and test methods that are to be followed for the mix design development.

Performance Characteristic	Standard Test Method
Scaling Resistance (X=visual rating of the surface after 50 cycles)	ASTM C 672
Freeze-Thaw Durability (x=relative dynamic modulus of elasticity after 300 cycles)	ASTM T 161 ASTM C 666 Proc. A
Chloride Permeability (x=coulombs)	AASHTO T 277 ASTM C 1202
56 Day Compressive Strength (Design Compressive Strength)	AASHTO T 22 ASTM C 39

Note: All tests to be performed on concrete samples that are moist or submersion cured for 56 days.

d. With the construction of an HPC deck slab, provision of a concrete overlay protective system is not warranted.

1.20.2 DESIGN CRITERIA

a. Refer to Subsection 1.20.6 for concrete cover requirements.

b. The provision of either permanent steel bridge deck forms or conventional removable timber forms shall be accounted for in deck slab designs.

For construction over electrified railroad tracks, permanent steel bridge deck forms shall always be used.

c. To account for the optional use of permanent stay in place (S.I.P.) forms, the deck slab design tables in this Section assume that an extra 3/8 inch thickness of concrete is added to the dead load of the slab.

When the S.I.P. ribs can not be aligned with the bottom main reinforcement steel, and the forms must be dropped to achieve the 1 inch bottom reinforcement cover, Subsection 1.20.6.g., for additional dead load considerations, should be referred to.

Additionally, provision of a 1½ inch bottom reinforcement cover must be accounted for in bridge structures that are located in a marine environment.

d. Section 3 of this Manual should be referred to for modifications to the AASHTO LRFD Bridge Design Specifications that concern design of concrete deck slabs. Otherwise, the criteria of Subsection 9.7 of the AASHTO LRFD Specifications shall be followed.

e. One-half (1/2) inch shall be deducted from the actual deck slab thickness in the design calculations for one course slabs as an allowance for depth of sawcut grooved finishing and wear.

f. The superstructure design for bridges with one course deck slabs shall include a 25 psf provision for a future 2 inch thick concrete overlay protective system.

g. The deck overhang shall be designed according to the provisions of Subsection A13.4 of the LRFD Specifications except that the nominal traffic barrier resistance to the transverse load, R_w, need not exceed 120% of F_t as specified in LRFD Table A13.2-1 for the respective test levels.

1.20.3 CONCRETE DECK OVERLAY PROTECTIVE SYSTEM CONSTRUCTION

a. For the rehabilitation of existing deck slabs, that meet the following criteria, a concrete overlay protective system (see Guide Sheet Plate 3.6-2) may be used:

   1). All bridges carrying Interstate Highway traffic.

   2). All elevated interchange ramps carrying Interstate Highway traffic.

   3). Other bridges on the State Highway System with a projected Average Daily Traffic (ADT) count of at least 2000 vehicles and that have a projected Average Daily Truck Traffic (ADTT) that is greater than 5% of an ADT of 2000 vehicles.

b. Section 518 of the NJDOT Standard Specifications provides criteria for two course deck slab construction. The Designer should study these specifications in his preparation of concrete documents.

c. If any of the bridges in the categories listed above are located in areas of significant adverse geometrics (see Subsection 1.20.10), which could preclude machine finishing of the concrete overlay protective system course, then opinions from construction forces regarding machine finishing capabilities in such cases should be obtained.

d. The concrete overlay protective system course is to be considered as part of the structural slab in the design calculations but one-half inch shall be deducted from the total thickness of the two courses as an allowance for depth of sawcut grooved finishing and wear.

e. Assume that the effective slab depth is taken from the bottom of the slab to the center of the top main reinforcement steel.

f. Bridges with concrete overlay protective systems shall not include a 25 psf additional dead load for the superstructure design.

1.20.4 ONE COURSE DECK SLAB CONSTRUCTION WITH A CORROSION INHIBITOR ADMIXTURE

a. If construction of an HPC deck slab cannot be planned, a one course deck slab with a corrosion inhibitor admixture shall be planned. The use of a corrosion inhibitor admixture shall conform to the requirements of Subsection 501.12, Subpart 19 of the NJDOT Standard Specifications for Road and Bridge Construction.

b. Plan notes to construct a one-course full depth deck slab, with a corrosion inhibitor admixture as part of the concrete design mix, shall be provided. A Section View of the one-course deck slab shall also be provided. This view should detail a 2¾ inch minimum top reinforcement cover.

1.20.5 CORROSION PROTECTED REINFORCEMENT IN DECK SLABS

a. All concrete deck slab reinforcement steel shall be corrosion protected. Use of epoxy coated, galvanized, stainless steel or stainless steel clad reinforcement steel is permitted. When epoxy coated reinforcement is planned, the top and bottom layers of rebars in structural deck slabs shall be epoxy coated. These bars include transverse bars, longitudinal distribution bars, corner, skew and header bars.

   In culverts, where the top slab is used as a riding surface, both layers of the top slab reinforcement steel shall be corrosion protected.

b. When galvanized reinforcement is considered, both the top and bottom mat layers shall be galvanized. In addition, chairs, tie wires, nuts, bolts, washers, other devices and miscellaneous hardware that is to be used to support, position or fasten the galvanized reinforcement shall be galvanized. Plastic chairs or plastic coated metal hardware, in lieu of galvanized components may be used.

c. When a bridge is located in a severe marine environment (Zone 3B, see Subsection 1.24.18, Paragraph (f)), cover for the bottom rebars shall be 1½ inches instead of the 1 inch normally specified.

1.20.6 THICKNESS AND REINFORCEMENT STEEL

a. Table-1 on page 1.20-6, for one-course construction is based on a 2½ inch top cover, a 1 inch bottom cover and placement of rebars perpendicular to traffic with a f'_c = 4000 psi and a f_y = 60 ksi. The Table has been prepared in order to establish uniformity in design and details. However, the Designer may develop other deck slab configurations. Calculations shall be included in the design folder.

b. Table-2 on page 1.20-7, for two-course construction with a corrosion inhibitor admixture is based on a 1½ inch top cover on the first course, a 1 inch bottom cover, and rebars placed perpendicular to traffic with a f'_c = 4000 psi and a f_y = 60 ksi. The Table has been prepared in order to establish uniformity in design and details. However, the designer shall develop the design of a deck slab for each bridge and the calculations shall be included in the design folder.

c. The selection of beam spacings cannot be standardized since this is dependent on beam type selection. Generally, beam spacings of 8 to 10 feet are preferred. The basis for the selection of beam spacings shall include consideration of the necessity of future deck replacement and the maintenance of traffic associated with a deck replacement.

d. The main reinforcement shall be placed normal to the stringers regardless of the skew of the deck slabs. The bars shall be straight, continuous, and of the same size and spacing in both the top and bottom of the slab.

Concrete Deck Slab Design Table

Table-1

One Course Construction

Span ft	Actual Slab Thickness in	Main Rebar Top and Bottom	Long. Dist. Rebar Top and Bottom	Additional Top Main Rebar in Overhang with 2'-10" Parapet	Additional Top Main Rebar in Overhang with 2'-8" Parapet & Sidewalk
4'-3" to 5'-3"	8 ¼	# 16 @ 12"	# 13 @ 12"	# 19 @ 12"	#19 @ 12"
5'-4" to 6'-3"	8 ½	# 16 @ 11"	# 13 @ 11"	# 19 @ 11"	#16 @ 11"
6'-4" to 7'-3"	8 ½	# 16 @ 9"	# 13 @ 9"	# 16 @ 9"	#13 @ 9"
7'-4" to 8'-3"	9	# 16 @ 8 ½"	# 13 @ 8 ½"	# 13 @ 8 ½"	#13 @ 17"
8'-4" to 9'-3"	9 ½	# 16 @ 8 ½"	# 13 @ 8 ½"	# 13 @ 8 ½"	#13 @ 17"
9'-4" to 9'-10"	10	# 16 @ 8"	# 13 @ 8"	# 13 @ 24"	None
9'-11" to 10'-6"	10	# 19 @ 10"	# 16 @ 10"	# 13 @ 69"	None
10'-7" to 11'-2"	10 ½	# 19 @ 9 ½"	# 16 @ 9 ½"	None	None
11'-3" to 11'-10"	10 ½	# 19 @ 8 ¼"	# 16 @ 9"	None	None
11'-11" to 12'-6"	10 ¾	# 19 @ 8 ¼"	# 16 @ 9"	None	None
12'-7" to 13'-2"	10 ¾	# 19 @ 7 ½"	# 16 @ 8 ½"	None	None

Table-2

Two Course Construction

Span ft	Actual Slab Thickness In	Main Rebar Top and Bottom	Long. Dist. Rebar Top and Bottom	Additional Top Main Rebar in Overhang With 2'10" Parapet	Additional Top Main Rebar in Overhang With 2'-8" Parapet & Sidewalk
4'-3" to 5'-3"	8"	# 16 @ 12"	# 13 @ 12"	# 22 @ 12"	#19 @ 12"
5'-4" to 6'-3"	8 ¼"	# 16 @ 12"	# 13 @ 12"	# 19 @ 12"	#19 @ 12"
6'-4" to 7'-3"	8 ¼"	# 16 @ 10"	# 13 @ 10"	# 16 @ 10"	#16 @ 10"
7'-4" to 8'-3"	8 ½"	# 16 @ 9 ½"	# 13 @ 9 ½"	# 13 @ 9 ½"	#13 @ 9 ½"
8'-4" to 9'-3"	9"	# 16 @ 9 ½"	# 13 @ 9 ½"	# 13 @ 9 ½"	#13 @ 9 ½"
9-4" to 9'-10"	9 ½"	# 16 @ 8 ½"	# 13 @ 8 ½"	# 13 @ 21 ½"	#13 @ 17"
9'-11" to 10'-6"	9 ½"	# 19 @ 10 ¾"	# 16 @ 10 ¾"	# 13 @ 41"	None
10'-7" to 11'-2"	10"	# 19 @ 10 ½"	# 16 @ 10 ½"	None	None
11'-3" to 11'-10"	10"	# 19 @ 9"	# 16 @ 10"	None	None
11'-11" to 12'-6"	10 ½"	# 19 @ 9"	# 16 @ 10"	None	None
12'-7" to 13'-2"	10 ½"	# 19 @ 8 ¼"	# 16 @ 9 ½"	None	None

Notes for Tables:

1. Design is based upon the criteria specified in Appendix A4 of the LRFD Specifications.

2. Span dimensions shall be based on the distance that is the center to center of girders.

3. Design is based upon following criteria: $f_y = 60$ ksi, $f'_c = 4000$ psi.

e. The spacing of S.I.P. form ribs shall match the spacing of the main bottom reinforcement steel (see BCD-9.6). Situations in which this requirement may be waived are listed in Part g. below.

Designers should locate stud shear connectors to avoid conflicts with the main bottom reinforcement spacing. This is due to the fact that there is little room for field adjustment when the main reinforcement steel must match the rib spacing. Shop drawings for S.I.P. forms should be checked accordingly.

f. For continuous beam spans additional corrosion protected longitudinal reinforcement bars shall be provided over the interior supports. Refer to Subsection 1.20.5 for guidance in the required placement of reinforcement steel. The reinforcement shall be designed and placed according to the criteria of Subsection 6.10.3.7 of the AASHTO LRFD Bridge Design Specifications.

g. The main reinforcement pattern in the acute corners of skewed slabs and in the deck slabs of curved girder bridges shall be given special consideration. In the acute corners of skewed slabs, a portion of the main reinforcement may have to be placed in a fanned arrangement extending into the corner of the deck slab. On curved girder bridges, the main reinforcement should generally be placed radially.

If it is anticipated that, in lieu of timber forms, S.I.P. forms will be utilized, and the main reinforcement will not be aligned with the S.I.P. ribs, a 1 inch thickness of concrete shall be added to the dead load of the slab. This is in lieu of the 3/8 inch thickness of concrete that is specified in Subsection 1.20.2 b.

This extra 5/8 inch thickness of concrete will account for the additional dead load that results from dropping the S.I.P. forms.

Dropping the forms may be needed to achieve the minimum 1 inch bottom rebar cover. A 2 inch nominal form depth shall be assumed. Deeper forms will require additional dead load consideration.

When the extra dead load is added, the Tables within this Section are no longer valid. The designer shall develop an independent slab design. The shop drawings shall be checked carefully to verify that the intended result is acceptable.

h. In deck slab corners where the acute angle is 65° or less, 7-#16 bars by 15'-0" long shall be placed directly under the top layer of bars. They should be detailed in a fanned arrangement. This reinforcement shall also be corrosion protected; such as, epoxy coated, galvanized or stainless steel.

1.20.7 DECK JOINTS

a. Refer to Section 21 for the design of transverse and longitudinal joints in deck slabs.

b. Shear locks, as specified in Subsection 1.24.15 of this Manual, shall be provided with the structural steel work when a longitudinal expansion joint is located in the roadway area.

c. See Guide Sheet Plates 3.8-1 and 3.8-2 for details of longitudinal joints.

1.20.8 HAUNCHES ON STRINGER BRIDGES

a. All steel stringer bridges with monolithic deck slabs shall be provided with a haunch over each stringer that is monolithic with the slab. The minimum depth of haunch shall be 1 inch at the centerline of the span. This is as measured from the top of the steel flange to the theoretical bottom of the slab at the center of the web. A deeper haunch may be required when the top flange exceeds 16 inches in width. This is to allow for deck slab cross slopes.

b. The minimum haunch dimension depth shall be one (1) inch located at the centerline of the span. It shall be calculated to include all factors such as roadway profile, architectural camber, camber for future overlay, camber for future utilities, deck cross slopes, etc.

c. For simple span welded steel girder bridges, the depth of the haunch at the centerline of bearings shall be the minimum depth, that is computed in b. above, plus the difference in thickness between the maximum and minimum top flange plates.

d. Haunches of fascia beams of multispan bridges shall be set so that the top of the webs of fascia beams in adjacent spans line up.

e. The depth of the haunches shall be labeled on the plans only at the centerline of bearings. The depth of the haunch at the centerline of bearing is necessary on the plans to enable the Contractor to verify the concrete seat elevations. The depth of the haunch at other locations along the span will be computed by the Contractor after the superstructure steel has been erected.

f. Haunches that are greater than 4 inches shall be reinforced with U-stirrups. The minimum reinforcement shall be #16 stirrups at 12 inches

g. Where field splices in the stringers are shown on the plans or permitted in the Specifications, the haunch shall be a minimum depth of 1 inch over the splice plate. A 1 inch minimum clear cover shall be maintained between the main steel reinforcement and the bolts.

1.20.9 CONCRETE PLACING SEQUENCE

a. A concrete deck slab placing sequence shall be shown on the plans for deck slabs supported by trusses, arches, continuous and cantilevered design. Other types of structures, such as single span curved girder bridges, may also require special deck placement sequences. The Designer shall evaluate unique situations and provide proper guidance on the plans.

b. The criteria stated in Subsection 501.12, Subpart 5., of the NJDOT Standard Specifications, that concerns dividing of deck slab concrete placement, should be referred to for proper plan detailing.

c. Details of keyed transverse construction joints for a deck placing sequence should be developed and shown on the plans.

The transverse construction joint shall be designed as an edge beam. For skewed spans, a skewed-stepped arrangement may be required because of the use of permanent steel stay in place forms.

d. In the construction of Integral Abutment deck slabs, if girder continuity is provided, a deck placing sequence should be detailed for spans greater than 100 feet.

1.20.10 MACHINE FINISHING

a. The following criteria could preclude the use of machine finishing of bridge deck slabs:

1). The bridge is on a curve of less than 250 feet radius.

2). The acute skew angle is less than 40 degrees.

3). The cross slope is variable.

4). Variable width occurs with non-parallel machine support rails.

5). Variable width is due to internal variable width lane with grade breaks at the edges of this lane.

6). Only one structure is in the contract and/or the length is less than 60 feet and curb to curb distance is 24 feet or less.

7). Staging of construction is such that machine finisher overhang will interfere with active vehicular traffic lanes.

b. It shall be the responsibility of the Structural Design Engineer to show the following note on deck slab plans where the above conditions could conceivably preclude the use of machine finishing:

NOTE: Machine finishing of deck slab shall not be required.

c. The construction industry may develop more sophisticated machines and techniques that could overcome the above adverse criteria; consequently, a final review shall be made to determine if the note is applicable depending on the state of the art at the time of advertising for bids.

d. It is generally accepted that finishing machines produce more durable and better quality decks. Therefore, Highway and Bridge Designers shall make every effort to eliminate adverse geometrics from bridge decks during design phases so that finishing machines may be used.

e. After finishing has been completed, the surface of the deck slab shall be textured with an artificial turf drag. Material requirements for the turf drag are given in Subsection 501.15 of the Standard Specifications. The drag shall be operated in the transverse or longitudinal direction and inaccessible areas shall be textured by hand methods.

f. When the concrete or concrete overlay protective system on the deck surface has cured in accordance with the provisions of Subsection 501.17 of the Standard Specifications and has reached a strength of at least 4000 psi, transverse grooves shall be sawcut into the surface of the bridge deck. Requirements for the sawcutting operation are given in Subsection 501.15 of the Standard Specifications.

g. Grooving of skewed bridge decks shall not be overlapped. Grooving passes on curved decks shall be made radial to the center of the curve with ungrooved gores at the outside of the curve. If the curve is such that the width of the gores exceed 4 inches, the first pass of the grooving machine shall be normal to the center line of the span at midspan with subsequent passes parallel to the initial pass.

1.20.11 APPROACH SLABS

a. Approach and transition slabs are required for all bridges on the State Highway System. This shall also apply to the reconstruction of such bridges.

b. For bridge structures not on the State Highway System, if either of the following conditions exist, provision of approach and transition slabs shall not be considered.

   1.) When the projected Average Daily Traffic (ADT) is less than 2000 vehicles.

   2.) When the Average Daily Truck Traffic (ADTT) is less than 5% of the ADT.

c. For bridge widening or rehabilitation projects; such as, installation of a concrete overlay protective system, provision of approach slab and transition slabs shall be subject to the approval of the Manager, Structural Engineering.

1.20.12 MEDIANS

a. Unless precluded by profile and geometric considerations, the median area between parallel bridges shall be "decked over" when the width between curb lines is 30 feet or less. See Guide Sheet Plate 3.6-4.

b. When the median width is greater than 30 feet, cost estimates shall be made for the alternative of "decking over" vs. "open well design".

c. Decking over is preferred in all cases for safety reasons when the extra construction cost is relatively insignificant.

d. Live load design for the median area shall be similar to the bridge deck slab live load design.

e. Medians on bridges which are designated for two course slab construction shall also be designed for a two course construction. A sawcut in the texture finish for the second course will not be required in the median area (use float finish). The Project Special Provisions should address this condition.

1.20.13 PARAPETS, BARRIERS AND SIDEWALKS

a. Provide 3/16" open deflection joints in parapets at intervals not exceeding 20 feet. Contraction joints at the midpoint between the open joints shall also be provided (see Bridge Construction Detail BCD- 3 and Standard Drawing Plates 2.2-3 and 2.2-4).

b. Contraction joints shall be provided in sidewalks at the locations of the 3/16" open parapet deflection joints (see Bridge Construction Detail BCD – 3).

c. Provide 3/16" open deflection joints in median barriers at intervals not exceeding 15 feet. There shall be no contraction joints between the open joints and no contraction joints located below the open deflection joints (refer to Bridge Construction Detail BCD-4).

d. Full depth joints shall be provided in parapets, median barriers and sidewalks at locations of transverse deck joints and at a distance not exceeding 20 feet. The full depth joint opening width shall equal the transverse deck joint opening width. (See Bridge Construction Detail BCD-3 and 4).

e. All reinforcing steel in parapets, median barriers and sidewalks shall be corrosion protected.

f. Refer to Bridge Construction Detail BCD-3 for additional reinforcement that is required to prevent concrete cracking in the overhang portion of the deck slab.

1.20.14 DECK SLAB OVERLAY PROTECTIVE SYSTEMS

a. Provision of a deck slab overlay protective system shall conform to the requirements of Subsection 518.06 of the NJDOT Standard Specifications for Road and Bridge Construction.

b. Provision of bituminous concrete overlays on bridge deck slabs is not permitted.

1.20.15 ALTERNATIVE DECK SLAB SYSTEMS

a. Subsection 9.8 of the AASHTO LRFD Bridge Design Specifications provides criteria on the design of Metal Decks. Criteria is provided for the use of open, filled and partially filled and unfilled grid decks that are composite with a reinforced concrete deck slab.

b. An example of an unfilled grid deck that is composite with the concrete deck slab is the Exodermic bridge deck system.

1.) The Exodermic system is comprised of an unfilled steel grid, typically 3 inches to 5.2 inches deep, with a 3.5 inch to 5.2 inch reinforced concrete slab on top of the grid.

2.) A portion of the grid extends into the reinforced concrete slab. This creates the composite action.

3.) An exodermic deck system can provide a lighter element to a bridge structure without sacrificing stiffness and strength.

c. Subsection 9.8.3 of the AASHTO LRFD Bridge Design Specifications provides criteria for the design of Orthotropic Deck systems.

1.) Orthotropic decks are lightweight and can be easily integrated with an existing bridge superstructure.

2.) Orthotropic decks may be used to reduce the bridge dead weight and to eliminate deck joints.

3.) Orthotropic decks consist of steel deck plates that are stiffened by longitudinal ribs and may be of two basic types:

- With torsionally stiff closed ribs
- With torsionally soft open ribs

d. The above metal deck systems as well as other prefabricated elements and systems may be evaluated for use in deck replacement projects as well as an overall element of a bridge structure.

e. Such prefabricated deck systems may be used where rapid deployment is a consideration. Concerns for traffic disruption and getting a bridge back into service as quickly as possible can play into the decision making with their use.

f. Use of precast deck panels and prefabricated deck slabs that are fabricated into girder systems may also be considered when rapid deployment is an issue.

SECTION 21

DECK JOINTS

1.21.1 FIXED AND EXPANSION

In accordance with the provisions of Subsection 14.5.3.2 of the AASHTO LRFD Bridge Specifications, when designing transverse deck joints for new bridge decks, the roadway gap (W) for a single gap occurrence shall be W ≤ 4 inches and for a multiple modular gap occurrence shall be W ≤ 3 inches.

a. Transverse deck joints on most new bridge decks should consist of either preformed elastomeric compression seals or glandular type strip seals. The use of bolt down type seals is restricted to limited applications on rehabilitation projects involving deck joint reconstruction.

   Modular type deck joints are recommended for joint movements in excess of 4 inches. To protect the concrete slab, all deck joints shall have steel armoring on the edges. This shall include deck joints on bridges that are to be rehabilitated or reconstructed. An exception to this is adjacent prestressed concrete slab and box beams with span lengths less than 55 feet.

b. Typical details for steel armored compression seal joints are shown on Guide Sheets Plates 3.8-3 through 3.8-15 and on Bridge Construction Detail (BCD-2). The details shown on these guide sheets are for typical installations on "new" construction or deck slab replacement projects.

   If modifications are made to the depth of the steel rail section, the stud arrangement and the connection details, the basic concepts can be applied to a joint rehabilitation project.

c. The chart shown on Guide Sheet Plate 3.8-3 shall only be used as a guide in the size selection of preformed elastomeric compression seals. Compression seals smaller than 2½ inches are generally recommended only for fixed end joints. For skewed structures, seals shall be sized such that movements parallel to the joint caused by racking are not greater than 15% of the nominal compression seal width. This is a conservative value utilized by many seal manufacturers.

d. Payment for structural steel shapes and plates used for bridge deck compression seal joints shall be scheduled for payment under a separate lump sum item "Structural Steel Deck Joints". However, the weight shall be calculated and noted on the plans.

   Payment for structural steel rails, shapes, plates, etc., used in strip seal expansion dams and modular bridge deck joints shall be included in the linear foot price bid for these items.

e. See Guide Sheet Plates 3.10-1, 3.10-2, 3.10-4, 3.10-5 and 3.10-6 for deck joint details used with prestressed concrete beams.

1.21.2 LONGITUDINAL

a. Longitudinal construction joints shall only be provided where necessary for stage construction and for compatibility with the deck slab pouring sequence on wide structures with many lanes. Longitudinal construction joints, if necessary, shall be located over a stringer.

Reference Guide Sheet Plates 3.8-1 and 3.8-2 for details concerning longitudinal construction joints in deck slabs.

b. Longitudinal expansion joints shall only be provided where necessary to accommodate transverse expansion on wide structures (i.e., generally for superstructures wider than 90 feet) and between parallel bridges. The joint shall preferably be located beneath the median barrier.

Reference Guide Sheet Plates 3.8-1 and 3.8-2 for details concerning longitudinal expansion joints in deck slabs.

1.21.3 STRIP SEAL EXPANSION DAMS

a. Strip seal expansion dams shall consist of an extruded neoprene rubber gland locked in the cavities of two parallel steel rail sections. The steel rail material shall conform to AASHTO M 270M/M 270 Grade 36 or AASHTO M 270M/M270 Grade 50. The entire joint system shall be hot dipped galvanized after fabrication.

Any galvanized coating of the deck joint system which is damaged during field welding or from other causes shall be repaired by methods outlined in ASTM A780. Unless specified, the galvanized surface should not be painted. If painting is required, refer to 503.15 D. of the NJDOT Standard Specifications for Road and Bridge Construction for guidance in repairing the damaged area. The damaged area shall be repaired prior to installing the neoprene gland. The neoprene gland shall be continuous for the full bridge width including sidewalks, parapets and median barriers.

b. Strip seal expansion dams may be used when the following conditions exist or, as approved by the Engineer, on a project to project basis:

1.) When the length contributing to expansion is less than 70 feet, and the skew is greater than 35 degrees.

2.) When the length contributing to expansion is greater than or equal to 70 feet and less than or equal to 250 feet, and the skew is greater than 25 degrees.

3.) As shown on Guide Sheet Plate 3.8-3, in the area outside of the 4 inch wide sealer limit on skews less than or equal to 25 degrees.

Special consideration shall be given when the length contributing to expansion is greater than 250 feet.

c. When a transverse strip seal intersects with a longitudinal compression seal, the joint subjected to the larger movement shall remain continuous and the other seal shall butt up against it. When longitudinal and transverse strip seals intersect, various factory molded intersections are available as needed. It is recommended that strip seal manufacturers be contacted in order that the most effective details can be specified for these situations.

d. It is essential to the operation of the strip seal that no form of hot or cold applied joint filler be placed over the top of the rubber gland. All sidewalk joints must have steel cover plates. Joints in parapets and median barriers should preferably, if possible, be designed without steel cover plates. In these cases the steel rail sections shall be angled up into the parapet or median barrier and the concrete tapered to the edge of the rail as required.

When approved, steel cover plates may be used if required on highly skewed structures or for specific project requirements.

e. The maximum allowable joint width measured in the direction of travel shall be 4 inches, with 3 inches preferred. The minimum joint widths shown on the construction plans for the superstructure shall be set at 70° F. They shall be set, based upon the project requirements and the minimum installation width of the seal, normal to the steel rail sections

The minimum joint installation width is generally equal to 1½ inches for smaller size strip seals.

Strip seals with a 5 inch classification are available. Their use must be carefully evaluated against the AASHTO LRFD Uniform Temperature factoring.

f. The designer should closely analyze and provide details and configurations in problematic areas; such as, sidewalks and parapets. The potential for joint leakage is usually greater in these areas, and they are often difficult to construct and maintain.

Joint details at sidewalks, parapets and median barriers shall be shown on the plans.

g. The joint anchorage into the deck should be designed with a factor of safety of at least 2.0. To assure that this element of the joint will not fail, the factor of safety should be applied to all known loads.

SECTION 22

DECK DRAINAGE

1.22.1 HYDRAULIC CRITERIA

a. In the design of drainage for bridge decks, the methods included in the NJDOT Roadway Design Manual shall be used.

b. Bridge deck drainage requirements shall be determined on a project to project basis.

c. Scupper spacing shall be in accordance with the NJDOT Roadway Design Manual.

1.22.2 CROSS SLOPES

The minimum cross slope on driving lanes and shoulders on bridge decks shall be in accordance with the Roadway Design Manual and shall match the approach roadway.

1.22.3 GRADES

a. Bridge decks require adequate grade for proper drainage. This will ensure that chlorides drain off the bridge deck and will prevent ponding and freezing of water. In addition, proper drainage prevents hydroplaning on decks with little surface texture.

b. Sag vertical curves should be avoided on bridge decks wherever possible for aesthetic reasons. However, when used, the requirements of the NJDOT Roadway Design Manual shall apply. In order to have adequate longitudinal drainage near the high point of vertical curves, the grade shall not be flatter than required for sight distance requirements and shall be in accordance with the NJDOT Roadway Design Manual. Vertical curves on bridge decks should provide a minimum grade of 0.5 percent. If the longitudinal grade is less than 0.5 percent, additional drains or special sloping of the gutters may be required.

1.22.4 INLETS AND DOWNSPOUTS

a. Generally, the number of inlet bridge drains should be kept to a minimum. Bridge drains complicate the deck slab and/or parapet details and generally become a maintenance problem in future years.

1.) Since complex drainage systems are more susceptible to blockage by debris, these systems should be avoided and the most simplistic alternative should be utilized.

2.) Bridge drains are generally not recommended on structures less than 400 feet long if they have full width shoulders, adequate cross slopes and have adequate catch basins on the bridge approaches, unless adverse geometric considerations dictate.

Structures which do not have full shoulders or have sidewalks (i.e., the design spread is much smaller than above) will require bridge deck drains at more frequent intervals as determined by design calculations. From a practical standpoint, deck drains should be placed near and up slope from expansion joints on the bridge deck to keep storm drainage out of the joints and away from bridge members.

b. Bridge drainage systems over streams shall be located midway between diaphragms or crossframes and shall discharge directly into the stream such that no part of the superstructure or adjacent substructure can be affected. Drainage directly onto unpaved embankments or natural ground where erosion could undermine structural elements will not be permitted.

c. Bridge drainage systems over land shall avoid horizontal runs of drain pipe if a reasonable modification to the design scupper spacing permits the placement of drains adjacent to piers at the low end of spans. Scuppers shall not be discharged on embankments or any traveled way (either vehicular or pedestrian). When applicable and feasible, drain pipe shall be hidden from the view of oncoming traffic.

d. Long runs of outlet pipe on flat grades shall be avoided. Where horizontal runs of drain pipe cannot be avoided, the minimum pitch shall be 8 percent.

e. Drainage from bridge superstructures or embankments shall not discharge on or across a railroad right-of-way without the approval of the railroad company.

f. Downspouts, where required, shall be fabricated from galvanized steel alloy pipe or fiberglass pipe and shall have a minimum diameter of 8 inches. No painting of the galvanized steel alloy pipe is required. Pipe shall be provided with readily accessible cleanouts and shall be located such that no water is discharged against any portion of the structure. The pipe shall preferably discharge into a drainage system which conducts the water away from the structure. Refer to Section 517 of the NJDOT Standard Specifications for Road and Bridge Construction for more information concerning downspout pipe materials.

g. Downspouts shall be located so as to facilitate their discharge away from traffic. Downspouts shall not be cast in the inside of or within any substructure limits.

h. Bicycle grates shall be used for all inlets.

1.22.5 CATCH BASIN SYSTEM AT BRIDGE ENDS

a. Unless cross-slopes or superelevation preclude flow on one side of the roadway, any bridge that is on a grade or in a sag, where it may collect highway drainage, should have catch basins provided just off the upgrade end of the bridge in each gutter.

Inlets placed up slope of the bridge must be designed and placed to intercept 100 percent of the approach flow using the return period selected for the roadway system. Most bridge drainage systems are marginal, and additional water from the approach roadways should not be imposed on them.

Water should be prevented from running down a crack at the paving notch and undermining an abutment or wingwall. A similar nuisance is created when water runs down a median strip, between parallel roadways and parallel bridges, and washes out the slope paving underneath.

b. This guidance will apply to new bridge designs, bridge replacements, and reconstruction projects.

c. Catch basins and inlets shall be designed so that they lead to drainage outfalls that do not pass through abutment walls.

SECTION 23

PARAPETS, RAILINGS, AND CHAIN LINK FENCING

1.23.1 FENCING WARRANTS

The following conditions warrant chain link fencing on structures. Also, the AASHTO publication, A GUIDE FOR PROTECTIVE SCREENING OF OVERPASS STRUCTURES - dated November, 1990 may be referred to for guidance.

a. Warrants for Fencing

1). Highway carrying, grade separation or high level bridges with facility for pedestrian traffic.

2). Expressed concern due to recorded incidents of vandalism from a structure.

3). Existing or potential for pedestrian traffic nearby consistent with item number 1 above.

a.) Schools, churches, etc.

b.) Built up areas

c.) Shopping areas, malls

4). Compliance with formally published federal guidelines, if applicable.

5). Locations where existing railing or parapet conditions are substandard with regard to pedestrian safety.

6). Fencing to preclude unsafe acts or conditions; such as, snow passing through railing, pedestrian access.

7). Where any local regulations, laws or ordinances require protective screening.

8). On overpasses where property is subject to damage, such as buildings or power stations located beneath the structure.

9). Where the above conditions are not clearly present, the Designer shall judge the specific location and submit, if deemed warranted, a request to install fencing. The request shall be directed to the Manager, Bureau of Structural Engineering.

b. Upgrading Existing Fencing.

Present standard for highway carrying bridges is 8 feet – 11 inches with curved top. Section 508 of the NJDOT Standard Specifications should be studied to coordinate plan development.

c. Fencing on Approaches

Roadway fencing criteria applies to right of way fencing only. The foregoing warrants apply to fencing on bridges and structures.

d. Pedestrian Bridges and Ramps

New construction - utilize enclosed type fencing on all pedestrian bridges, stairs and ramps. (Type 7 system).

Existing bridges - utilize enclosed type fencing on all pedestrian bridges, stairs and ramps. (Type 7 system).

1.23.2 TYPES OF PARAPETS, BRIDGE RAILINGS

Page 1.23-5 illustrates crash tested bridge railing systems. NCHRP Report 350, "Recommended Procedures for the Safety Performance Evaluation of Highway Features", has established criteria; such as, speed, vehicle type and angle of impact by which bridge railing systems are categorized as meeting Test Level (TL) designations. The illustrated systems meet Test Level 4 criteria (TL-4). For other than Interstate highways, TL-4 type systems shall initially be considered as the minimal acceptable system for use on New Jersey bridge structures.

For those bridge structures that carry Interstate traffic, a TL-5 bridge railing system shall be utilized. Standard Drawing Plates 2.2-3 and 2.2-4 provide details for a 4 feet – 2 inches high heavy truck parapet (Texas Type HT railing) and 3 feet – 6 inches high "F" Shape railing respectively. These railings are classified as TL-5 systems. With the exception of the following stipulations, either of these systems may be used on an Interstate Highway.

1. The "F" shape barrier is recommended as a better choice where heavy vehicle containment is a significant consideration. Accordingly, for those bridge structures that are located on a segment of Interstate roadway with a horizontal curve of less than 1000 feet or incorporate an Exit/Entrance ramp with a horizontal curve radius that is less than 800 feet, the "F" shape barrier shall be used.

2. When a noise barrier is to be installed behind a bridge railing to address the concern of a large vehicle; such as, a tractor trailer or bus, overtipping and damaging the noise barrier, the Texas Type HT system shall be used.

3. Designers must study the location of a specific bridge site when designating which of the two above TL-5 systems should be used. If the bridge parapet is essentially a continuation of the roadway barrier, then the Texas Type HT railings should be used. This will provide a uniform transition. If the bridge location is independent of a roadway barrier, then the "F"-Shape system should be used.

On non-State-owned, non-NHS classified roadways, the use of Test Level systems, lower than the TL-4 systems, are permitted. The Designer shall evaluate the roadway classification, design speed and truck traffic data for this determination. The above referenced NCHRP Report should be used for identification of the design speed and truck type which were used in establishing the Test Level ratings.

If a bridge structure, located on a non-State-owned, non-NHS roadway, meets the applicable Test Level test data for design speed and truck type usage, designation of a TL-1, TL-2 or TL-3 system is permitted.

With the use of the following type parapets, in considering the height of the parapet/railing configurations, a 4 ft. 6 inch height, from the riding surface, for bicycle traffic and a 3 ft. 6 inch height from the walking surface, for pedestrian traffic, as warranted, should be provided.

<u>Type 1.</u> The 4 - bar tubular open steel bridge railing system, for traffic and pedestrian use, provides better driver visibility because of its see through feature. Refer to Standard Drawings 2.2-1 and 2.2-2 for detailing of this system.

<u>Type 2.</u> Concrete parapets, 6'-6" high and integrated with a sidewalk are used for spans over electrified railroad tracks.

<u>Type 3A.</u> The 2'-8" concrete parapet surmounted by a 6'-3" high chain link fence is used on local roads or land service roads which require pedestrian sidewalks. This system is used only where Type 3B cannot be used.

<u>Type 3B.</u> Same as Type 3A, except it has a curved top.

This system cannot be used on narrow sidewalks unless a 2'-6" minimum horizontal clearance between curb and tip end of curved chain link fence post is provided.

<u>Type 4.</u> A 2'-8" high parapet surmounted with an ornamental railing. Ornamental one-rail railing or two-rail railing is considered on an individual bridge basis depending on overall aesthetic considerations. This system is used on low level, short span bridges over a shallow stream or drainage area.

<u>Type 5.</u> Concrete parapets, 2'-10" minimum height, with NJ barrier curb configuration are generally used on bridges which do not have sidewalks. Ornamental one-rail railing may be considered on an individual bridge basis.

<u>Type 6.</u> Concrete parapets, 6'-8" high, integrated with NJ barrier configuration are used on spans over electrified railroad tracks where sidewalks are not required.

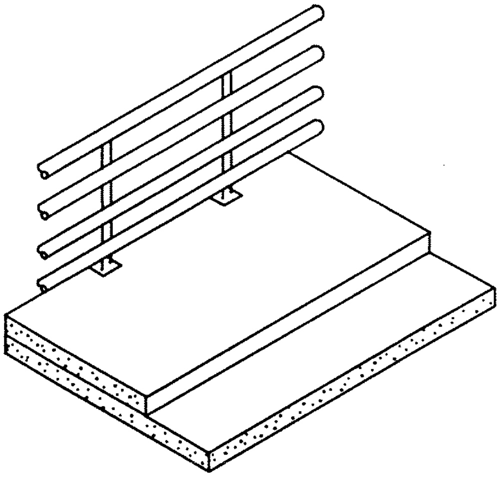
See Guide Sheet Plate 3.7-1

<u>Type 7.</u> A curved-top, totally enclosed chain link fence system, is used on pedestrian bridges. Enclosed fence shall be used for the full span length including shoulders.

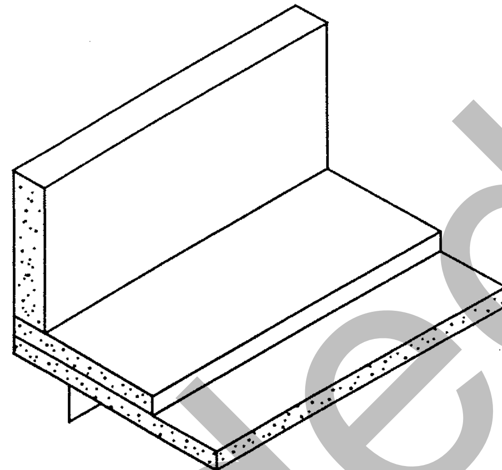
In accordance with the provisions of Subsection 13.7.3.1.1 of the AASHTO LRFD Bridge Design Specifications, railing systems that have been previously crash tested may be used without further analysis. Therefore, the systems identified in this Section, as detailed in the Bridge Construction Details of the Standard Roadway Construction – Traffic Control Bridge Construction Details set of drawings or, in Standard Drawings 2.2-3 and 2.2-4 that are contained in this Manual, may be used in a project without designing them to the LRFD criteria.

In order to enhance the physical appearance of bridge railings, architectural treatments to crash tested bridge railing configurations are permitted. However, the configuration (shape and size) and reinforcement detailing of crash tested systems cannot be changed. Accordingly, architectural treatments to bridge railings shall be submitted to the Bureau of Structural Engineering for review before their adoption into a project.

Any provision of recess patterns to a crash tested configuration shall be limited to a one (1) inch maximum depth. The recess patterns shall also be detailed to require a 45 degree chamfered or beveled edge.



Type 1



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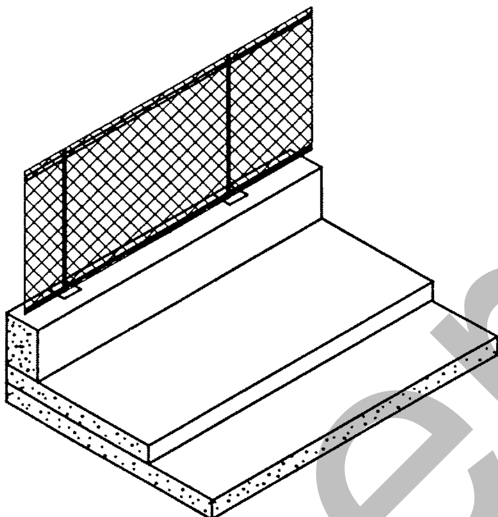
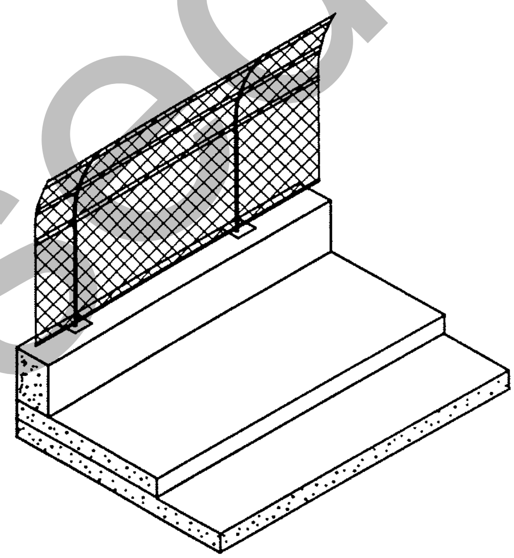


Type 3A



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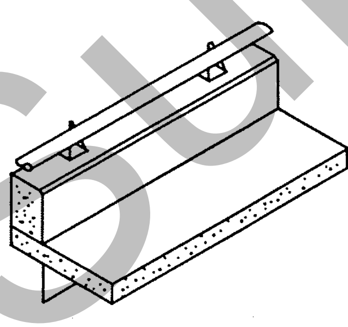

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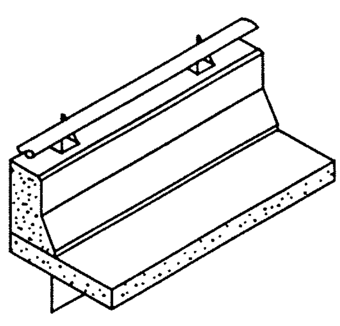

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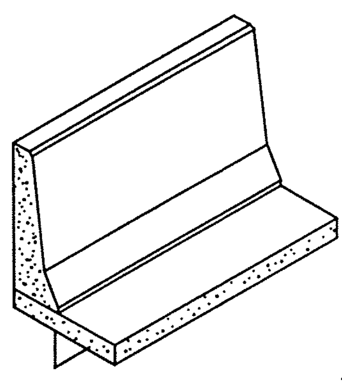

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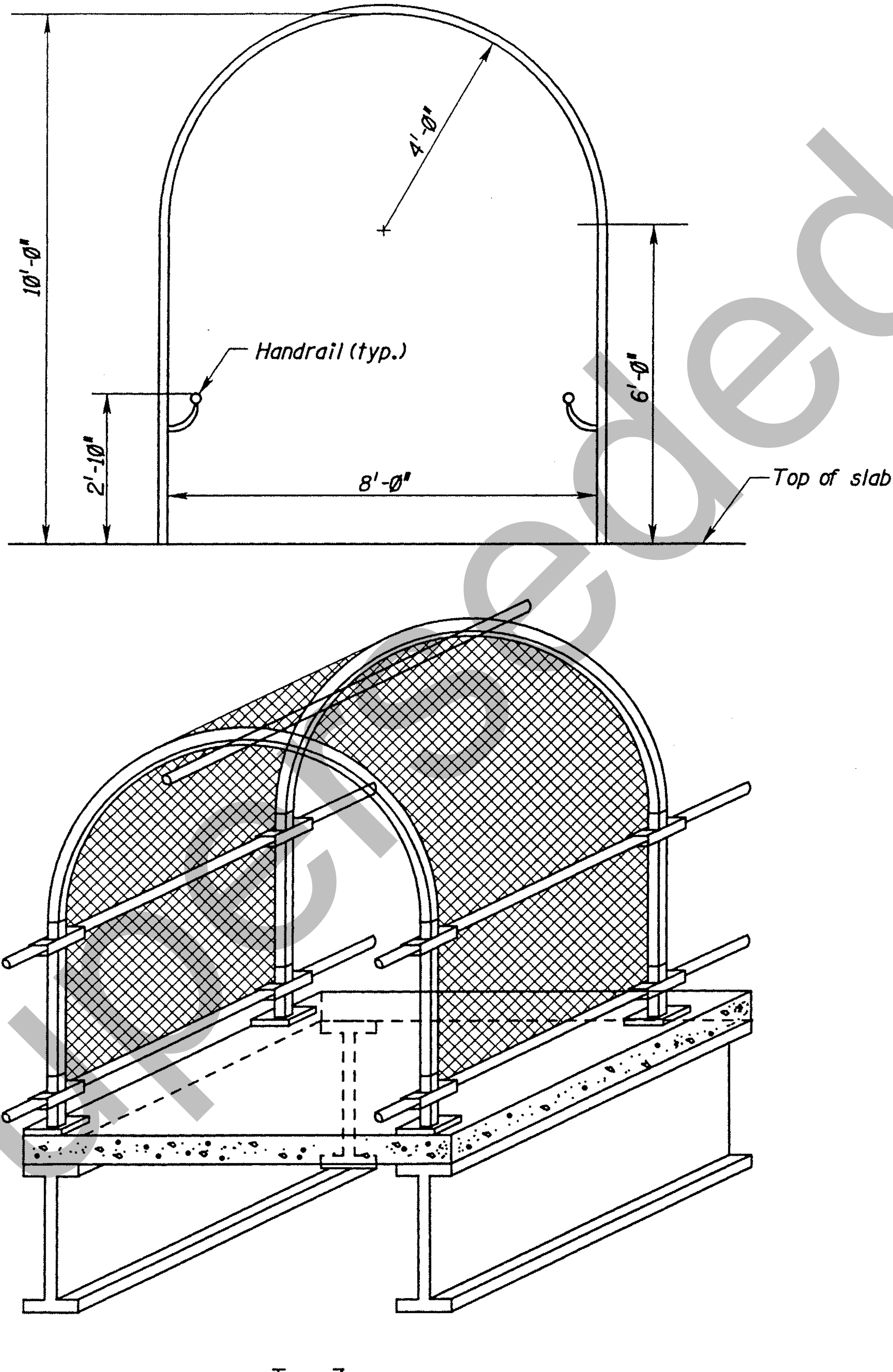
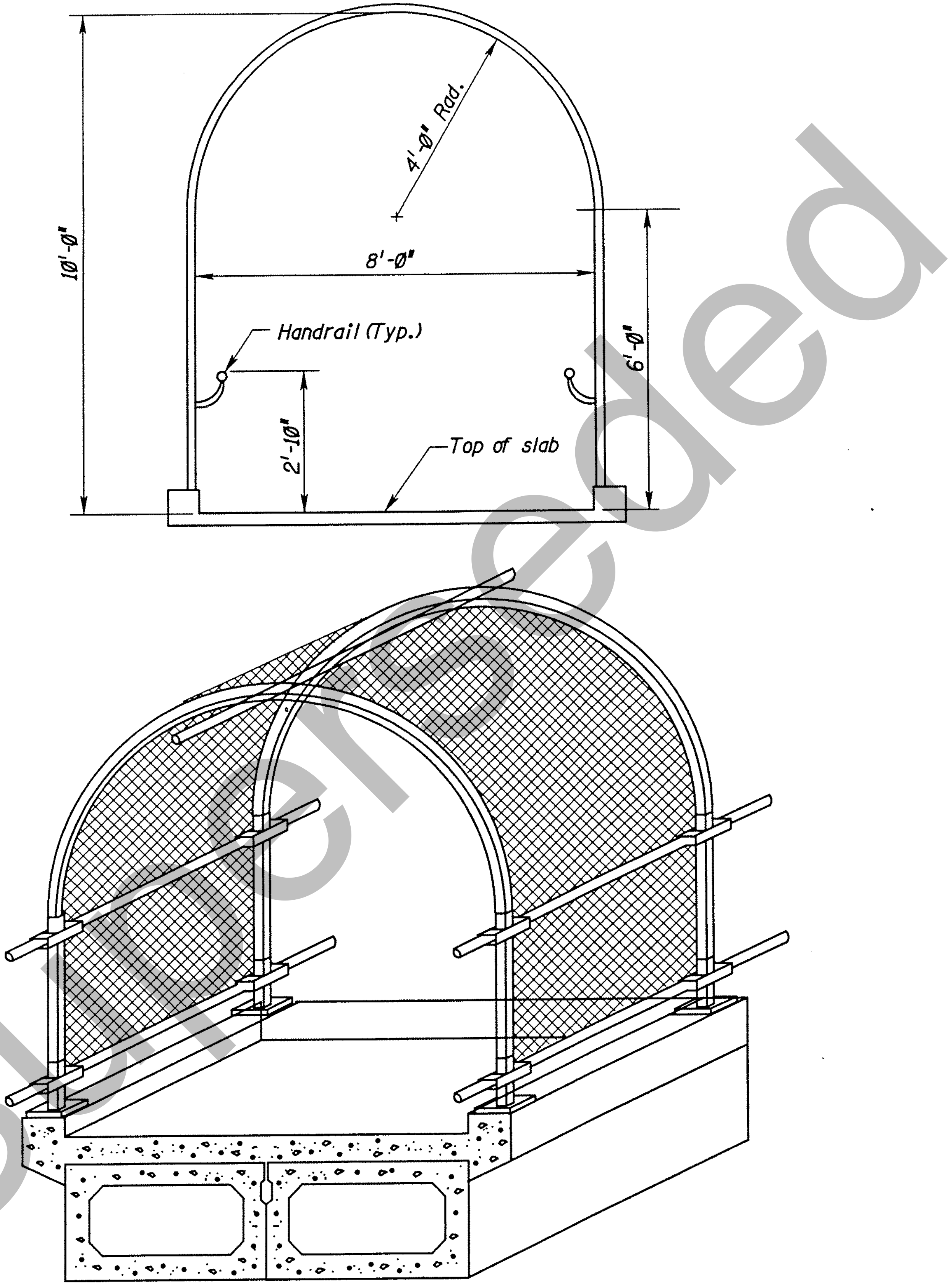


Type 7



Type 7 (Concrete Superstructure)

SECTION 24

STRUCTURAL STEEL

1.24.1 DESIGN

1. Section 6 of the AASHTO LRFD Bridge Design Specifications for Highway Bridges (with current interims), with modifications specified under Section 3 of this Manual, shall govern the design of structural steel members.

2. Curved girder structures shall be designed in accordance with the Allowable Stress Design Method of the current AASHTO Standard Specifications for Highway Bridges. The AASHTO Guide Specifications for Horizontally Curved Steel Girder Highway Bridges with Design Examples for I-Girder and Box Girder Bridges should be referred to for guidance.

3. Acceptable Structural Steel superstructure types for New Jersey bridge structures may include rolled beams, welded plate I-girders and steel tubs. Truss and thru girder systems shall not be considered.

1.24.2 TYPE OF STEEL

(a) Structural steel grades shall conform to the AASHTO M 270M/M 270 (ASTM A 709/A 709M), grades. Table 6.4.1-1 of the AASHTO LRFD Bridge Design Specifications provides a listing of designated Grades.

The use of Grades 36, 50, 50W and HPS designated Grades are permitted. The HPS prefix designates High Performance Steel Grades.

Grade 50W and HPS Grades are weathering steel grades. Subsection 1.24.19 of this Manual may be referred to for guidance on the use of weathering steel.

The use of High Performance Steel (HPS) is strongly encouraged. Economic studies indicate, that when use of HPS is planned, furnishing of hybrid girders is the most economical choice when using HPS. Girder webs consisting of HPS70W and flanges of Grade 50W may initially be considered; however, loading conditions should determine the required girder section. Also, when designing continuous steel girder superstructures, economic studies indicate that HPS should be used in the negative moment region with Grade 50W in the positive moment region.

The grade or grades of steel to be furnished shall be designated on the plans.

(b) All structural steel that is to be used in main load-carrying member components that are subject to tensile stresses shall conform to the applicable Charpy V-notch Impact Test requirements of AASHTO M 270M/M 270 (ASTM A 709/A709M).

Welded girders made of High Performance Steel (HPS), steels shall be fabricated in accordance with the AASHTO "Guide for Highway Bridge Fabrication with HPS70W Steel" which supplements the ANSI/AASHTO/AWS D1.5 Bridge Welding Code.

(c) The use of Grades 50W and HPS Grades are subject to the cleaning and painti requirements that are specified in Subsection 503.15 Subpart F. of the NJDO Standard Specifications.

(d) All structural steel plans shall have the following note shown thereon:

STRUCTURAL STEEL: AASHTO M 270M/M 270, GRADE ___ (ASTM A709/A 709M, GRADE___) with Supplementary Requirements for Notch Toughness for all member components marked (T).

(e) It shall be the responsibility of the Structural Design Engineer to designate the main load carrying member components that are subject to tensile stress. For this purpose, the designation (T) shall be noted on the contract plans.

The components to be designated (T) shall include flanges, webs, and splice plates of the welded stringers, girders, or rolled beams (also see Guide Sheet Plate 3.9-21.) The above note and designations shall be verified on the shop drawing plans.

1.24.3 SPAN TYPE SELECTION

(a) Simple and continuous stringers are within the range of span types that can be considered for the majority of structures. The choice should be made on the basis of judgment, economy, appearance and serviceability.

(b) Bridges shall be designed to satisfy minimum levels of superstructure redundar such that the failure of one member would not lead to the collapse of the bridg. Subsection 1.3.4 – Redundancy of the AASHTO LRFD Bridge Specifications specifies that multiple load path or continuous structures should be developed.

Accordingly, redundant type (multiple load path) systems shall always be used. To satisfy this requirement, bridge structures in New Jersey shall be design and constructed with a minimum of four (4) girder lines.

Should the need for non-redundant (single load path) systems be unavoidable, their use shall be subject to approval, in writing, by the Manager, Bureau of Structural Engineering. A request for an approval shall include substantial justification why a non-redundant structure is the only structure that will meet the project requirements.

The approval shall be obtained prior to the Preliminary Plan submission and before beginning final design development. Such approval will be subject to the special design, fabrication, and plant inspection provisions of the AASHTO/AWS Section 12 "Fracture Control Plan for Non-Redundant Members" (see Subsection 1.24.5).

(c) Continuous spans are only recommended for structures founded on rock, point bearing piles, or unyielding soils. The soil may be considered unyielding if the following conditions are met:

- The bearing capacity is at least 2 tons per square foot.

- The available soil data permits the settlement to be reliably computed.

- The effects of the differential settlement are accounted for in the design of the superstructure.

Design differential settlement shall be considered at a maximum of one (1) inch.

(d) Structures containing pin and hanger connections for suspended/cantilever spans are not permitted. If somehow deemed necessary, suspended/cantilever span design shall be subject to approval, in writing, by the Manager, Bureau of Structural Engineering prior to the Preliminary plan submission.

Pin and hanger connections may only be utilized on redundant (multiple load path) systems. Members shall be restrained against lateral movement on the pins and against lateral distortion due to bridge skew or curvature. Pin and hanger connections shall be designed in accordance with the AASHTO LRFD Bridge Design Specifications.

1.24.4 ECONOMICS OF STRINGER DESIGN

(a) In the design of welded plate girders, consideration should be given to minimizing the number of transverse intermediate stiffeners.

This guidance is based on principal for the following reasons:

(1) Welding to the parent metal in itself introduces a discontinuity and should be avoided as much as possible.

(2) Elimination of projections and obstructions and the resulting flat surfaces optimize the chances of improved quality of workmanship in the cleaning and painting of the structural steel both in the fabricating shop, initial field coating and future maintenance painting.

(3) Fabrication cost differentials between welding stiffeners versus use of additional material in the main components of girders; such as, additional web thickness, are not overwhelmingly significant. This should be considered during design.

(b) Consideration shall also be given to minimizing the number of butt welded flange plate transitions. Plate size transitions may be located at the field splice so that butt welding requirements are either reduced or eliminated. It is the Designer's responsibility to check the availability of plate sizes in order to determine the location of shop splices for flange plates.

(c) Reduction of material mass is not necessarily the ultimate factor in determining span type selection. Material mass of the stringers may represent about 25% of the completed, in-place cost. The bulk of the cost is in fabrication, delivery and erection.

According to some concepts of thought in the steel fabricating industry, any initial construction cost savings in reduction of material mass may not be overwhelmingly significant when fabricating, shop fit-up, and erection cost differentials are considered. Simplification and repetition of details, reduction of fabricating operations, and ease of erection are often better means of achieving minimum cost.

(d) Guide Plates contained in Section 3 of this Manual, for Structural Steel fabrication, are based on economical fabrication detailing. These details should be studied in project development.

(e) Due to the limited availability of rolled beam sections, their use should be carefully studied before their selection as bridge superstructure members.

1.24.5 FRACTURE CONTROL PLAN

(a) Steel bridge members or member components designated as Fracture Critical Members (FCM's) shall conform to the provisions of the most current edition of the AASHTO/AWS D1.5 Bridge Welding Code.

(b) Fracture critical members or member components (FCM's) are tension members or tension components of members whose failure would be expected to result in collapse of the bridge.

(c) The responsibility for determining which, if any, bridge member or member component is in the FCM category shall rest with the Structural Design Engineer.

(d) If it is determined that any member or member component is in the FCM category, the following note shall be shown on the structural steel plans:

<u>Fracture Critical Members</u>: Members or member components designated as FCM shall be subject to the provisions of the most current Edition of the AASHTO/AWS D1.5 Bridge Welding Code, Section 12.

Shop drawings shall be reviewed by the Structural Design Engineer accordingly.

1.24.6 COMPOSITE DESIGN

(a) Steel stringers with a concrete deck slab shall normally be designed as composite structures, assuming no temporary supports will be provided for the beams or girders during placement of the permanent dead load.

(b) Shear connectors shall be 7/8 inch diameter end welded studs. Height of studs depends on concrete haunch dimensions. Shear connectors shall penetrate at least 2 inches into the bottom mat of the deck slab, but the top of the stud head shall be

3 inches minimum below the top of the deck slab. Use of the same height stud on any one bridge is preferred.

(c) See Page 1.3-18 for criteria concerning the negative moment area of continuous spans.

1.24.7 CAMBER

(a) Simple Spans. The various conditions of dead load deflection and camber for each simple span stringer shall be tabulated on the structural steel plans as shown below:

DEAD LOAD DEFLECTIONS (Inches)							CAMBER (Inches)			
Stringer Number	Location	Structural Steel	Concrete Slab (Including Haunches)	Stay In Place Form And Added Concrete Thickness	Sidewalks Parapets Barriers	Future Paving Allowance	Total Dead Load Camber	Vertical Curve Ordinate	Architectural Camber	Total Camber Required
	Mid-Span									
	1/4 Point									

The column headed "Vertical Curve Ordinate" shall be used exclusively for simple span stringers located within the limits of a crest vertical curve, provision for its ordinates must be made within the concrete haunch. Consequently, the tabulation of its ordinates is unnecessary.

Total dead load camber is equal to the sum of the dead load deflections. An architectural camber of L/100 inches, where L is the span length in feet, shall be provided for all simple span stringers unless the vertical curve ordinate meets this, in which case the architectural camber may be omitted. When establishing the depth of the concrete slab and haunch in composite design, the following items shall be considered:

1. Total camber required.
2. Girder dimensional tolerances per Section 3.5 of the ANSI/AASHTO/AWS Bridge Welding Code D1.5.
3. A minimum cover of 3 inches over the shear connectors.

When total camber is less than minimum that can be maintained in a beam (W Section) no camber is required but a note stating "Beams shall be placed with any mill camber up" shall be shown on the drawings.

(b) Continuous and Cantilevered Spans. The various conditions of dead load deflections and cambers for each stringer shall be tabulated at the tenth point of spans and at the field splice points (at dead load points of contraflexure if field splices are not provided).

Examples and notes for continuous spans are provided on Pages 1.24-6 to 1.24-8.

CAMBER TABLE

POINT NUMBER		Centerline Brgs. Abut.	SPAN 1: 1	2	3	4	5	6	7	IP1	8	9
CAMBER	Steel	0										
	Concrete Slab	0										
	SIP Forms and Addl. Concrete Thickness	0										
	S.D.L.	0										
	V.C.	0										
	Architectural	0										
	TOTAL	0	C1=	C2=	C3=	C4=	C5=	C6=	C7=	C=	C8=	C9=

POINT NUMBER		Centerline Brgs. Pier 1: 10	SPAN 2: 11	12	IP2	13	14	15	16	17	IP3	18	19
CAMBER	Steel	0											
	Concrete Slab	0											
	SIP Forms and Addl. Concrete Thickness	0											
	S.D.L.	0											
	V.C.												
	Architectural	0											
	TOTAL	C10=	C11=	C12=	C=	C13=	C14=	C15=	C16=	C17=	C=	C18=	C19=

POINT NUMBER		Centerline Brgs. Pier 2: 20	SPAN 3: 21	22	IP4	23	24	25	26	27	28	29	Centerline Brgs. Abut.
CAMBER	Steel	0											0
	Concrete Slab	0											0
	SIP Forms and Addl. Concrete Thickness	0											0
	S.D.L.	0											0
	V.C.												
	Architectural	0											0
	TOTAL	C20=	C21=	C22=	C=	C23=	C24=	C25=	C26=	C27=	C28=	C29=	

CAMBER TABLE NOTES

1. The total camber as tabulated is assumed to be measured vertically to the top of the fully cambered web from a straight line drawn from the intersection of top of web and centerline of bearing at one end of the girder to the intersection of top of web and centerline of bearing at the other end of the girder.

2. The camber labeled "Steel" in the table is the camber required in the girder to offset the deflection due to the dead load of the steel in the girder plus all necessary diaphragms, cross frames, etc.

3. The camber labeled "Conc. Slab" in the table is the camber required in the girder to offset the deflection due to the dead load of the concrete slab.

4. The camber labeled "SDL" in the table is the camber required in the girder to offset the deflection due to the superimposed dead load, that is, the curb, sidewalk, railing and future wearing surface.

5. The camber labeled "Stay-in-Place forms and added concrete thickness" is the camber required in the girder to offset the deflection due to the weight of the stay-in-place forms and due to the weight of added concrete that is needed to meet the deck grades.

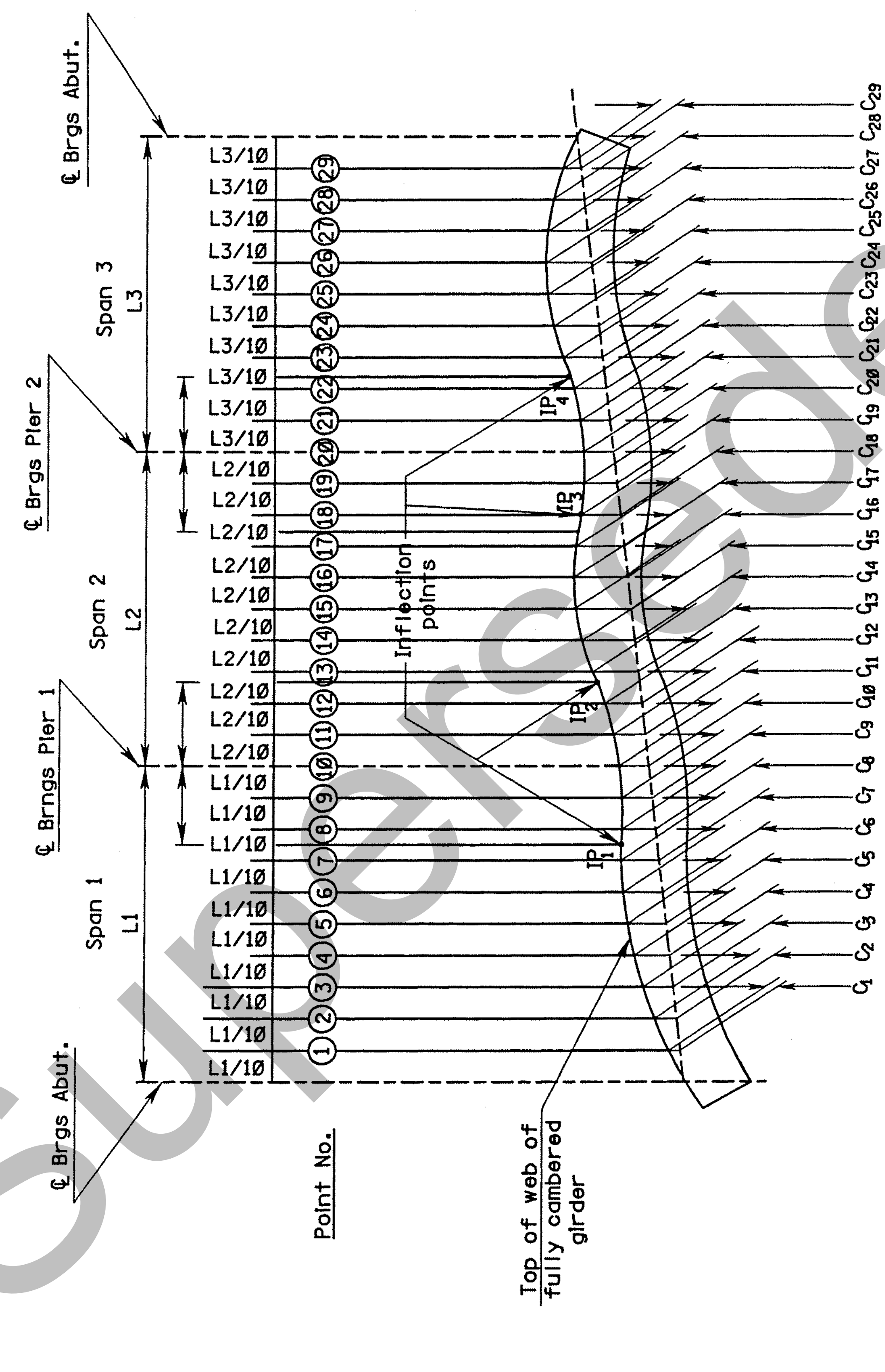
6. The camber labeled "VC" in the table is the camber required in the girder to follow the vertical curve. The Vertical Curve value shall be used exclusively for stringers located within the limits of a crest vertical curve. Where such stringers are located within the limits of a sag vertical curve, provision for its value must be made within the concrete haunch. Consequently, the tabulation of its values is unnecessary.

7. The camber labeled "Architectural Camber" shall be a value of L/100 inches, where "L" is the span length in feet. If the vertical curve value provides this camber value, the architectural camber may be omitted.

8. Cambers listed in the table as positive are upward cambers.

9. Cambers listed in the tables as negative are downward cambers.

10. The cambers are tabulated in inches.



CAMBER DIAGRAM

(c) Sag Cambers

Because of the objectionable appearance of a sag camber in a stringer, sag or negative cambers should be avoided. The following are a few guidelines on possible means of avoiding negative camber in a stringer.

(1) Avoid sag vertical curves on bridges.

(2) Never begin or end a superelevation transition or runoff in the middle of a span. Always begin or end transitions off the structure or, if this is impossible, begin or end the transition at a centerline of bearing or a centerline of pier.

(3) Never place a sag camber in a straight stringer on a curved roadway in order to accommodate the variation in the theoretical bottom of slab elevation. The variation should be taken up in the haunch.

(4) Upward dead load deflection may occur in some areas of continuous girders when the ratio of maximum to minimum span lengths becomes significant. There always is a possibility that computed camber built into the girder is not completely removed with the application of dead load. Camber due to a future wearing surface will remain when construction is completed. Additional camber may remain due to differences between design assumptions and actual girder performance.

1.24.8 MULTIPLE SPAN STRUCTURES

(a) It is desirable, from an aesthetic viewpoint, that a uniform depth of concrete fascia be kept for the full length of the exposed fascia. All fascia beams shall be set so that the bottom of the top flanges will be aligned.

(b) Stringers, beams, and girders shall generally be of uniform depth for the full length of the structure, except where changes in depth are absolutely necessary to meet underclearance requirements or where a change in depth is desirable to enhance the appearance of the structure. Changes in depth shall not normally be made in structures with varying spans. Interior stringers shall be made the same depth as the fascia stringer.

1.24.9 DIAPHRAGMS AND X-FRAMES

(a) The criteria of Subsection 6.7.4 – Diaphragms and Crossframes of the LRFD Specifications shall be followed in analyzing the need for their provision.

(b) Standard Drawing 2.4-5 of this Manual provides conceptual detailing of diaphragms and crossframes.

1.24.10 TRANSVERSE INTERMEDIATE STIFFENERS

(a) See Subsection 1.24.5.

(b) See Guide Plate 3.9-6.

1.24.11 BEARING STIFFENERS

See Guide Plate 3.9-5.

1.24.12 CONNECTOR PLATES FOR INTERIOR DIAPHRAGM X-FRAMES

See Guide Plate 3.9-14 and 3.9-15.

1.24.13 STABILITY DURING TRANSPORTATION AND ERECTION

The stability of the stringers and girders during transport and erection is normally the responsibility of the Contractor, but, wherever possible, the design should be such that temporary bracing or diaphragms are not required. In reviewing shop drawings, Engineers shall satisfy themselves that the Contractor has properly met his contractual responsibilities in this respect.

1.24.14 WELDED DETAILS

(a) Field Welding to stringers, plate girders or any major component of the structure shall not be permitted unless approved by the Manager, Structural Engineering, prior to the submission of working drawings.

Field welding in such cases shall conform to the following Sections of ANSI/AASHTO/AWS Bridge Welding Code D1.5. The following parameters shall be included in the Special Provisions:

- Pre-qualification of the proposed welding procedures shall be in accordance with Section 5, Part A.
- Qualifications of the welding operator shall be in accordance with Section 7, Part B.
- The Quality Control Inspector shall meet the qualifications specified in Section 6.1.3 and 12.16.
- All fillet welds shall be 100% Magnetic Particle (MT) tested in addition to Visual Inspection.

(b) The ANSI/AASHTO/AWS Bridge Welding Code D1.5 promulgates the following concepts of inspection, which, in effect, are separate functions:

1.) Fabrication/Erection Inspection and Testing (Quality Control) is to be performed by the Contractor or Fabricator as a mandatory requirement.

2.) Verification Inspection and Testing (Quality Assurance) is the prerogative of the State.

Provisions in the ANSI/AASHTO/AWS Bridge Welding Code D1.5 requires that contract documents identify main members and also that contract documents identify groove welds in these members as to category of stress (tension, compression or reversals of stress). Both of these identifications are needed to define the extent of non-destructive testing required by the Contractor as a minimum level under QC inspection specifications.

Identification of the nondestructive inspection required for all welds included in Section 6.7, Parts B and C, of the ANSI/AASHTO/AWS Bridge Welding Code D1.5, shall be accomplished by providing symbols and notes as per paragraph (b) above. This essentially fulfills the requirement of the Bridge Welding Code.

For main member components in structure types such as trusses, bents, towers, box girders etc., it shall be the Structural Design Engineer's responsibility to identify such members and welds as part of the details on the contract drawings with the appropriate welding and NDT symbols.

(c) Certain miscellaneous details (supports for screed rails, steel deck forms, miscellaneous connection plates, gussets, etc.) shall normally not be welded by the use of fillet welds (regardless of the direction of weld), plug welds, or tack welds to members or parts subject to tensile stress. At locations where welding cannot be avoided, the maximum stress at the point of attachment shall not exceed nominal fatigue resistance as defined in Subsection 6.6.1.2.5 of the AASHTO LRFD Bridge Design Specification.

The attachment of these details shall not be allowed where the stress exceeds the nominal fatigue resistance.

(d) The contract plans and shop drawings shall clearly show the flange areas where no welding is permitted and the areas on continuous girders where the stiffeners are to be connected to the top or bottom flanges. See Guide Sheet Plate 3.9-7 for weld terminations.

(e) In the fabrication of HPS girders, the AASHTO Guide Specifications for Highway Bridge Fabrication with HPS 70W steel recommends that filler metals for Grade 50W base metal be specified for all fillet welding. When the use of HPS is planned, this criteria should be stated on the Plans.

1.24.15 SHEAR LOCKS

Shear locks shall be provided when a longitudinal expansion joint is located in the roadway area per Subsection 1.20.7 b. of this Manual. The shear locks shall be located at intermediate diaphragms within the middle half of the span. A minimum of three shear locks shall be provided per span. The shear locks are intended to eliminate differential deflections due to live load and impact.

1.24.16 FLARED DECKS

Beams should be laid out parallel as much as practicable. Non-parallel beams shall be kept to a minimum.

1.24.17 FIELD SPLICES

(a) To facilitate the fabrication, shipping and the erection of steel girders, one optional field splice will be permitted in spans between 120 and 150 feet in length. This field splice shall be located between the 1/3 and outer 1/4 points of the span length.

When the span exceeds 150 feet, optional field splices may be located between each of the 1/3 and outer 1/4 points.

In continuous spans, the bolted field splice shall preferably be made at or near the points of dead load contraflexure.

(b) Locations and details of the optional field splice shall be shown on the plans. The Contractor may request modifications subject to approval by the Engineer.

(c) Field splices shall be designed and detailed using AASHTO M 164M/M 164 (ASTM A 325M/A 325) high strength bolts. The flanges should have sufficient excess area at points where splicing is anticipated to permit a bolted splice to be made.

(d) Splice locations are generally selected near transitions in flange thickness or width where there is sufficient flange area to permit hole drilling while still maintaining the required net area.

(e) When rolled beams are used for continuous structures, the field splices should be located in areas where no cover plates are required. Consideration should be given to the fact that the fatigue strength of the section adjacent to the bolted connection (Category B*) is less than the fatigue strength of the base metal in areas where there is no splice (Category A*).

*See Article 6.6 of the AASHTO LRFD Bridge Design Specifications.

(f) See Subsection 1.20.8 g. of this Manual concerning depth of concrete haunch at location of field splices.

1.24.18 PAINT COATING SYSTEMS

(a) **Environmental Zones.** Past studies of air pollutants and sea salt and their effects on structural paint has resulted in establishing the State of New Jersey into four environmental zones. These zones are listed on Page 1.24-15. The current structural steel paint systems used by the Department, listed in the Table on page 1.24-17, are acceptable for use in all four environmental zones.

(b) **High Pollutant Level Zones.** When planning the rehabilitation of structural steel, there is no evidence to show that repainting schedules are adversely affected in areas where, due to the bridge structure's location, pollutant levels may be higher. Thus industrial and rural areas should normally be considered comparable with regard to the use of current structural steel paint systems. Unusual situations such as structures over or near factories may require individual study to access the quality and the extent of required removal of the existing coating system.

(c) **Salt Splash Zones.** The effect of salt splash water on the deterioration of structural paint is dependent upon its salinity. It has been established that waters with salinity high enough to initially require use of paint coating system specifications include all coastal waters (Bays, Harbors, etc.) and coastal parts of tidal rivers. The limits of salt splash zones of tidal rivers in New Jersey are delineated by the following table:

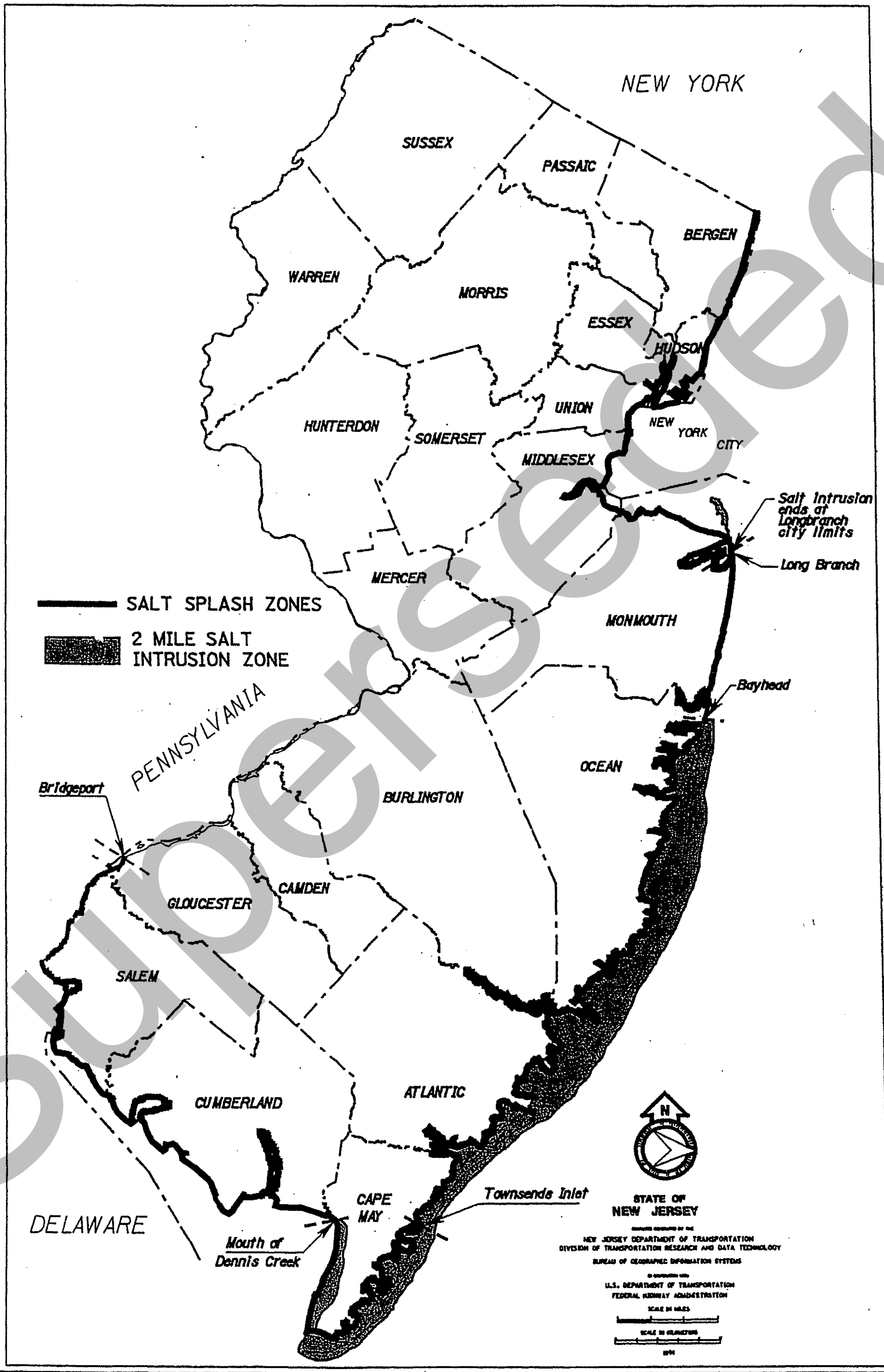
RIVER:	Salt Splash Zone Limit
Delaware	Bridgeport, NJ
Mullica	14th mile of River's Length
Hudson	New York Border
All other tidal rivers	15th mile of River

Note: Salt splash zones are defined as areas that are 15 feet or less above the high water level.

(d) **Salt Intrusion Zones.** Certain areas of the State due to their geographic configuration are subjected to high concentrations of sea salt suspended in the air. These areas are designated to be in salt intrusion zones. Salt intrusion is generally limited to a 2 mile coastal region (see Pages 1.24-15 and 16).

(e) Bridge structures that are located in areas where pollutant levels may be high, or in salt splash zones or in salt intrusion zones will initially require use of a paint coat system. However, as per the guidance provided in Subsection 1.24.19 the use of weathering steel may be considered. Subsection 1.24.19 contains guidance on evaluating the use of weathering steel.

ZONAL AREAS OF NEW JERSEY AFFECTED BY SALINITY



The following notes are included to clarify the map on the previous page:

1. A river's point of measurement is to start where the mouth noticeably changes into a bay or ocean.

   Examples: Hackensack and Passaic Rivers .... Newark Bay
   Mullica River .... Great Bay
   Raritan River .... Line parallel from South Amboy to opposite coastline
   Shrewsbury River .... Sea Bright Bridge

2. Sea salt intrusion areas are surrounded on three sides by salt water (peninsula, protrusion) such that at least one side faces open ocean or, are those land masses completely surrounded by salt water.

3. Except for the Delaware and Hudson Rivers, designated splash zones are only approximations of splash zones on rivers.

4. Dashed lines denote transition points from splash zones to 2 mile intrusion zones.

(f) Listed below are the four environmental zones identified in the State of New Jersey:

ZONE 1 - Rural or industrial, mild exposure. Where severe corrosion is not a problem.

ZONE 2 - Industrial, severe exposure. Area where corrosion is a serious problem. Progressively aggressive industrial locations.

ZONE 3A - Marine, mild exposure. Structural steel more than 15 feet above mean high water. Structure located in less severe coastal salt intrusion zone.

ZONE 3B - Marine, severe exposure. Structural steel less than 15 feet above mean high water. Structure located in severe coastal salt intrusion zone.

The cleaning and painting systems for new structural steel shall be based on specifications that are contained in Subsection 503.15 of the NJDOT Standard Specifications.

For all projects involving painting of existing structural steel, Section 514 of the NJDOT Standard Specifications should be referred to for governing criteria. As stated therein, when planning such work, a written request shall be submitted to the NJDOT Bureau of Maintenance Engineering for direction as to the coating system (Organic Zinc or Epoxy Mastic) that is to be specified for use in the project.

The guidelines listed in the Table on page 1.24-18 can be referred to for guidance in planning the work.

Also, as stated in the referred to Section 514 of the Standard Specifications, a request should be submitted to the Bureau of Project Support to request an EPA ID number. The EPA ID manifest number shall be listed on the manifest for processing of the waste. A minimum of two (2) weeks is required to obtain this information.

The Bureau of Maintenance Engineering and the Bureau of Project Support should be given the structure number, location (highway route number or road name and milepost), municipality, zip code and County.

Coating System	Paint System	Surface Preparation	Acceptable Environmental Zones	Selection Criteria
IEU	P: Inorganic Zinc Rich I: Epoxy Polyamide F: Aliphatic Urethane	Near-White Blast Cleaning, SSPC-SP-10	All	Use for the painting of all new structural steel.
OEU	P: Organic Zinc Rich I: Epoxy Polyamide F: Aliphatic Urethane	Near-White Blast Cleaning, SSPC-SP-10	All	Use for all existing structural steel with an ASTM D610 Rust Grade of 6 or less and when no major structural work involving steel replacement is scheduled in the near future.
EU	P: Aluminum Epoxy Mastic I: Aluminum Epoxy Mastic F: Aliphatic Urethane	Hand/Power Tool Cleaning, SSPC-SP-2/3 (with spot commercial blast SSPC-SP-6 if and where directed)	All	Use for the painting of all existing structural steel with an ASTM D610 Rust Grade greater than 6.
Leave Steel Unpainted				Use this option for all existing structural steel with an ASTM D610 Rust Grade of 6 or less and when major structural work, involving steel replacement, is scheduled in the near future. (Use of this option will depend on site conditions)
Key: P=Primer I=Intermediate F=Finish				

(g) The Standard Specifications provide color chip numbers for the following finish coat colors:

Foliage Green; Lake Blue; Brown

Brown should be specified only at those locations where a significant aesthetic objective is to be achieved. Brown should not be specified for Non-Redundant (Single-Load-Path) type bridges.

Generally, designation of finished colors should be based on the following consideration. If a bridge is located in an opened area (urban or rural) where it is more exposed to the open sky, then Lake Blue should be designated. If a bridge is located in an area other than this, Foliage Green should be designated.

Other finish coat colors; such as, gray or off-gray may be used. The color chip number for these colors may be obtained by contacting the Bureau of Maintenance Engineering. The obtained color chip number should be provided in the Project Special Provisions.

(h) The following notes are required on Structural Steel plans to compliment the requirements of the Standard Specifications.

Coating System: ____________________

Finish Coat Color: __________________

1.24.19 WEATHERING STEEL

1. Uncoated weathering grade steels have been available to the bridge engineering industry for many years. The cost-effectiveness of using this material has been demonstrated in both short and long-term savings. The additional cost of this grade of steel is offset by the elimination of the need for initial complete painting. As stated earlier, these steels are currently supplied under AASHTO Specification M270M (ASTM A709M) "W" Grades.

2. Environmental benefits also result from the use of weathering steel. The reduction in initial painting reduces emissions of volatile organic compounds (VOC) when oil based coatings are used.

3. The conditions stated below shall render a site not suitable for use of weathering steel.

   a. Grade Separations in "Tunnel-Like" Conditions. Refer to 4.a. below for additional clarification.

   b. Low Level Water Crossings; such as,

      1.) 10 feet or less over stagnant, sheltered water.
      2.) 6 feet or less over moving water.

4. If a proposed structure is to be located at a site with any of the characteristics noted above, the use of uncoated Weathering Grade steel shall not be contemplated. The guidance provided below, shall be considered in analyzing these conditions.

   a. Grade Separations. The so-called "tunnel effect" is produced by the combination of narrow depressed roadway sections between vertical clearances and deep abutments adjacent to the shoulders as are found at urban/suburban grade separations. These roadway/bridge geometrics combine to prevent roadway spray from being dissipated by air currents and can result in excessive salt in the spray being deposited on the bridge steel. In such locations, the use of uncoated weathering steel should be avoided as deicing salts may result in adverse conditions.

   b. Low Level Water Crossings. Sufficient clearance over bodies of water must be maintained so that spray or condensation of water vapor does not result in prolonged periods of wetness of the steel. Clearance to bottom flange of at least 10 feet over sheltered, stagnant water and at least 6 feet over running water is recommended.

5. Marine or Industrial Environment. When the project site is located in a marine or industrial environment, a more precise technical evaluation of the suitability of uncoated weathering steel may be obtained from a corrosion consultant, from conducting standardized environmental tests or from both. If serious doubt remains after such an evaluation, then engineering judgment should lean towards coated steel.

6. If weathering steel is approved for use, the following items should be studied in detailing the construction of a bridge:

   a. Elimination of bridge joints where possible.

   b. Expansion joints must be able to control water that is on the deck. Consider the use of a trough under the deck joint to divert water away from vulnerable elements.

   c. Paint areas of steel as specified in Subsection 503.15 F of the NJDOT Standard Specifications. If the use of weathering steel is planned for parallel bridges, the distance between the bridges must be assessed to determine if the adjacent fascia girders should be completely painted. The Bureau of Structural Engineering should be contacted for concurrence if it is believed that complete painting is deemed necessary.

   d. Do not use welded drip bars where fatigue stresses may be critical.

   e. Elimination of details that serve as water and debris "traps".

f. "Hermetically seal" box members when possible, or provide weep holes to allow proper drainage and circulation of air.

g. Cover or screen all openings in boxes that are not sealed.

h. Protection of pier caps and abutment walls to minimize staining.

i. Seal overlapping surfaces exposed to water (to prevent capillary penetration action).

j. Provide drip plates as detailed in Guide Plate 3.9-23.

1.24.20 BEARING DEVICES

The following guidance shall be considered for the design of new structures or for those projects that involve, as applicable, a superstructure replacement. For decision making guidance as to the seismic retrofit of existing bridges, Section 45 of this Manual should be referred to for guidance.

A. Requirements for Bearings

Standard Drawings 2.5-1"Elastomeric Bearing", 2.5-2 "Pot Bearing" and 2.5-3 "Seismic Isolation Bearing" may be referred to for a basic presentation of these type bearing systems.

1. General

Structural bearings for use on new bridges or for superstructure replacements shall include use of Steel Reinforced Elastomeric Bearings, Elastomeric Pads, either circular or rectangular, High Load Multi-rotational Bearings or Seismic Isolation Bearings.

High Load Multi-Rotational (HLMR) bearing systems shall include those types that consist of a rotational element of the pot type, disc type or spherical type. When expansion is required, HLMR bearing systems may include sliding surfaces.

Components of such bearings shall include masonry, sole and shim plates, bronze or copper alloyed bearing and expansion plates, anchor bolts, guide devices, polytetrafluorethylene (PTFE) sheets or surfacing lubricants and adhesives.

When load conditions indicate that plain Elastomeric Pads or Reinforced Elastomeric bearing systems are sufficient, detailing shall be provided on the final plans for their use. However, when load conditions indicate that HLMR or Isolation Bearing systems are warranted, then the complete design of these bearing assemblies is not required with the final plan submission. As described herein, sufficient information is to be provided on the plans to permit the bearing assembly type to be selected by the Contractor. Subsection 503.04 of the NJDOT Standard Specifications provides guidance on Working Drawing submissions. Subsection 503.08D. of the NJDOT Standard Specifications provides guidance on furnishing the selected bearing system.

Bearings shall be supplied as fixed bearings, guided expansion bearings or non-guided expansion bearings. Bearings shall adequately provide, as applicable, for the thermal expansion and contraction, rotation, camber changes and creep and shrinkage of structural members.

The design, materials, fabrication and installation methods shall be in accordance with the AASHTO LRFD Bridge Design Specifications Section 14, the NJDOT Standard Specifications for Road and Bridge Construction and Section 18 of the AASHTO LRFD Bridge Construction Specifications.

a. Fixed Bearings – Fixed Bearings shall allow rotation but no transverse movement in the bearing plane.

b. Guided Expansion Bearings – Guided expansion bearings shall allow rotation and longitudinal movement in the bearing plane. Transverse movement shall be restricted.

c. Non-Guided Expansion Bearings – Non-guided expansion bearings shall allow rotation, longitudinal movement and transverse movement in the bearing plane.

2. General Design Considerations

a. Only one fixed or guided expansion bearing shall be assumed to resist the sum of all the horizontal forces at each abutment, bent, column, hinge or pier. Seismic forces are an exception as these forces may be resisted by all fixed or guided expansion bearings located at a given substructure unit. Longitudinal loads are resisted only at fixed bearings, and transverse loads are resisted by fixed and guided expansion bearings.

b. Provide at least two fixed or guided expansion bearings, each able to resist all horizontal forces at each abutment, column, hinge or pier for design redundancy.

c. Bearing systems conforming to these guidelines shall not be used at vertical loads that are less than 20 percent of their capacity. Bearings for less than 20 percent require a special design. Special designs are also required where high horizontal and/or vertical loads are anticipated.

d. Frictional resistance of bearing slide surfaces shall be excluded when specifying horizontal load requirements.

e. Alignment of bearing guiding systems relative to the anticipated movement direction of the structure shall be carefully considered so as to avoid failure of the bearing guide system. Special studies or designs may be required on curved or skewed structures to ensure correct alignment.

f. The substructure and superstructure shall be designed so that the sole and masonry plates remain rigid under all service conditions in areas around and in contact with the bearings.

g. The substructure and superstructure design shall permit bearings to be removed for inspection or rehabilitation with minimal jacking of the structure.

h. Avoid specifying total clearance of more than 0.06 inches between guides and guided components where possible.

i. Subsection 14.4.2 of the AASHTO LRFD Specifications calls for an increase of 0.005 and 0.02 radians of rotation for the service and strength states, respectively. These increases address uncertainties in the manufacturing and installation tolerances. The additional increases may be lowered if the bearing supplier can demonstrate through a Quality Control Plan that the tolerances can be controlled in the manufacture of a bearing assembly.

For New Jersey bridge projects the acceptable tolerance for the beveled slope of a load plate shall be plus or minus 0.002 radians. 0.002 radians will be the maximum acceptable rotation due to fabrication. This is subject to the submission of a Quality Control Plan that demonstrates a manufacturer's ability to control the fabrication and setting tolerances.

3. Construction Document Requirements

a. Final Plans shall include a "Bearing Table", as illustrated on the following page, that indicates the following information:

1.) A listing of all minimum and maximum vertical and horizontal service loads without group factors, and transverse and longitudinal rotation requirements for applicable AASHTO LRFD Load Groups as shown in the following Table. This will include all longitudinal forces, transverse forces and seismic forces.

2.) Minimum design rotation requirements of the bearing and construction tolerance.

b. The following information should also be noted or detailed on the plans.

1.) Magnitude and direction of movements at all bearing support points including thermal, creep and shrinkage movements.

2.) The location, quantity and type of each bearing (fixed, expansion or guided expansion) and the location of all bearing units. An actual bearing layout is preferred or a bearing framing plan to provide this data may be used.

4. Subsection 18.1.4.2 of the AASHTO LRFD Bridge Construction Specification provides guidance concerning fabrication tolerances of the various bearing assembly

types. Table 18.1.4.2-1 establishes tolerance dimensions that will aid the design of the respective systems. These Tables should be studied so that a sound assessment can be made on a bearing system selection.

5. To facilitate selection of a bearing system, the following table should be provided in the design plans. In order to limit the table size, Engineering judgment should be used to eliminate groups which obviously will not control the bearing design.

Design loads shall be based on the load combinations and load factors that are specified in Subsection 3.4 of the AASHTO LRFD Bridge Design Specifications.

	Load Combination Limit State	SERVICE LOADS									
		VERTICAL		HORIZONTAL				ROTATION (RAD)			
				TRANSVERSE		LONGITUDINAL		TRANSVERSE		LONGITUDINAL	
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
Strength I											
Strength II											
Strength III											
Strength IV											
Strength V											
Extreme Event I											
Extreme Event II											
Service I											
Service II											
Service III											
Fatique											

6. Design Requirement

The Designer is advised that he must provide estimated bridge seat elevations with the submission of final plans. The exact elevations will be determined upon submission of the shop drawings that will, of course, designate the bearing height.

The estimated bridge seat elevation heights should be based on the loads that the bearings must be designed to and the required degree of rotation and displacement.

Additionally, anchor bolt location and grillage steel spacing may have to be adjusted upon determination of the bearing system. Accordingly, notes to this affect shall be provided.

The following note shall be provided when designating bridge seat elevations: "Bridge Seat Elevations are based on a bearing height of ____________".

B. The following narrative is provided to familiarize the Designer as to the basic features of the permitted bearing assembly types:

1. Elastomeric Bearings

   Elastomeric Bearings shall include unreinforced pads (consisting of elastomers only) and reinforced bearings with steel or fabric laminates. Rectangular or circular types are permitted.

   Subsection 14.7 of the AASHTO LRFD Bridge Design Specifications and Subsection 18.2 of the AASHTO LRFD Bridge Construction Specifications shall be referred to for guidance in the design of elastomeric bearings. The following information is offered in determining the suitability of elastomeric bearing application.

   a. Elastomeric bearings have been developed to provide a maintenance free device capable of accommodating expansion and rotation by utilizing the unique characteristics of the elastomeric material.

   b. Elastomeric bearings are generally placed between sole plates and masonry plates. In some instances, they can be placed directly between the superstructure member and the substructure unit.

   c. Elastomeric bearings are available in three basic types as follows:

      - Plain elastomeric pads
      - Steel reinforced elastomeric pads
      - Fabric reinforced pads (usually a fiberglass composition)

   d. Laminations can be created in the elastomer by introducing a layer of steel or fabric between the layers of elastomer. The sheets separating the layers of elastomer are completely encased within the elastomeric material. For vertical loads, each layer of the elastomer behaves like an individual pad, while the horizontal strain is additive to each layer. That is, as layers are applied, the allowable horizontal strain is increased. Therefore, adding laminations is a convenient way to accommodate larger lateral movements for the same compressive loads.

   e. As required by the AASHTO LRFD Bridge Design Specifications, elastomeric materials shall have a hardness of from 50 to 70 durometers.

   f. Superstructures composed of prestressed concrete box beams or I-beams with spans of 125 feet or less may be considered for use of plain or laminated elastomeric pads. A potential horizontal movement of 2 to 3 inches should be considered when analyzing such use.

   g. When permitted by design conditions, it is not necessary to bond the elastomeric pads to the superstructure and substructure concrete surfaces. In such cases, restraining lips or keeper plates should be provided around the pads. This will inhibit the potential of the pads walking off the bearing locations. When placed between steel sole plates and masonry plates, the elastomeric material is usually bonded with adhesive to the steel plates. In such cases keeper plates are usually used to retain the bearing in place in case the adhesive does not hold.

h. Elastomeric bearings may be provided with PTFE sliding surfaces. The elastomeric material is used to accommodate rotation and a PTFE surface mated with a stainless steel plate will handle lateral movement.

   In such applications, keeper plates should be provided to restrain the movements in case. Provision of restraining bars to limit the movement of the elastomeric material and to enable the PTFE sliding surface to accommodate the movement should also be considered.

2. Seismic Isolation Bearings

   a. The basic intent of seismic isolation is to increase the fundamental period of vibration such that the structure is subject to significantly lower earthquake forces.

   b. The reduction in forces is accompanied by an increase in displacement demand which must be accommodated with a flexible mount.

   c. The following elements describe the basic composition of a bridge seismic isolation system:

      - A flexible mounting so that the period of vibration of the bridge is lengthened sufficiently to reduce the force response.
      - A damper or energy dissipator so that the relative deflections across the flexible mounting can be limited to a practical design level.
      - A means of providing rigidity under low (service) load levels such as wind and braking forces.

   d. Rather than resisting the large forces that are generated by earthquakes, seismic isolation systems decouple the bridge deck from the ground motion. When used in combination with a flexible device such as an elastomeric bearing, an energy dissipator can control the response of an isolated structure by limiting both the displacements and the forces.

      Standard Drawing number 2.5-3 may be referred to for a basic presentation of Seismic Isolation Bearings. This drawing is for informational purposes only and is not to be included in a contract set of plans.

   e. Seismic design, performance and testing shall be assessed in accordance with the AASHTO Guide Specifications for Seismic Isolation Design.

f. Seismic Isolation bearing assemblies shall include seismic isolation bearings (isolators), sole plates, masonry plates, mounting plates, lead cores, steel shims, bolts, washers and anchor bolts.

g. The following loads will govern the design of the various components of the bearing assembly:

- Vertical Loads will govern the plan size of the assembly and the internal rubber layer thickness.
- Short term loads will govern the lead core diameter.
- Long term displacements will govern the total rubber height and the lead core diameter.
- Imposed rotations will govern the internal rubber layer thickness and the total rubber height.

h. If deemed suitable, and as per the requirements of Section 503 of the NJDOT Standard Specifications, the Designer shall provide sufficient information to facilitate the selection and design of the bearing assembly by the Contractor.

3. High Load Multi-Rotational (HLMR) Bearing Systems

a. Pot Bearings

1.) The rotational elements of a pot bearing shall consist of at least a pot, a piston, an elastomeric disc and sealing rings:

2.) Subsection 14.7.4 of the AASHTO LRFD Bridge Design Specifications may be referred to for guidance in designing pot bearing systems.

b. Disc Bearings

1.) As defined in Subsection 14.7.8 of the LRFD Specifications, a disc bearing functions by deformation of a polyether urethane disc. The disc must be able to resist vertical loads without excessive deformation and be able to accommodate imposed rotations.

2.) Disc bearings are typically composed of four fundamental components: the load plates, the upper and lower bearing plates, a horizontal load transfer mechanism and a elastomeric disc.

4. Bearing Selection Evaluation

a. The bearing type selection should be based on achieving the most economical solution that will support all required movements. An initial evaluation will reveal that reinforced elastomeric bearings or elastomeric bearing pads will often be the lowest maintenance and most economic solution as a bearing selection.

b. HLMR bearing systems shall only be used where loading conditions warrant their use.

   Accordingly, economics should not be the sole category in selecting bearing types. Accommodating longitudinal, transverse and rotational movements as well as consideration of governing skew controls should be evaluated in the bearing selection.

c. Subsection 14.6.2 of the AASHTO LRFD Specifications provides a Table that tabulates bearing suitability. This Table can be referred to in determining bearing system selection.

SECTION 25

PRECAST/PRESTRESSED CONCRETE

1.25.1 GENERAL DESIGN CONSIDERATIONS

1. Subsection 5.9 of the AASHTO LRFD Bridge Design Specifications provides criteria on the design of prestressed concrete members.

2. The PCI publication, "Precast Prestressed Concrete Bridge Design Manual" also explains and applies major AASHTO LRFD Bridge Design Specifications provisions that pertain to prestressed concrete beams.

3. NJDOT stipulations provided in Section 3 of the Manual shall also be followed in the design of prestressed concrete members.

1.25.2 PRECAST/PRESTRESSED CONCRETE SECTIONS

Standardization of precast/prestressed concrete sections has simplified design, led to wider utilization of precast/prestressed concrete and has led to a reduction in cost when precast/prestressed concrete is selected. Designers should review the following guidance in evaluating precast/prestressed concrete usage.

1. **Prestressed Concrete I-Girders.** Details of AASHTO prestressed concrete I beams are illustrated on Standard Drawing Plates 2.3-1 and 2.4-1 through 2.4-5. Reproductions (22 by 36 inches) are available for insertion into contract plans. They may be obtained from the Engineering Documents Unit of the Bureau of Quality Management Services.

   Informational notes to Designers shall be erased from the reproductions of the standard drawings prior to the insertion of the sheets into the construction plans and items marked with a (D) shall be completed by the Designer.

   If continuity design for live load (see Subsection 1.25.9) is selected as a result of the bridge structure selection study, details for the positive restraint moment connection, sole and bearing plates, elastomeric bearing pads, and any other necessary details must be changed (or shown) on the standard plans.

2. **Prestressed Concrete Voided Slab and Box Beams.** Standard drawings for prestressed concrete voided slab and box beams are not presently available. Complete details, including the prestressed strand pattern and bearing details shall be shown in the contract plans for each bridge. Refer to Subsections 1.25.5 through 1.25.7 for additional criteria on box and slab beam usage.

3. **Prestressed Concrete Bulb Tee Shapes.** Studies have concluded that bulb tee shapes are more efficient than I-girder shapes. When compared to the AASHTO Type VI girder an alternative bulb tee shape may lead to reduction in girder weights of up to 35%. Also when compared to the respective I-girder span length capability, a cost savings of 17% may be realized if a bulb tee section is selected. Guide Plate 3.10-26 has been developed to illustrate 3 New England Bulb Tee (NEBT) configurations. Other configurations are available. If a Designer wishes to pursue a NEBT design, he should contact prestressed fabricators to ascertain availability of forms for its casting.

   The Federal Highway Administration has initiated an effort to establish measures for the economic fabrication of prestressed concrete members. Toward that end a committee titled Prestressed Concrete Economic Fabrication (PCEF) was formed. The work of the committee has produced a bulb tee shape that they wish be adopted as a standard shape by State agencies. Guide Plate 3.10-27 details 3 configurations of the PCEF Bulb Tee Shape. Other configurations are available. If a Designer wishes to pursue use of the PCEF shape, he should contact fabricators for availability of forms for its casting.

4. **Spliced Prestressed Concrete I-Girders.** Spliced concrete I-girder bridges have been shown to be cost-effective for a span range of 120 to 300 feet. A feature of spliced bridges is the flexibility they provide in selection of span length, number and locations of piers, segment lengths and splice locations. Spliced girders have the ability to adapt to curved superstructure alignments by utilizing short segment lengths and accommodating the change in direction in the cast-in-place joints.

5. **Precast Concrete Segmental.** Segmental concrete bridges have become an established type of construction for highway and transit projects on constrained sites. Typical applications include transit systems over existing urban streets and highways, reconstruction of existing interchanges and bridges under traffic or projects that cross environmentally sensitive sites. In addition, segmental construction has proved to be appropriate for large-scale, repetitive bridges such as long waterway crossings or urban freeway viaducts or where the aesthetics of the project are particularly important.

   Current developments suggest that segmental construction will be used on a larger number of projects in the future. Standard cross sections have been developed to allow for wider application of this construction method to smaller-scale projects. Surveys of existing segmental bridges have demonstrated the durability of this structure type and suggest that additional increases in design life are possible with the use of HPC.

   Subsection 5.14.2 of the AASHTO LRFD Bridge Design Specifications provides criteria for the design and construction analysis of segmental bridge construction. Section 10 of the AASHTO LRFD Bridge Construction Specifications should also be studied for information on post tensioning requirements that must be applied to segmental concrete construction. Also, the American Segmental Bridge Institute (ASBI) provides a forum where owners, designers, contractors and suppliers can gather information on segmental bridge construction.

1.25.3 MATERIALS

1. Strands.

   a. Uncoated seven-wire prestressing steel low relaxation strands, conforming to ASTM A416/A 416M (AAHSTO M 203M/M203) Grade 270, shall be used. Complete prestressing details shall be provided on the plans.

   b. If determined to be more suitable; such as, to offset the potential of corrosion due to the environmental location, epoxy-coated seven-wire prestressing steel low relaxation strands conforming to ASTM A882/A 882M, Supplements S1, Grade 270 may be used.

2. Bars.

   a. Uncoated high-strength steel bars for prestressing concrete conforming to ASTM A722/A722M (AASHTO M 275M/M275), including Supplements S1 and S2 shall be used.

   b. If determined to be more suitable, zinc-coated reinforcing bars conforming to ASTM A767 shall be used or epoxy-coated reinforcing bars conforming to ASTM D3963 (AASHTO M284/M 284M) shall be used.

3. Wire.

   Uncoated stress-relieved wire for prestressed concrete conforming to ASTM A421/A421M (AASHTO M 204M/M204) shall be used.

4. Post-Tensioning Anchorages and Couplers.

   Refer to Subsection 5.4.5 of AASHTO LRFD Bridge Design Specifications for guidance concerning use of these devices.

5. Ducts.

   Refer to Subsection 5.4.6 of AASHTO LRFD Bridge Design Specifications for guidance concerning use of those devices.

6. Concrete.

   Generally the design strengths for prestressed/precast concrete shall be based on Class P, P-1 or P-2 concrete. Sections 502 and 914 of the NJDOT

Standard Specifications can be referred to for guidance concerning use of these classes of concrete.

Use of HPC prestressed concrete girders should be evaluated by Designers in their appraisal of alternative bridge structure types. HPC in prestressed girders will optimize their performance with respect to service loads and exposure conditions.

If a design strength greater than that used with Class P-2 is necessary for the design of prestressed concrete beams, then the use of High Performance Concrete (HPC) should be pursued. The Designer shall familiarize himself with the following HPC performance criteria for the design and fabrication of prestressed concrete beams.

Section 20 of this Manual may be referred to for a basic definition of HPC.

Performance Characteristics	**Standard Test Method**
Creep (x = inch/pressure unit) @ 180 days	ASTM C 512
Modulus of Elasticity @ 28 days of age	ASTM C 469
56 Day Design Compressive Strength	AASHTO T 22 ASTM C39
Shrinkage (x = length change in microstrain)	ASTM C157
Chloride Permeability (x = coulombs)	AASHTO T 277

Note: All tests to be performed on concrete samples that are moist or Submersion cured for 56 days.

The chloride permeability performance criteria will only be required when prestressed concrete beams are constructed at a height that is less than 15 feet above brackish water.

Specifications for the development of HPC mix designs shall be provided in the project Special Provisions.

1.25.4 DESIGN/CONSTRUCTION CRITERIA

1. Drilling for inserts into prestressed concrete members is not permitted.

2. For any pre-tensioning application ½ inch or 0.6 inch diameter strands shall be used. Minimum spacing of prestressing strands shall be as specified in Subsection 5.10.3.3.1 of the AASHTO LRFD Bridge Design Specifications.

3. Stress limits of tendons for pre-tensioning and post-tensioning applications shall be as specified in Subsection 5.9.3 of the AASHTO LRFD Bridge Design Specifications.

4. Shipping and handling stresses shall be considered when designing prestressed concrete beams. This is especially important for long span members (over 130 feet) with slender webs and small flanges.

5. Epoxy-coated low-relaxation strands have significantly higher relaxation potential than that of uncoated strands. The use of a relaxation loss value that is equal to doubling the relaxation loss that is calculated for uncoated strands has been recommended by manufacturers. Strand manufactures should be contacted to account for suitable relaxation loss values.

6. Anchorage seating losses are typically higher for epoxy-coated strands than for uncoated strands. This should be considered in stressing and elongation calculations.

7. One of the most important decisions of precast component design is the ability to move the member from the precast plant to the job site. Weight and size limitations for the mode of transportation (truck, rail and barge) should be taken into consideration in the design of precast members. Designers should consult with fabricators on transportation considerations.

8. Various decisions in the design of prestressed concrete members determine the bridge construction cost. The PCI Bridge Design Manual, Chapter 4 describes strategies for economy, and may be referred to as an aid in decision making.

9. When considering prestressed beam layouts, a minimum of four girder lines should be provided to account for redundancy concerns and to account for future repair needs.

10. Standard Drawing 2.4-5 provides details for steel diaphragms. Steel diaphragms shall be used where intermediate diaphragms are required for prestressed beam configurations. Cast-in-place concrete diaphragms shall be used at end diaphragm locations.

11. Draped, straight and straight/unbonded strand patterns shall be considered as potentially equal solutions for prestressed beam analysis and fabrication. Designers should consult prestressed fabricators to ascertain use of strand

patterns in their fabrication process. Alternative patterns, to what is detailed on the plans, subject to the conditions stated herein, may be proposed during fabrication.

1.25.5 ADJACENT VOIDED SLAB AND BOX BEAM DESIGN

1. It is recommended that adjacent slab and box beams not be utilized for bridges with skew angles greater than 30 degrees. Utilizing these beams on skews greater than 30 degrees shall be subject to approval by the Manager, Bureau of Structural Engineering prior to the Preliminary plan approval.

   Prestressed concrete box beam bridges shall utilize 4 foot wide box beams whenever possible. All efforts should be made to avoid a mixture of 4 foot and 3 foot wide box beams in satisfying geometrical constraints.

2. Prestressed concrete adjacent slab and box beams shall be surmounted with a minimum 5 inches thick concrete deck slab designed for composite action. Reinforcement steel shall be #16 @ 12 inch centers, both directions, with 2½" cover (see Guide Sheet Plate 3.10-7) and shall be corrosion protected.

3. Non-composite design (but with composite details and construction) should also be considered. Additional reserve strength may be gained by adding several strands without a significant increase in the cost of fabricating the slab and box beams.

4. The AASHTO LRFD Bridge Construction Specifications allow a tolerance of plus/minus ¼ inch in the width of box beams. Abutment seats shall be detailed of sufficient length to accommodate this possible dimensional overrun in a group of beams.

   Abutment seats may be sloped in the transverse direction to conform with the deck cross slope; however, bearing seats shall generally be set level in the longitudinal direction parallel to the direction of the beams. If the bearing seats are not set level in this direction, gravity loads will cause shear in the elastomer.

   The use of a tapered sole plate or tapered grout pad may be required so that the bearing surfaces are set level to avoid imposing excessive rotation and the resulting stresses in the bearing (see Guide Sheet Plate 3.10-9).

1.25.6. TRANSVERSE TIES AND KEYWAY GROUTING

1. The construction plans shall be consistent with the Special Provisions. Accordingly, the following criteria shall be followed in the plan development of adjacent prestressed slab and box beam construction:

   a. The transverse ties shall be installed and tensioned before the longitudinal keyways are grouted.

b. Keyways shall be filled with nonmetallic, nonshrink grout conforming to Subsection 914.03 of the NJDOT Standard Specifications.

c. Keyways shall be grouted and cured in accordance with Subsection 502.14 of the NJDOT Standard Specifications (see Guide Sheet Plate 3.10-12). Refer to Subsection 5.14.1.2.8 of the AASHTO LRFD Bridge Design Specifications.

2. See Guide Sheet Plates 3.10-13 and 3.10-14 for transverse tie details. Transverse ties shall be high tensile strength steel bars conforming to AASHTO M 275M/M 275 (ASTM A722/A722M) or one-half inch diameter, Grade 270 strands. Bars should preferably be 1 inch in diameter; however, bars up to 1-3/8" in diameter may be used, if necessary.

   The end anchorage shall be protected from corrosion in accordance with Subsection 917.11 of the NJDOT Standard Specifications.

3. The force required per transverse tie duct per span is computed by dividing one third of the span superstructure dead load including the beams, deck, sidewalk, utilities and parapets by the number of transverse tie ducts within the fascia beam. The computed value shall be stated on an appropriate contract plan sheet.

   Refer to Subsection 5.9.3 of the AASHTO LRFD Bridge Design Specifications for the stress limits of reinforcing bars and strands.

   Generally rods are preferred over strands for transverse ties because the end anchorage details are less complicated. If prestressing strands are utilized as transverse ties instead of high strength rods, more than one 7 wire strand may be utilized per transverse duct, if necessary. Allowable end anchorage stresses in prestressed beams shall be in accordance with Subsection 5.4.3 of the AASHTO LRFD Bridge Design Specifications.

   Anchorages in prestressed beams shall develop at least 95% of the actual ultimate strength of prestressing steel. (Refer to Subsection 5.4.5 of the AASHTO LRFD Bridge Design Specifications.)

   The total force required per transverse duct and the individual strand forces, if applicable, shall be shown on the contract plans.

4. Special design considerations may be required in cases where channel beams are placed next to box beams. Adequate reinforcement shall be designed in the area of the transverse ducts and/or the configuration of the shear key shall be modified such that any allowable beam sweep can be taken into consideration before the beams are tensioned.

1.25.7 SPREAD BOX BEAM DESIGN

1. Spread box beams are particularly useful for structures supporting utilities or where a shallower superstructure is needed than can be provided by Prestressed Concrete I-Beams or Steel Plate Girders.

2. It is recommended that spread box beams not be utilized for bridges with skew angels greater than 30 degrees. Approval to utilize this concept on skews greater than 30 degrees shall be subject to approval by the Manager, Bureau of Structural Engineering prior to the Preliminary Plan approval.

3. Variations on standard spread box beam design (i.e., double spread boxes or a multi-beam structure with spread boxes under sidewalks for utilities) can be considered as alternates where applicable. These arrangements may provide shallower beams and/or a thinner deck slab and may be more economical than standard spread boxes.

4. Spread box beam bridges shall utilize wide beams whenever possible based on cost advantage or other consideration. All efforts should be made to avoid a mixture of 4 foot and 3 foot wide box beams in satisfying geometrical constraints.

5. Prestressed concrete spread box beams and bridge deck slabs shall be designed in accordance with the AASHTO LRFD Specifications and as modified by Section 3 of this Manual. Reference Guide Sheet PLATES 3.10-19 through 3.10-25 inclusive, for details on spread box beams.

   The maximum spacing center to center of beams shall be 12 feet unless otherwise approved by the Manager, Bureau of Structural Engineering.

6. Prestressed concrete spread box beams shall be designed assuming full composite design between the deck slab and the beams. Deck slab thicknesses, reinforcing steel and haunches shall be in accordance with Section 20 of this Manual.

7. Load distribution factors shall be selected in accordance with Subsection 4.6 of the AASHTO LRFD Bridge Design Specifications.

8. Guidance for continuity design for live load shall be in accordance with Subsection 1.25.9. Continuity design for live load details shall be similar to those for I-beams except that a minimum of three 1 ¼inch anchor dowels will be required at the fixed end pier. Corrosion protected reinforcement steel, as required by design, shall be placed in the top of the deck slab in the negative moment region. For Positive Restraint Moment Connection details, refer to Guide Sheet PLATES 3.10-16 and 3.10-17.

9. The Abutment seat slope in the transverse and longitudinal direction, shall be similar to that of adjacent voided slab and box beam specified in Section

1.25.5 Item 4. Complete details shall be shown on the contract plans. Elastomeric bearing pad selection shall be according to Subsection 1.25.8.

10. Diaphragms shall be provided at the following points: at the ends of each beam, at midspan for spans up to and including 80 feet and at third points for spans longer than 80 feet.

    End diaphragms shall always be placed parallel to the centerline of the bearing. Intermediate diaphragms shall be placed parallel to the centerline of the bearing for skews up to and including 15 degrees and shall be placed perpendicular to the beam for skews greater than 15 degrees.

    Threaded inserts shall be cast into the box beams to connect the box beams and the exterior diaphragms.

    End diaphragms which are located at fixed bearings shall be the full depth of the box beams and shall be a minimum of 12 inches wide. Reference Guide PLATES 3.10-20 and 3.10-21 for more information. End diaphragms which are located at expansion bearings shall be 12 inches above the bottom of the beam and shall be a minimum of 12 inches wide. Reference Guide Sheet PLATE 3.10-22 for more information.

    Intermediate diaphragms shall be 12 inches above the bottom of the beam and shall be of minimum of 10 inches wide. Reference Guide Sheet PLATE 3.10-21 for more information. Pier diaphragms on structures continuous for live load shall be at least 8 inches wider than the positive restraint moment connection.

    All dimensions shall be perpendicular to the respective diaphragms. Reinforcing steel size, embedment and spacing shall be by design and shall be shown on the contract plans.

    Concrete for diaphragms shall be Class A conforming to Section 914 of the NJDOT Standard Specifications, and the quantity shall be included in the pay item "Concrete in Superstructure, Deck Slabs".

    Use of steel diaphragms is permitted. Standard Drawing number 2.4-5 provides details for intermediate steel diaphragms for prestressed concrete beams. This drawing may be studied for its suitability to the spread box beam concept.

11. When utilities are less than half the depth of the end diaphragm and are approximately centered in the diaphragm, they shall pass through the end diaphragm in a sleeve. Where multiple ducts pass between two beams, it might be necessary to cast a rectangular hole in the end diaphragm. Partial depth end diaphragms at expansion bearings can be lengthened for that purpose.

Utilities which are sleeved through end diaphragms should generally pass through the end diaphragm as close to the center as possible. Other utility arrangements not stated may require the end diaphragm to be shortened to a minimum depth of 18 inches and the utilities be hung from an adjacent support system.

In all cases, the designer shall secure approval from the representative of the utility company and the NJDOT Bureau of Structural Engineering for the location and method of support of all utilities.

12. If Stay-in-Place forms are utilized, weld anchors shall be embedded into each beam for the purpose of attaching the form support angles. Reference Bridge Construction Detail BCD-9 for more information.

13. Guide Sheet PLATES 3.8-14 and 3.8-15 contain armored joint details for box beams. Designers shall verify its use on a project to project basis. Modification to these details or a different design may be necessary to accommodate field conditions or for attachment to a thicker deck slab of 8½ inches minimum. Armored joint connection plate assembly spacing shall be limited to 4 feet center to center maximum.

14. For Epoxy Waterproofing Seal Coat limits, refer to Section 1.25.10.

15. Details shown in Guide Sheet PLATES 3.10-19 through 3.10-25 are for one-course bridge deck slabs. Modification to these details may be necessary for two-course deck slabs.

1.25.8 BEARINGS

(a) Subsection 1.24.20 of this Manual provides criteria for bearing systems that satisfy seismic needs. Such type bearing systems should be provided for all new prestressed concrete I Beam superstructure designs.

In the rehabilitation of existing prestressed concrete I-beam structures, that utilize steel rocker bearings, Section 45 of this Manual should be referred to for guidance in retrofitting such type bearings.

(b) Seismic considerations shall be determined in the design of bearing systems for prestressed slab and box beam bridges. Accordingly, Elastomeric bearing pads may be used for prestressed concrete slab and box beams. Elastomeric bearing pads may be designed in accordance with Section 14 of the current AASHTO LRFD Bridge Design Specifications. The nominal hardness for laminated (reinforced) bearing pads shall be 55 ± 5 durometers.

For the purpose of bearing design, the bridge site shall be classified as being in temperature Zone C and the elastomer shall be Grade 3.

1.25.9 CONTINUITY DESIGN FOR LIVE LOAD

1. The concept of continuity design for LL + I + DL2 load moments shall be considered for multi-span precast prestressed concrete I-beams and spread box beam designs unless foundation conditions preclude consideration of continuous design (see Subsection 1.24.3(c)). This concept shall not be considered for bridges where the skew angle is greater than 30 degrees.

2. Details of the concept, which illustrate the diaphragm at the pier, continuity rebars in the deck slab, positive restraint moment connection in the bottom of the prestressed concrete I-beam, and use of preformed elastomeric bearings are illustrated on Guide Sheet Plates 3.10-15 to 3.10-18.

3. Design shall be in accordance with Subsection 5.14.1.2.7 of the AASHTO LRFD Bridge Design Specifications.

4. A comparison of the concept indicates the following differences in details when compared to simple span design:

SIMPLE SPAN DESIGN for DL CONTINUOUS SPAN DESIGN for LL + I + DL2	**SIMPLE SPAN DESIGN for DL + LL +I +DL2**
Deck Slab:	**Deck Slab:**
N/A	Preformed elastomeric compression seal or glandular type strip seal.
N/A	Steel joint armor.
Continuity rebars.	N/A
Concrete placing sequence.	N/A
Deck Diaphragms at Pier:	**Deck Diaphragms at Pier:**
One Diaphragm, ______ " wide (depends on skew)	Two Diaphragms, 9 inches wide
PC I-Beams:	**PC I-Beams:**
Possible reduction in the beam size-force combination.	N/A
Possible fewer strands.	N/A
Positive restraint moment connection.	N/A

Bearings:	**Bearings:**
Refer to Subsection 1.24.20	Refer to Subsection 1.24.20
Width usually greater because of space needed between beams for positive restraint moment connection and bridge skew.	N/A
Keeper block.	N/A
N/A	Corrosion protected rebars (Epoxy coated, Stainless Steel or Galvanized)
N/A	Epoxy waterproofing seal coat.

5. The same size, number and arrangement of prestressed concrete beams shall be used within a series of spans made continuous for live load. Cut-off points for the continuity rebars in the cast in place deck slab shall be staggered in a minimum of three increments. A concrete deck slab placing sequence (see Subsection 1.20.9 of this Manual and Subsection 501.12 - 5 of the NJDOT Standard Specifications) shall be shown.

   When a two course deck slab is used, the transverse joint for the overlay shall be offset about 2 feet from the joint in the first course slab.

6. The principal reason for the possible use of this concept is the reduction in the number of deck slab joints rather than economy. Continuity design for live load may not be practical or economical for a bridge of a few short spans, but substantial economy could result for multiple (nine or more) spans between 80 and 110 feet.

7. If indicated as a possible alternative for the bridge type, the continuity design for live load concept shall be used for all prestressed concrete I-beams. The simple span design concept shall be used if approved by the Manager, Bureau of Structural Engineering, prior to the Preliminary submission.

8. Prestressed concrete slab and box beam bridges are generally utilized on short span structures. They are usually designed as simple spans for DL+ LL+ I+ DL2 with transverse deck slab expansion joints. Transverse cracking in the deck slab overlay at the pier is more likely to occur because of the shallow deck if the continuity concept is used in the construction.

   Generally, the continuity design for live load concept need not be considered for the typical adjacent slab and box beam bridges, but may be considered for the occasional multi-span bridge where long span/deep box beams are required or where seismic considerations warrant.

1.25.10 EPOXY WATERPROOFING SEAL COAT LIMITS

Prestressed concrete beams shall be treated with an epoxy waterproofing seal coat conforming to Subsection 912.07 of the NJDOT Standard Specifications for Road and Bridge Construction. The limits for sealer application shall be shown on the construction plans and shall conform to the following:

Beam Type	Areas to be Treated	Application limits (*), (**)
I-beams	Ends, sides bottoms	4 foot length from the beam and end for exterior surfaces and 8" length from the beam end for interior surfaces
Adjacent box beams, channel beams, voided slabs	Ends, bottoms and exterior face of fascia beams	4 foot length at the ends of beams subject to deck joint leakage
Spread box beams	Ends, sides and bottoms	4 foot length at the ends of beams subject to deck joint leakage

Epoxy waterproofing seal coating is not required for diaphragm connection areas.

As per bearing manufacturer's recommendations, epoxy waterproofing shall be omitted from the bearing contact area. This requirement shall be reviewed.

* For continuous bridges epoxy waterproofing seal coat shall be applied only to the beam ends located under or near deck joints.

** If the structure is located in a severe salt intrusion zone or a salt splash zone, (Zone 3A or 3B, see chart entitled "Zonal Areas of New Jersey Affected by Salinity" in Subsection 1.24.18 of this Manual) and is located less than 15 feet above the mean high salt water mark, the entire beam, along with both sides, bottom and ends shall be treated with epoxy waterproofing seal coat.

SECTION 26

REINFORCEMENT STEEL DETAILS

1.26.1 REINFORCEMENT PRESENTATION

a. SOFT METRIC REINFORCING BARS

Due to the past requirement of providing contract plans in metric units, the reinforcement steel industry shifted to stamping of reinforcement in soft metric size designations. As advised by the Concrete Reinforcing Steel Institute (CRSI) this practice is to continue for the foreseeable future.

Accordingly, it is important for Designers to be aware of this practice with respect to the detailing of soft metric reinforcing bars on contract plans. The term "soft metric" is used in the context of bar sizes and bar size designations. "Soft metric conversion" means describing the nominal dimensions of inch-pound reinforcing bars in terms of metric units, but not physically changing the bar sizes. In 1997, producers of reinforcing bars (the steel mills) began to phase in the production of soft metric bars. Within a few years, the shift to exclusive production of soft metric reinforcing bars was essentially achieved. Virtually all reinforcing bars currently produced in the USA are soft metric. Thus, USA-produced reinforcing bars furnished to any construction project will be in a soft metric designation. Therefore, to be consistent with what is delivered to Department projects, plan development must detail soft metric bar sizes.

Designation of Bar Sizes. The sizes of soft metric reinforcing bars are physically the same as the corresponding sizes on inch-pound bars. Soft metric bar sizes, which are designated #10, #13, #16, and so on, correspond to inch-pound bar sizes #3, #4, #5, and so on. The metric bar designations are simply a re-labeling of the inch-pound bar designations. The following table shows the one-to-one correspondence of the soft metric bar sizes to the inch-pound bar sizes.

SOFT METRIC BAR SIZES VS. INCH-POUND BAR SIZES

Soft Metric Bar Size Designation	Inch-Pound Bar Size Designation
#10	#3
#13	#4
#16	#5
#19	#6
#22	#7
#25	#8
#29	#9
#32	#10
#36	#11
#43	#14
#57	#18

Minimum Yield Strengths or Grades. Virtually all steel mills in the USA are currently producing reinforcing bars to meet the metric requirements for tensile properties in the ASTM specifications. Minimum yield strengths in metric units are 300, 350, 420 and 520 Mpa (megapascals), which are equivalent to 40,000, 50,000, 60,000 and 75,000 psi, respectively. Metric Grade 420 is the counterpart of Standard Grade 60.

Bar Marking. Soft metric reinforcing bars are required to be identified with the Producer's mill designation, bar size, type of steel, and minimum yield strength or grade.

Based on the fact that industry produces reinforcement steel bars in a metric size designation, Designers must indicate the metric bar size in plan sheet detailing. The following guidance shall also be followed in plan sheet preparation.

1.) On any plan sheet that presents the drawings for a portion of a bridge structure, such as a pier, all reinforcement bars pertinent to that pier shall be detailed and billed on that sheet (see Subsection 1.26.2 g. below).

2.) The same designation shall not be used to detail reinforcement steel that is of a different size, length or shape and that is to be placed in a substructure element or in a superstructure.

3.) When detailing lengths of reinforcement bars, consideration must be given to transportation and handling, and where extremely long lengths are contemplated, to availability and special orders.

4.) All sizes of bars are readily available in lengths up to 60 feet. However, #10 and #13 bars more than 40 feet long tend to bend in handling; therefore, they should be avoided. Sizes #16 through #57 in lengths exceeding 60 feet can be rolled at mills by special order. Seventy (70) feet should be considered the practical limit in any circumstance.

5.) When the location of bar splices is arbitrary, as in the case of the longitudinal reinforcement of deck slabs on stringers, the following maximum lengths are preferred:

#19 bars and up .... 50'-0"

#16 bars .... 39'-0"

#13 bars .... 30'-0"

b. Provide corrosion protected reinforcement for the following components:

- Deck slab, top and bottom mat
- Sidewalks, parapets, median barriers
- Haunch area
- Mild reinforcement in prestressed box and slab beams and in prestressed concrete beams
- Abutment backwall
- Grillage reinforcement in abutments and piers
- Footings dowels in corrosive environments
- Integral abutment relief slabs and sleeper slabs
- Precast culverts, precast arch and 3-sided precast culverts – top mats if fill Is less than two feet
- Cast in place culverts – top and bottom mats if top slab is used as riding surface
- Bottom one third of noise barrier panels, noise barrier posts and footing if located within roadway splash zone
- Pedestals and barrier pedestals of sign support structures

The above list shall not be considered all inclusive. The Design Manual should be studied for thorough guidance. Engineering judgement should also be used to aid in identifying where corrosion protected reinforcement may be helpful in protecting other components of the structure.

c. The current types of corrosion protected reinforcement permitted include the following:

- Epoxy coated
- Galvanized
- Stainless steel
- Stainless steel clad

While it is understood that epoxy coated reinforcement is the most commonly used, a Designer should evaluate site specific locations to assess if components of a bridge may warrant use of either of the other types stated above.

1.26.2 REINFORCEMENT DESIGNATION

a. To provide uniformity in all bridge plans, the following rebar designations shall be used:

A ....Abutments
C..Culverts
D..Dowels
F..Footings
P..Piers
S..Deck Slabs

SS.. Sidewalks
PP..Parapets

Use additional prefix letter or number when needed, i.e., NA for North Abutment, EA for East Abutment, 1 for Span 1, 2 for Pier 2, etc.

b. The following illustrates detailing notations:

25 - #16 - F1@ 18"

20 - #16 - W2 @ 18"

18 - #16 - W3 @ 18"

20 - #16 - 1S2 @ 6"

20 - #16 - 2S3 @ 6"

c. Explanation of abbreviations shall be noted on the plans.

LEGEND

(FF)	Indicates Front Face
(RF)	Indicates Rear Face
(T)	Indicates Top
(B)	Indicates Bottom

d. If it becomes necessary to provide varying length reinforcement bars to accommodate a flared condition on any part of a structure, do not detail the bars in a table of small increment changes in length; detail the bars in groups of the same length to accommodate the flare by variance of lap. All bars in the same group shall carry the same bar designation.

e. Bars may be detailed to the closest 1 inch of length and the mass of reinforcement bars shown in the Bill of Material shall be to the nearest ten (10) pounds.

f. The dimension of all laps shall be shown on the plans.

g. The Bill of Material shall be in the following form:

REINFORCEMENT STEEL – PIER #1				
No.	Mark.	Size	Length	Remarks
24	1P1	#25	15'-5"	Detailed
12	1P2	#25	30'-0"	Straight

When epoxy coating is required on rebars, "Epoxy Coated" shall be noted in the REMARKS column.

When galvanizing is required on rebars, "Galvanized" shall be noted in the REMARKS column.

When stainless steel is required on rebars, "Stainless Steel" shall be noted in the REMARKS column.

h. Bent bars shall be detailed with complete dimensions. Hooks and bends shall conform to the charts shown on Page 1.26-6.

i. Other reasonable systems of bar designations will be considered for approval on an individual basis.

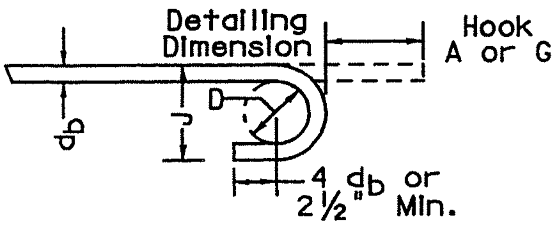
j. The Designer shall designate which corrosion protective system is to be used. Mixing of corrosion protection types in a single structural unit should be avoided.

REINFORCING BAR DATA

AASHTO M 31 CHART FOR REINFORCING STEEL BARS

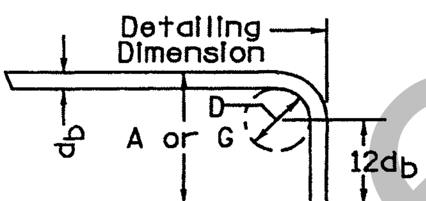
Bar Size Designation	Nominal Weight lb/ft	Nominal Dimensions: Diameter in.	Nominal Dimensions: Cross Sectional Area in.²
#10	0.376	0.375	0.11
#13	0.668	0.500	0.20
#16	1.043	0.625	0.31
#19	1.502	0.750	0.44
#22	2.044	0.875	0.60
#25	2.67	1.000	0.79
#29	3.4	1.128	1.00
#32	4.303	1.270	1.27
#36	5.313	1.410	1.56
#43	7.65	1.693	2.25
#57	13.6	2.257	4.00

STANDARD HOOKS DETAILS



D=Bend Diameter

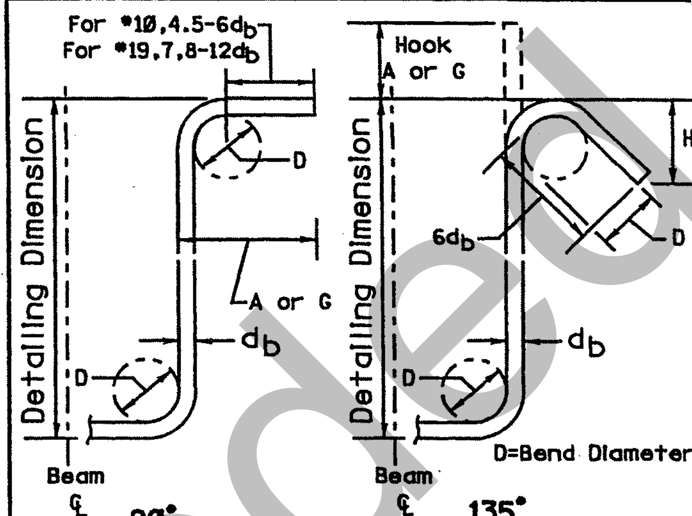
180°



90°

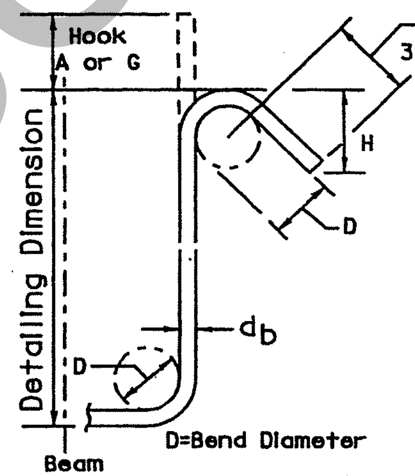
Bar Size Designation	180° A or G	180° J	180° D	90° A or G	90° D
	Dimensions of Standard Hooks, All Grades				
#10	5"	3 1/8"	2 3/8"	6"	2 3/8"
#13	6"	4"	3"	8"	3"
#16	7"	5"	3 3/4"	10"	3 3/4"
#19	8"	6"	4 1/2"	1'-0"	4 1/2"
#22	10"	7"	5 1/4"	1'-3"	5 1/4"
#25	11"	8"	6"	1'-5"	6"
#29	1'-3"	11 3/4"	9 1/2"	1'-7"	9 1/2"
#32	1'-5"	1'-1 3/8"	10 7/8"	1'-10"	10 7/8"
#36	1'-7"	1'-2 3/4"	1'-0"	2'-0"	1'-0"
#43	2'-2"	1'-9 1/2"	1'-6"	2'-7"	1'-6"
#57	2'-11"	2'-4 1/2"	2'-0"	3'-6"	2'-0"

STIRRUP HOOKS



STIRRUPS (TIE BENDS SIMILAR)

SEISMIC STIRRUP/TIE



135°

Bar Size Designation	D (in.)	135° H* (in.)	135° A or G (in.)	90° A or G (in.)	135° Seismic Hook A or G (in.)	135° Seismic Hook H* (in.)
#10	1 1/2	2 1/2	4	4	4 3/8	3
#13	2	3	4 1/2	4 1/2	4 1/2	3
#16	2 1/2	3 3/4	5 1/2	6	5 1/2	3 3/4
#19	4 1/2	4 1/2	8	12	8	4 1/2
#22	5 1/4	5 1/4	9	14	9	5 1/4
#25	6	6	10 5/8	16	10 5/8	6

*H dimension is approximate.

THE DATA SHOWN ABOVE IS BASED ON CONCRETE REINFORCING STEEL INSTITUTE IN CONFORMANCE WITH THE ACI BUILDING CODE (ACI 318-95).

SECTION 27

CLASSES OF CONCRETE

1.27.1 THE NJDOT STANDARD SPECIFICATIONS

The NJDOT Standard Specifications for Road and Bridge Construction provide the following classes of concrete for the various items of work of concrete structures:

Structural Concrete Items / Cast-in-Place Items	Concrete Class	Design Compressive Strength
Nonreinforced Footing	B	3000 psi
Reinforced Footings	B	3000 psi
Abutments, Walls Solid Shaft Piers, Pylons	B	3000 psi
White Concrete Barrier Curb, Bridge	B	3000 psi
Piles	B	3000 psi
Columns and Caps for Piers, Arch Spans, Rigid Frames, Culverts	A	4000 psi
Decks, Sidewalks, Concrete Patch, Parapets, Curbs	A	4000 psi
Seal (Tremie) Concrete	B	3000 psi
Prestressed Items		
Beams	P, P-1 & P-2	*
Posts	P, P-1 & P-2	*
Piles	P	*
* P=5000 psi, P-1 =5500 psi, P-2=6000 psi		
Precast Items		
Crib Wall Members	A	4000 psi
Piles	B	3000 psi
Culverts	P	5000 psi
Proprietary Retaining Wall Members	P	5000 psi
Noise Barriers	P	5000 psi
Posts	P	5000 psi
Others		
Concrete Slope Protection*	C	3000 psi

* This item is located in Table 914-1 under Roadway Concrete Items.

The classes of concrete for the various structure components shall be noted on the plans.

SECTION 28

BRIDGE LIGHTING

1.28.1 GENERAL REQUIREMENTS

1. The Department's Traffic Signal and Safety Engineering Unit will determine the need for lighting (or provisions for future lighting) on an individual project/structure basis.

2. When preliminary bridge plans are submitted in accordance with Section 7 of this Manual, one copy of the General Plan and Elevation sheet will be submitted to the Traffic Signal and Safety Engineering Unit for review of the bridge plan and noting of the electrical requirements thereon.

3. If light standards are to be located on the bridge as part of the project (or in a future contract), provisions shall be made in the parapet for a concrete boss with the circle of anchor bolts embedded therein.

4. A 2 foot – 8 inch high parapet and a 2 foot – 10 inch barrier require a 11½" bolt circle.

5. Light standards shall not be located in the midspan range. They shall be located as near to a support as practical to reduce the effect of vibrations caused by live load.

SECTION 29

GORE AREAS ON BRIDGES

1.29.1 GENERAL CRITERIA

a. Page 1.29-3 establishes guidelines for reserve area for the possible installation of impact attenuator devices in gore locations.

b. Guide rails and bridge rails are designed to handle glancing blows. Head on vehicular impacts which occur at gore areas may cause serious damage to vehicles or injury to motorists.

c. The development of cushioning, or energy dissipating devices are required in front of hazardous fixed objects.

d. The sketch on Page 1.29-3 shows dimensions to be used in determining if adequate space is available for installation of an impact attenuator device. The Table on page 1.29-3 shows a range of dimensions the significance of which is as follows:

Minimum

Restricted Conditions - These dimensions approximately describe the space required for installation of the current generation of impact attenuator devices without encroachment on shoulders and with the nose of the device offset slightly back of the parapet or shoulder line.

However, there are impact attenuators that will not fit in the space provided by these dimensions.

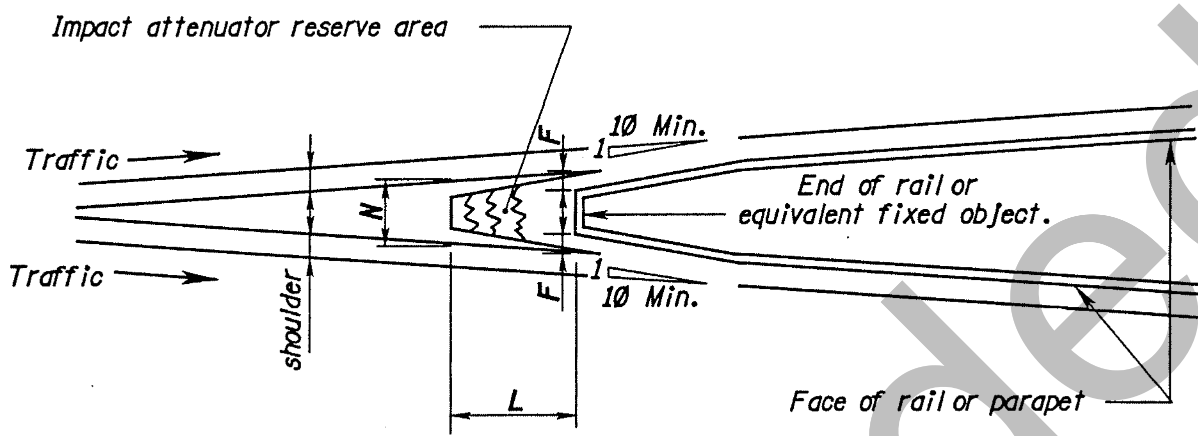
Unrestricted Conditions - These dimensions should be considered as the minimum for all projects except for those sites where it can be shown that the increased cost for accommodating these dimensions, as opposed to those for restricted conditions, will be unreasonable.

(For example, if the use of the greater dimensions would require the demolition of an expensive building or a considerable increase in construction costs, then the lesser dimension might be considered).

Preferred

These dimensions, which are considerably greater than required for the present generation of impact attenuator devices, should also be considered optimum.

There is no intention to imply that if space is provided in accordance with these dimensions that the space will be fully occupied by an impact attenuator device. The reason for proposing these dimensions is so that, if experience shows that devices should be designed for greater ranges of vehicle weights and/or for lower deceleration forces, there will be space available for installation of such devices in the future. In the meantime, the unoccupied reserved impact attenuator space will provide valuable additional recovery area.



DESIGN SPEED ON MAINLINE (M.P.H.)	DIMENSION FOR IMPACT ATTENUATOR RESERVE AREA ON NEW CONSTRUCTION (FEET)								
	MINIMUM						PREFERRED		
	RESTRICTED CONDITIONS			UNRESTRICTED CONDITIONS					
	N	L	F	N	L	F	N	L	F
30	6	8	2	8	11	3	12	17	4
50	6	17	2	8	25	3	12	33	4
70	6	28	2	8	45	3	12	55	4
80	6	35	2	8	55	3	12	70	4

NOTE:

For intermediate design speeds, use the values for the higher design speed (i.e., for design speed of 40 M.P.H use values for 50 M.P.H design speed)

Reference N.J.D.O.T. Design Manual for Roadway.

SECTION 30

CULVERTS AND ARCHES

1.30.1 DESIGN CRITERIA

1. As stated on page 1.3-23 of this Manual, the design of cast-in-place concrete culverts shall conform to Subsection 12.11 of the AASHTO LRFD Design Specifications.

2. The design of precast concrete culverts and arch sturctures items shall be based on the Allowable Stress Method of the existing AASHTO Standard Specifications for Highway Bridges.

3. Designers may advance the use of precast concrete member usage. That is, it is not necessary to establish alternate methods of culvert construction to meet project specific requirements. Use of precast concrete box culverts, precast concrete arch structures or three (3) sided precast concrete structures is permitted.

1.30.2 WATERWAY OPENINGS

1. For establishing waterway openings, reference for guidance shall be made to the following documents:

   - AASHTO LRFD Bridge Design Specifications Article 2.6
   - AASHTO Model Drainage Manual
   - U.S. Department of Transportation, Federal Highway Administration, Publication No. FHWA HI-96-032 November, 1995, Hydraulic Engineering Circular No. 20
   - The NJDEP Stream Encroachment Technical Manual

2. Reference is directed to Section 17 of the NJDOT Procedures Manual concerning Permit acquisition. Preliminary bridge drawings will not be accepted until applicable Permit requirements have been completed.

1.30.3 HYDRAULIC AND HYDROLOGIC DATA

1. The following tabulation with complete information shall be shown on preliminary bridge plans and final bridge plans:

HYDRAULIC AND HYDROLOGIC DATA	
DRAINAGE AREA (SQ.MI)	
DESIGN DISCHARGE (C.F.S.)	
DESIGN WATER SURFACE ELEVATION (FT)	
ENERGY LINE ELEVATION (FT)	
FREQUENCY	100 YR.

2. All culverts shall be designed, through methods outlined in Section 46 of this Manual, to resist scour.

1.30.4 GENERAL

1. For cast-in-place reinforced concrete box culverts, the horizontal joint between the walls and top slab shall be designated OPTIONAL CONSTRUCTION JOINT when the height between the upper and lower horizontal joints is 8 feet or less. The construction specifications provide that if the Contractor elects to omit the joint, he shall delay placing the concrete in the top slab for at least 2 hours after the concrete in the walls has been placed.

   In addition, the joint between the invert slab and the side walls shall be detailed as a construction joint, and the invert slab concrete shall achieve a minimum compressive strength of 3000 psi prior to the construction of the remainder of the culvert.

2. Wingwall footings at their junction with the invert slab shall be detailed without a construction or contraction joint so that the footing concrete is placed monolithically with the invert slab.

3. Large storm drains (2 feet diameter or larger) shall not be discharged through walls of culverts in order to minimize adverse hydraulic characteristics. Otherwise, the Structural Design Engineer shall obtain an approval from the Manager, Bureau of Structural Engineering and concurrence from the Manager, Hydraulic Design Unit if this stipulation provides excessive burden.

4. The illustration on Guide Plate 3.12-4 shows guidelines for establishing excavation payment limits for roadway and bridge items of work.

5. Guide Plates 3.12-1 and 3.12-2 provide guidelines for developing uniform details on contract drawings for single and twin cell box culverts, respectively. The designer shall design and detail the culvert on the plans assuming cast-in-place concrete construction.

6. The Special Provisions for select projects (such as where staging is required or where limited construction time is essential to restore normal vehicular or rail traffic) may require precast culvert construction.

   In such cases, the Structural Design Engineer shall select opening sizes for the cast in place concrete culvert which are obtainable in standard precast concrete sections. A partial listing of standard precast sizes are shown on the next page. The Designer shall contact various local precasters to obtain the latest information on standard precast culvert sizes that are commercially available.

Height by Width in Feet

4 by 8	4.5 by 8	5 by 8	5.5 by 8	6 by 8
4 by 10	4.5 by 10	5 by 10	5.5 by 10	6 by 10
4 by 12	4.5 by 12	5 by 12	5.5 by 12	6 by 12
4 by 14	4.5 by 14	5 by 14	5.5 by 14	6 by 14
4 by 16	4.5 by 16	5 by 16	5.5 by 16	6 by 16
4 by 18	4.5 by 18	5 by 18	5.5 by 18	6 by 18
4 by 20	4.5 by 20	5 by 20	5.5 by 20	6 by 20
4 by 22	4.5 by 22	5 by 22	5.5 by 22	6 by 22

7. Provisions for a low flow fish passage in the form of a fish trough or other means may be required for culverts in certain locations. The NJDOT Project Manager will notify the designer of a need for a low flow fish trough during the permit review process prior to the development of the Final design. design. For specific requirements and exceptions refer to N.J.A.C. 7:13-3.14, fish passage in the "Technical Manual for Stream Encroachment" from the New Jersey Department of Environmental Protection.

8. In order to increase the inlet performance and for improved flow through the culvert, the bottom of inner top slab and walls edges shall be beveled as follows at the entrance of the culvert:

   a. For single cell box culverts, a 45 degree bevel of ½ inch per foot of culvert clear height shall be provided for the top slab and bottom edge of the culvert entrance. A 45 degree bevel of ½ inch per foot of culvert clear width shall be provided for both side walls and inside edges of the culvert waterway entrance.

   b. For twin cell box culverts, in addition to the bevels specified above, the center wall shall have a 45 degree of 2½ inches on both sides. This is based on a minimum 8 inch wall thickness. For every 1 inch increase in the center wall thickness, there shall be a ½ inch increase of the bevel on both sides.

1.30.5 DESIGN CRITERIA FOR PRECAST REINFORCED CONCRETE BOX SECTIONS FOR CULVERTS

1. Precast reinforced concrete box sections shall not be used where the top slab is to be used as a riding surface.

2. Precast reinforced concrete box culverts shall be designed by the service load design method (allowable stress design) in accordance with Division 1, Section 16.7 of the AASHTO Standard Specifications for Highway Bridges (including current Interims).

3. Live load shall conform to AASHTO HS20+25% or an alternate military loading of two axles 4 feet apart with each axle weighing 24,000 pounds, whichever produces the greatest stress. For Non-Federal Aid Highways with

Average Daily Truck Traffic (ADTT) less than 500, alternative design criteria, as specified in Section 44 of this Manual, shall be used.

4. Dead load shall include 25 pounds per square foot for future application of a 2 inch thick wearing surface when the earth fill above the top of culvert is less than 2 feet.

5. Headers, cut-off walls, wingwalls, footings and aprons shall be designed by the allowable stress design method in accordance with the AASHTO Standard Specifications for Highway Bridges (including current interims).

6. Concrete for precast concrete elements shall be Class "P" in accordance with Table 914-2 of the NJDOT Standard Specifications, and have a minimum design compressive strength of f'_c = 5000 psi.

7. The minimum concrete cover over the circumferential reinforcement shall be 1½ inches except on the exterior side of the top slab where it shall be 2 inches.

8. The wall thickness for precast culverts shall be a minimum of 8 inches. The top and bottom slab thickness shall be a minimum of 10 inches. Dependent on project site conditions these thicknesses may be reduced. Any reduction must account for an adherence to concrete cover requirements and provision of required reinforcement size and distribution. Calculations shall be provided and shall account for the reduction.

9. A flexible watertight rubber gasket shall be provided at the joint between the precast units. The gasket shall be continuous around the circumference of the joints. Details of the transverse joint between the culvert sections shall be provided on the plans.

10. A coarse aggregate layer shall be provided under the precast reinforced concrete box culvert sections. The depth of the coarse aggregate layer shall be a minimum of 2 feet. It shall extend 1 foot on each side of precast reinforced concrete box culvert section.

11. A waterstop shall be provided to prevent water from entering vertical joints between the end of precast culvert sections and any cast-in-place appurtenances such as wingwalls, cutoff walls, aprons and cast-in-place culvert end sections.

12. Two rows of threaded inserts or bar extensions (longitudinal tie bolts) shall be provided in the end culvert section to facilitate the attachment of the culvert end section to the wingwalls. A detail of this connection shall be provided on the plans.

13. As per item 12, provide the same detail, if applicable, for the headwall attachment.

14. If precast concrete units are used in parallel for multicell installations, the parallel units shall be placed a maximum of 6 inches apart. The 6 inch space between the units shall be filled in conformance with the Standard Specifications. The purpose of this procedure is to ensure a positive means of lateral support between the parallel precast units.

15. The use of precast concrete end sections, including headwalls and wingwalls, are permitted.

    However, precast end sections shall not be used when the skew angle requirements result in a situation where the short wall of a precast end section is less than 3 feet.

    If approved for use, adequate provisions shall be made for cast in place appurtenances such as wingwalls, aprons and cutoff walls.

16. The top mat of reinforcement, and ties, in the top slab shall be corrosion protected when the earth fill over the precast culvert is less than 2 feet.

17. Lifting devices or holes will be permitted in each box section for the purpose of handling and erection. All lifting holes shall be filled with nonshrink grout, after the grout has cured, the area shall be coated with an epoxy waterproofing seal coat.

18. Placement of precast units:

    - The precast units shall be pulled against the prior installed section such that an adequate seal is obtained between the two connecting units and the rubber gasket.
    - Prior to backfilling, a 2 foot wide strip of filter fabric shall be placed over the top and side transverse joints.
    - To provide continuity and concrete shear transfer between the precast box sections, a longitudinal tie rod or prestressing strand shall be placed in position through a 1½ inch diameter hole.
    - Four (4) longitudinal ties, one in each corner of the precast section, shall be provided.
    - Longitudinal ties that are used to tie the precast units together shall be ¾ inch diameter high tensile strength steel bars conforming to AASHTO M 275M (ASTM A 722) Type I or ½ inch 7 wire Grade 270 ksi strands conforming to AASHTO M 203M (ASTM A 416) or equivalent. The Designer shall evaluate the practicality of using steel bars. Issues such as needed length and shipping may preclude the use of steel bars. Under such circumstances wire strands will be more practical.
    - No splices are permitted in the strands. Bars shall be galvanized in accordance with AASHTO M 111.
    - End anchorages (nuts, washers and anchor plates) shall be compatible with the tie rod system and shall be galvanized in accordance with AASHTO M 111.

- The anchorages and end fittings for the ½ inch 7 wire strand and the corrosion protection method shall be detailed on the plans.
- Each tie rod shall be stressed to a tension of 30 kips.
- After tensioning, the exposed ends of the ties shall be removed so that no part of the ties, or of the end fittings, extend beyond a point 1 inch inside the anchorage pocket.
- All hardware associated with the end anchorage systems shall be galvanized. After tensioning has been completed the exposed parts of the end fittings shall be coated with two coats of bituminous paint.
- If hand holes are used for the installation of longitudinal ties, they shall be spaced appropriately.

19. The precast reinforced concrete culvert units shall be manufactured in steel forms and steam cured in conformance with Subsection 501.12 (Subpart 17) of the NJDOT Standard Specifications.

20. Precast reinforced concrete culvert units shall not be shipped until 72 hours after fabrication and the 28 day compressive strength requirement is met.

21. Precast reinforced concrete culvert units shall be given one coat of an epoxy waterproofing seal coat on the exterior of the roof slab. This coating shall be provided at the precasting plant. In addition, any top slab hand hole pockets or lifting holes, which are grouted in the field, shall received one coat of epoxy waterproofing seal coat after the grout has properly cured.

22. All working drawings shall conform to the format specified in Subsection 105.04 of the NJDOT Standard Specifications.

23. The materials used for precast concrete box culverts shall conform to the current edition of the New Jersey Department of Transportation Standard Specifications for Road and Bridge Construction and applicable sections of the Special Provisions.

    Reinforcement steel shall conform to AASHTO M31M/M31, Grade 60. Welded deformed steel wire fabric, conforming to AASHTO M221M/M221 and having a diameter of at least 3/8 inches may be substituted for deformed bars.

    Longitudinal tie bolts, where utilized, shall conform to the requirements of current ASTM designation A307 and shall be hot-dip galvanized after fabrication, including threading in accordance with the requirements of current ASTM A153.

    Concrete for precast culverts shall conform to Section 914 of the NJDOT Department of Transportation Standard Specifications for Road and Bridge Construction, except that Coarse aggregate shall be washed gravel or broken stone of Argillite, Granite, Gneiss, Quartzite or Trap Rock, conforming to the requirements of Section 901 and shall be graded as specified for standard

Height by Width in Feet

4 by 8	4.5 by 8	5 by 8	5.5 by 8	6 by 8
4 by 10	4.5 by 10	5 by 10	5.5 by 10	6 by 10
4 by 12	4.5 by 12	5 by 12	5.5 by 12	6 by 12
4 by 14	4.5 by 14	5 by 14	5.5 by 14	6 by 14
4 by 16	4.5 by 16	5 by 16	5.5 by 16	6 by 16
4 by 18	4.5 by 18	5 by 18	5.5 by 18	6 by 18
4 by 20	4.5 by 20	5 by 20	5.5 by 20	6 by 20
4 by 22	4.5 by 22	5 by 22	5.5 by 22	6 by 22

7. Provisions for a low flow fish passage in the form of a fish trough or other means may be required for culverts in certain locations. The NJDOT Project Manager will notify the designer of a need for a low flow fish trough during the permit review process prior to the development of the Final design. design. For specific requirements and exceptions refer to N.J.A.C. 7:13-3.14, fish passage in the "Technical Manual for Stream Encroachment" from the New Jersey Department of Environmental Protection.

8. In order to increase the inlet performance and for improved flow through the culvert, the bottom of inner top slab and walls edges shall be beveled as follows at the entrance of the culvert:

   a. For single cell box culverts, a 45 degree bevel of ½ inch per foot of culvert clear height shall be provided for the top slab and bottom edge of the culvert entrance. A 45 degree bevel of ½ inch per foot of culvert clear width shall be provided for both side walls and inside edges of the culvert waterway entrance.

   b. For twin cell box culverts, in addition to the bevels specified above, the center wall shall have a 45 degree of 2½ inches on both sides. This is based on a minimum 8 inch wall thickness. For every 1 inch increase in the center wall thickness, there shall be a ½ inch increase of the bevel on both sides.

1.30.5 DESIGN CRITERIA FOR PRECAST REINFORCED CONCRETE BOX SECTIONS FOR CULVERTS

1. Precast reinforced concrete box sections shall not be used where the top slab is to be used as a riding surface.

2. Precast reinforced concrete box culverts shall be designed by the service load design method (allowable stress design) in accordance with Division 1, Section 17.7 of the AASHTO Standard Specifications for Highway Bridges (including current Interims).

3. Live load shall conform to AASHTO HS20+25% or an alternate military loading of two axles 4 feet apart with each axle weighing 24,000 pounds, whichever produces the greatest stress. For Non-Federal Aid Highways with

Average Daily Truck Traffic (ADTT) less than 500, alternative design criteria, as specified in Section 44 of this Manual, shall be used.

4. Dead load shall include 25 pounds per square foot for future application of a 2 inch thick wearing surface when the earth fill above the top of culvert is less than 2 feet.

5. Headers, cut-off walls, wingwalls, footings and aprons shall be designed by the allowable stress design method in accordance with the AASHTO Standard Specifications for Highway Bridges (including current interims).

6. Concrete for precast concrete elements shall be Class "P" in accordance with Table 914-2 of the NJDOT Standard Specifications, and have a minimum design compressive strength of f'_c = 5000 psi.

7. The minimum concrete cover over the circumferential reinforcement shall be 1½ inches except on the exterior side of the top slab where it shall be 2 inches.

8. The wall thickness for precast culverts shall be a minimum of 8 inches. The top and bottom slab thickness shall be a minimum of 10 inches. Dependent on project site conditions these thicknesses may be reduced. Any reduction must account for an adherence to concrete cover requirements and provision of required reinforcement size and distribution. Calculations shall be provided and shall account for the reduction.

9. A flexible watertight rubber gasket shall be provided at the joint between the precast units. The gasket shall be continuous around the circumference of the joints. Details of the transverse joint between the culvert sections shall be provided on the plans.

10. A coarse aggregate layer shall be provided under the precast reinforced concrete box culvert sections. The depth of the coarse aggregate layer shall be a minimum of 2 feet. It shall extend 1 foot on each side of precast reinforced concrete box culvert section.

11. A waterstop shall be provided to prevent water from entering vertical joints between the end of precast culvert sections and any cast-in-place appurtenances such as wingwalls, cutoff walls, aprons and cast-in-place culvert end sections.

12. Two rows of threaded inserts or bar extensions (longitudinal tie bolts) shall be provided in the end culvert section to facilitate the attachment of the culvert end section to the wingwalls. A detail of this connection shall be provided on the plans.

13. As per item 12, provide the same detail, if applicable, for the headwall attachment.

size No. 57 or 67.

24. Reference Subsection 1.30.4, Item 8 for guidelines concerning beveling inner edges of the culvert entrance.

25. Standard Drawings 2.11-1 through 2.11-5 provide detailing for precast concrete box culvert items. These drawings may be used to prepare contract plans.

1.30.6 PRECAST CONCRETE ARCH STRUCTURES

1. Precast concrete arch structures are a cost effective solution to short span bridges or tunnels. The system includes precast arch elements, and precast wingwalls that are founded on cast-in-place footings.

2. The design of precast concrete arch structures shall be based on the current AASHTO Standard Specifications for Highway Bridges.

3. Working drawings shall be provided for the design of such structures. The drawings shall provide the following detailing:

   a. Plan, Elevation and Section views of the arch units. Also, details for all appurtenances; such as, wingwalls and headwalls and details of the joint sealing method between the units shall be indicated.

   b. Erection details that indicate handling points, section lengths, profiles and dimensions of each unit, reinforcement layout and lifting loads.

4. Hydraulic data, as indicated in Subsection 1.30.3, shall be provided by the Designer. This will facilitate the design of the precast concrete arch structure. The precast units shall be designed with a minimum concrete compressive strength of 5000 psi (Class P concrete).

5. When the earth cover over the arch units is less than 2 feet, corrosion protected reinforcement shall be provided in the outside/top of reinforcement.

6. The concrete cover over the reinforcement steel shall be 2 inches on the outside face of the arch unit and 1½ inches on the inside face.

7. The arch units shall be founded on cast-in-place concrete footings that conform to Class B concrete. The footing shall be a monolithic body either through a single concrete pour or tied together by construction joints.

1.30.7 PRECAST REINFORCED CONCRETE THREE-SIDED STRUCTURES

1. The design of such precast structures shall conform to the criteria of Subsection 17.8 of the AASHTO Standard Specifications for Highway Bridges.

2. Precast unit thicknesses and concrete cover stipulations shall conform to the respective requirements that are provided in Subsection 1.30.5 for precast box culverts.

3. Other requirements stated in Subsection 1.30.5 for concrete class, watertight rubber gaskets, waterstops and corrosion protected reinforcement reinforcement location shall be applied for the design of three-sided precast concrete structures.

4. Concrete foundation requirements shall be the same as those stated in Item 6. of Subsection 1.30.6.

SECTION 31

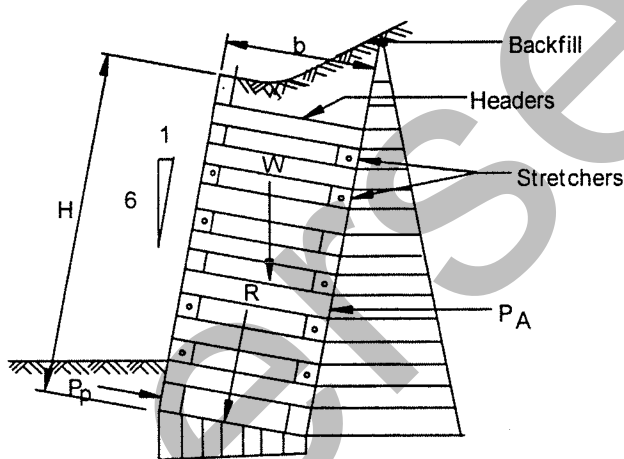
CRIB WALLS

1.31.1 DESIGN AND DETAILS

a. Subsection 7.6.3 of the AASHTO LRFD Bridge Construction Specifications provides criteria for material designation and installation of Crib Walls.

b. Reinforced concrete crib walls may be considered for use where yielding foundation material is indicated and it is not scheduled to be removed under roadway items of work and where aesthetics is not a factor.

c. Design criteria for gravity walls apply. The wall section resisting overturning is taken as a rectangle of dimensions (H x b). The mass of the crib is equal to that of material within (H x b) including the mass of crib members.



TYPICAL SECTION

d. Low walls (4 feet high and under) may be detailed with a plumb face. Higher walls are battered on the face at least 2 inches per foot. For high walls (12 feet high and over) the batter is increased or supplemental cribs are added at the back.

e. Closed face crib walls shall be used in all cases. Expansion joints shall be spaced no more that 90 feet apart. Double headers shall be used at expansion joints and at changes in alignment.

f. The wall should not be laid up higher than 3 feet above the level of the fill within the crib.

g. No special requirements for drainage and frost action are required. The wall should be free draining.

h. For design of structural elements against applied pressures, refer to SEELYE's Foundations Design and Practice publication.

i. Where foundations conditions are especially adverse, a special sill unit to spread the load or cast-in-place concrete spread footing is recommended.

j. Pay items for concrete crib wall shall be as specified in the NJ Standard Specifications for Road and Bridge Construction (Section 516).

k. Rebars shall be used for reinforcement. Wire mesh will not be permitted.

l. Contract plans shall include a plan, elevation, sections, and fully dimensioned details of headers and stretchers.

m. The NJ Standard Specifications for Road and Bridge Constructions permit the Contractor to propose use of crib members with dimensions different than those shown on a set of plans. These units are commonly referred to as "King Size". Header spacing is 8 feet instead of 6 feet and dimensions of the members are slightly larger. Working Drawings shall be checked accordingly.

SECTION 32

SIGN SUPPORT STRUCTURES (OVERHEAD AND CANTILEVER)

1.32.1 GENERAL DESIGN CRITERIA

a. The current NJDOT Standard Sign Support Structure designs have been completed in accordance with the 1994 edition of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals and the 1996 AASHTO Standard Specifications for Highway Bridges with the following modifications:

FUNCTIONAL REQUIREMENTS

Vertical Clearance for Sign Support Structures.

Minimum vertical underclearance for overhead and cantilever sign support structures shall be 17 ft. 9 inches.

WIND LOAD

The existing Standard Drawings have been developed with a design wind velocity of 80 miles per hour.

ALLOWABLE UNIT STRESS

The allowable stresses utilized for aluminum alloy members is in accordance with the publication titled "Aluminum Design Manual - Specifications and Guidelines for Aluminum Structures."

b. Fatigue Resistance

Fatigue is a complex phenomenon that is governed by factors that are highly variable and difficult to quantify. The provisions of the AASHTO Standard Specifications for Highway Bridges for structural fatigue design are based upon a nominal stress approach in which details are grouped into categories according to their relative fatigue resistance. An allowable range of stress is specified for each category.

The fatigue stress range resulting from application of the fatigue load described below shall be less than the allowable stress range for the particular detail. Most common details are categorized in Section 10.3 of the AASHTO Standard Specifications for Highway Bridges.

The maximum stress range for these details is tabulated as the fatigue strength for greater than two-million cycles. The fatigue limit for details on tubular connections is given in AWS D1.1 Structural Welding Code - Steel.

Other details and the applicable fatigue stress category are provided in the above referenced AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

c. For Overhead Sign Support Structures, see Sign Structure Drawings OH-G1 to OH-G6 of the General Design Criteria and Standard Drawings for Overhead and Cantilever Sign Support Structures, 2002 Edition, set of drawings to obtain design information and instructions for developing Sign Structure Drawings OH-D1 to OH-D10 as Contract Plans.

d. For Cantilever Sign Support Structures, see Sign Structure Drawings CA-G1 to CA-G5 of the General Design Criteria and Standard Drawings for Overhead and Cantilever Sign Support Structures, 2002 Edition, set of drawings to obtain design information and instructions for developing Sign Structure Drawings CA-D1 to CA-D8 as Contract Plans.

e. See Section 33 of this Manual for criteria concerning Bridge Mounted Sign Support Structures.

1.32.2 VARIABLE MESSAGE SIGN (VMS) SUPPORT STRUCTURES

a. Initially, the NJDOT Standard Overhead and Cantilever Sign Support Structure Drawings shall be studied to determine if member sizes therein can be used for VMS support structure member selection.

b. If it is determined that support structures cannot be provided by use of the Standard Drawings, the design of Overhead and Cantilever sign support Variable Message Sign (VMS) structures shall conform to the following publications and to the criteria stated under Item d. below:

- AASHTO LRFD Bridge Design Standard Specifications.
- The 2001 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, with current Interims.
- American Welding Society - Structural Welding Code - Steel (Current Edition)

c. The use of walk in type VMS boxes is not recommended. Generally walk in type boxes are 4 feet wide and 10 feet high. This size and subsequent weight result in support structures that may be difficult to fabricate and construct. Current technology should be studied in selecting VMS message boards. Advances in technology have resulted in smaller message boards that can be installed on smaller support structures.

d. The following guidance shall be followed in designing and developing contract documents for the construction of VMS sign support structures:

- A fatigue analysis, based on criteria specified in the above referenced 2001 AASHTO Specifications, shall be performed to determine adequate member sizes using three dimensional modeling. For Cantilever sign structures, all joints shall be assumed to be rigid. The greatest sign area shall initially be considered for use.

- Fixed message signs, on a project to project basis, will be permitted on Overhead VMS sign support structures only. Accordingly, the General Notes for overhead VMS sign support structures shall indicate the sign area for which the VMS Structure has been designed, and the sign design area that can be accommodated by the remaining truss area.

- To accommodate the potential future placement of fixed message signs, the minimum vertical underclearance, that is to be considered for the placement of the VMS board, shall be 26 feet to the centerline of the truss. This is considerate of a fixed message sign design height of 15 feet and the 17 feet – 9 inches minimum vertical underclearance to the lower limit, if erected, of the maintenance walkway. If a maintenance walkway is not erected, the minimum vertical underclearance shall be to the bottom of the sign board.

- VMS boards shall be centered vertically between the upper and lower truss chord members.

- The horizontal distance from the centerline of the truss chords to the center of gravity of the VMS board shall be minimized.

- Cantilevered VMS sign support structures shall be designed to accommodate one VMS board only. A note to this effect shall be provided in the General Notes portion of the contract plans.

- If desired, a maintenance walkway may be provided.

e. Upon determination of required member sizes, a fatigue analysis shall be performed on all the members and connections. As per the criteria in Subpart f. below, natural wind gusts, truck induced gusts and galloping induced gusts shall be applied. The following guidance may be followed:

- One possible method that may be used to determine design forces would be to load the sign structure model to theoretical failure, as determined by the chords and posts, and designing the strut to chord connections based upon the forces in the strut at that load.

- Fatigue categories for the gusset plate/chord connection shall be as follows:

For the chord:	Category D (Transition > 2 inches)
	Category E (Transition ≤ 2 inches)

For the gusset plate itself: Category ET - the plate and end weld must be checked regarding punching shear criteria.

- For the cantilever VMS sign structure, all three phenomena shall be applied. For the overhead VMS sign structure, the natural wind gusts and truck induced gusts phenomena need only be applied.

- For the truck induced gust loads, no lane load reduction factor need be applied.

- For cantilever VMS sign structures, truck induced gusts shall be applied to the full length of the bottom face of the VMS board, and to the projected area of the bottom chord, the walkway and any miscellaneous attachments that are exposed to the roadway below. Wind forces acting on truss members that are beyond the bottom face of the truss are not to be accounted for.

- For overhead VMS sign structures, truck induced gusts shall be applied to the middle 36 foot length of the truss. This will include the full length of the bottom face of the VMS board, to the projected area of both bottom chords, the bottom diagonals and the bottom struts, the walkway, and to any miscellaneous attachments that are exposed to the roadway below. Wind forces acting on truss members that are beyond the bottom face of the truss are not to be accounted for.

- Gusset plates should be designed for actual bending stresses and checked against allowable stresses.

- For the slotted tube-to-gusset connection detail, the combined stress of axial as well as bending shall be used to determine the fatigue stresses.

- All chord splices are to be designed in accordance with AASHTO criteria. As such, the chord splices and stub to post connections shall be designed for the average of the actual and allowable stresses in the chords, but not less than 75% of the member's capacity.

f. Upon completion of the initial fatigue analysis, if member sizes are determined to be inadequate, new sizes shall be selected and a new analysis shall be made. In performing each analysis, the following guidance may be applied:

1). General Design

VMS sign support structures should be designed for deflection and strength using the load combinations in accordance with the current Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, including dead load plus maximum wind load.

2). Vibration and Fatigue Design

In addition to the strength design, all structural details must be checked for fatigue resistance, computing nominal stress ranges at the details, and assuring that the stress ranges are less than the constant-amplitude fatigue limits for the particular details. This should ensure an essentially infinite life.

3). Fatigue Loads

As discussed in Section 11 of the herein referenced 2001 AASHTO Specifications, four wind loading phenomena (vortex shedding, galloping, natural wind gusts, and truck-induced wind gusts), have been identified in causing large-amplitude vibrations and fatigue failure in sign, signal and luminaire support structures.

As overhead support structures are far less flexible, only natural wind gusts and truck-induced wind gusts are applicable to overhead sign structures.

The primary concern in the design of cantilevered VMS structures is the galloping loading phenomenon. Therefore, for cantilever VMS structures, galloping, natural wind and truck induced wind gusts are applicable.

4). The following fatigue loads, identified in Subsection 11.7 of the herein referenced 2001 AASHTO Specifications, shall be applied in analyzing VMS sign structures for fatigue resistance. The Fatigue Importance Factor (I_F) shall be based on the Fatigue Category II values that are stated In Table 11.1 of the herein referenced 2001 AASHTO Specifications.

a.) Natural Wind Gusts

Overhead and cantilever VMS sign support structures shall be designed to resist an equivalent natural wind gust pressure.

This natural wind gust pressure range shall be applied in the horizontal direction to the area projected on a vertical plane of all support structure members and the VMS board.

b.) Truck-Induced Gusts

Overhead and cantilever VMS sign support structures shall be designed to resist an equivalent static truck induced gust pressure.

Refer to the guidance provided under item 3. above for direction as to the limits that should be followed in applying the truck induced gusts to both type VMS sign structures.

c.) Galloping Induced Gusts

Additionally, cantilevered VMS support structures shall be designed for galloping induced cyclic loads.

This equivalent static pressure should be applied vertically, as a shear stress, on the frontal surface area of all sign attachments that are mounted to the horizontal mast arm.

5). Deflection Criteria

For the overhead support structures, the maximum deflection shall be limited to 2 ½ inches per 100 feet of the span length.

For the cantilever support structures, each applicable wind load range described above should be applied separately and the largest vertical or horizontal deflection range should be limited to 8 inches.

The 8 inch range is defined as the sum of the potential upward and downward or potential horizontal axis displacement of the cantilever structure.

This criteria is included to minimize potential vibration damage to the VMS, ensure motorist visibility, and to reduce motorist concerns.

1.32.3 HIGH STRENGTH BOLTED CONNECTIONS

a. Specifications contained in Section 509 of the NJDOT Standard Specifications for Road and Bridge Construction, concerning installation of sign support structures, shall be adhered to in developing contract documents.

b. Sign Structure bolt connections shall be installed in accordance with the criteria stated in Subsection 11.5.6.4 of the AASHTO Standard Specifications for Highway Bridges, Division II.

In accordance with the AASHTO Specifications, when calibrated wrenches are used for bolt installations, they shall be set to provide a tension that is not less than five (5) percent of the minimum tension that is specified in the following Table:

Required Fastener Tension - Minimum Bolt Tension In kips*

Bolt Size	AASHTO M 164M ASTM A 325M	AASHTO M 253M ASTM A 490M
5/8	19	24
3/4	28	35
7/8	39	49
1	51	64
1 - 1/8	56	80
1 - 1/4	71	102
1 - 1/2	103	148

* Equal to 70% of the bolt material's ultimate strength (as specified in ASTM specifications for tests of full-size A 325M and A 490M bolts with UNC threads loaded in axial tension) rounded to the nearest kips.

c. For bolt sizes that are greater in size than those provided in the above Table, a calculation shall be performed to determine the proper torque that should be applied to bring such bolts to a fully tighten condition.

As stated above, the minimum bolt tension is equal to 70% of the bolt material's ultimate strength. The following formulas may be used to derive the required torque value for bolt assembly installations:

$F_1 = 0.7 \times F_u \times A_T$ where "F_1" is the bolt minimum tension "F_u" is the ultimate strength and "A_T" is the tensile stress area

$A_T = {}^{\pi}/_{4}\left(d - \dfrac{0.9743}{n}\right)^2$ $\{ in^2 \}$ where "d" is the bolt diameter in the unthreaded portion, "n" is the number of threads per inch and "P" is the thread pitch

$F_1 = \dfrac{T}{K \times d}$ where "T" is the torque and "K" is a friction coefficient depending on thread lubrication

The third formula may be used to derive the required torque for the bolt sizes listed in the above Table. As a worst case, a value of 0.2 may be used for "K".

d. The calculated values for those bolts that are to be used in the installation of all sign support structures shall be indicated in the General Notes of such contract drawings.

1.32.4 FOUNDATION

a. At least one boring for each footing location is required (see Section 36).

b. Foundation conditions may require pile types other than those indicated on the Standard Drawing Plates. In such a case, the Standard Contract Plan Plates shall be modified accordingly. A foundation report shall be included in the Preliminary plan submission in any case (see Section 36). This report can simply state, when warranted, that a study of the borings confirm that footings indicated on the Standard Plates are satisfactory for use in the design without any changes.

c. Subsurface utilities which cannot be relocated, or other special conditions, may require individual footing designs.

d. Acquisition of property is sometimes a long term process. Footings should be redesigned on an individual basis if taking of property outside of right of way can be avoided.

e. Top of concrete pedestals shall not project higher than 4 inches above finished ground line.

f. Footing designs should be provided in the furnishing of contract drawings for VMS structures.

i. Refer to item 1.16.3 of this Manual for guidance concerning bottom of footing locations.

1.32.5 PLAN SUBMISSIONS

a. Bridge sketch plans 8½ by 11 inches (see Section 6) shall be submitted for approval of geometrics prior to Preliminary Plan Submission.

b. Preliminary bridge plans will be required for sign support structures in accordance with Section 7. This submission shall include: Key Plan to Structures, Elevation of Structures, Foundation Report and Boring Logs and Estimated Construction Cost.

c. If changes are made on any of the Standard Contract Plan Plates to suit the conditions of a particular project, such as the foundation, then half-size copies of those plates that were changed, shall be included with the Preliminary plan submission. Changes shall be indicated in red.

d. Shop drawings to be prepared by the contractor and approved by the Designer are required by the contract specifications.

1.32.6 STANDARD DRAWINGS

a. Standard drawings for sign support structures are available for use in a project. They may be obtained from the Engineering Documents Unit of the Bureau of Quality Management Services. Telephone: 609-530-5587 or downloaded from the NJDOT website (http://www.state.nj.us/transportation).

b. No changes in design criteria or details shall be made on the standard drawing and plan plates without prior authorization except as permitted in Subsections 1.32.3 c. and 1.32.4 c.

c. The Design Unit will be advised during the Preliminary stage of locations where the sign panels are to be of the 100% reflectorized area type. At such locations, the external lighting system and the maintenance walkway may be omitted. Otherwise, when sign lighting is deemed necessary, an alternate lighting system, such as the Lumi-Trak Sign Lighting system, may be used. If it is determined that an alternate lighting system is to be used, then Standard Drawings that detail Maintenance Walkway criteria may be omitted from the final plans.

   These decisions will be made on a project to project basis by the Traffic Signal and Safety Engineering Unit of the Bureau of Design and Engineering Support. Locations selected depend on roadway geometrics, sight distance etc.

   The Design Unit shall make the necessary changes to the standard contract plans for the structures designated prior to submission of Final Plans. The vertical underclearance shall remain as prescribed on the Standard Drawings.

d. For the permanent record, the design calculations submitted at the Final Submission shall include a list of the Standard Design Instruction Drawings used in preparing the contract plans.

e. The provision of maintenance walkways is not required for overhead and cantilever sign structures. Other lighting systems such as the Lumi-Trak system may be used. If a walkway is somehow deemed necessary, the appropriate standard drawing shall be used.

1.32.7 STRUCTURE NUMBERS

Structure numbers (7 digit) for the individual sign structures will be assigned during the Final plan review (similar to the structure numbers for bridges as per Section 40). Temporary identification numbers used during the design phase shall be changed accordingly in the tabulations and contract pay items.

1.32.8 GENERAL

a. Overhead and cantilever sign support structures located on a bridge superstructure should not be located in areas where they will be subject to the vibrations caused by live load deflections of the superstructure. Tower shaft base plates shall be located directly on the substructure units if compatible with design and details.

Special support details shall be considered for any other case.

b. Support structures that are required to support Variable Message Sign structures are subject to loading conditions that were not anticipated in the development of the overhead and cantilever sign support structures standard drawings. The Designer is required to perform additional analysis for dynamics that such structures will be subjected to while in service. Refer to 1.32.2 above for guidance.

c. In the furnishing of sign panels for overhead and cantilever sign support structures, the size of the panels shall be such that the panel shall project a minimum of 6 inches above and below the respective top and bottom chord.

d. As stated on the Standard Drawings, where appropriate, alternate Foundation Designs for both overhead and cantilever sign structures may be considered.

e. When alternate Foundation Designs, such as drilled shafts, are considered, the Tables on pages 1.32-11 through 1.32-14 for Overhead Sign Supports and page 1.32-16 for Cantilever Sign Supports should be referred to for application of loads.

f. The proposed approximate quantities for Foundation Excavation, Concrete in Structures, Footings and Reinforcement Steel in Structures shall reflect the summation of, respectively, all the overhead and cantilever sign structures that are within a contract. The location of sign panels shall be dimensioned from the centerline of an end post.

Each sign support structure shall be listed individually in numerical order for each type that is in a contract. Refer to Subsection 1.32.7 for assigning of structure numbers.

Contract Pay Items for Lighting and Electrical work are usually included with the Roadway Items of work.

Table 32.1
OVERHEAD SIGN SUPPORT
LOADS AT BOTTOM OF BASEPLATE

SS (%)	span (ft)	height (ft)	Pdl,max (kips)	Pdl,min (kips)	Pwind (kips)	Pice,max (kips)	Pice,min (kips)	Hwind (kips)	Ht,wind (kips)	Mt,wind (kips-ft)
40%	45.00	25.00	4.33	2.39	30.85	2.65	0.40	4.03	0.60	15.81
60%	45.00	25.00	4.65	2.44	42.53	2.84	0.43	5.48	0.81	22.29
70%	45.00	25.00	4.81	2.47	48.75	2.94	0.44	6.25	0.98	25.73
80%	45.00	25.00	4.97	2.49	54.64	3.03	0.45	6.98	1.10	28.99
40%	45.00	30.00	4.65	2.72	39.14	2.72	0.47	5.21	0.60	19.77
60%	45.00	30.00	5.22	3.08	52.80	2.92	0.58	7.16	0.81	27.86
70%	45.00	30.00	5.38	3.11	60.35	3.01	0.59	8.13	0.98	32.17
80%	45.00	30.00	5.54	3.13	67.50	3.11	0.61	9.04	1.10	36.24
40%	45.00	40.00	5.29	2.72	47.14	2.81	0.62	6.22	0.60	23.72
60%	45.00	40.00	5.61	3.46	64.16	3.00	0.66	8.26	0.81	33.43
70%	45.00	40.00	6.07	3.84	71.53	3.16	0.78	9.26	0.98	38.60
80%	45.00	40.00	6.23	3.87	79.96	3.26	0.80	10.29	1.10	43.49
40%	55.00	25.00	4.88	2.57	36.50	3.10	0.40	4.74	0.72	18.95
60%	55.00	25.00	5.26	2.61	50.93	3.33	0.43	6.52	1.03	26.94
70%	55.00	25.00	5.45	2.64	58.01	3.45	0.45	7.40	1.18	30.86
80%	55.00	25.00	5.82	2.94	63.61	3.55	0.55	8.37	1.32	34.78
40%	55.00	30.00	5.20	2.88	46.21	3.17	0.47	6.09	0.72	23.68
60%	55.00	30.00	5.83	3.26	62.98	3.41	0.59	8.47	1.03	33.67
70%	55.00	30.00	6.02	3.29	71.58	3.52	0.61	9.56	1.18	38.57
80%	55.00	30.00	6.46	3.62	78.47	3.68	0.73	10.60	1.32	43.48
40%	55.00	40.00	5.83	3.58	55.38	3.26	0.64	7.21	0.72	28.42
60%	55.00	40.00	6.52	3.99	74.64	3.55	0.78	9.64	1.03	40.40
70%	55.00	40.00	6.71	4.03	84.77	3.66	0.80	10.87	1.18	46.29
80%	55.00	40.00	7.19	4.43	92.96	3.80	0.93	12.28	1.32	52.18
40%	65.00	25.00	5.41	2.70	42.1	3.55	0.40	5.43	0.84	22.05
60%	65.00	25.00	5.86	2.77	58.97	3.82	0.44	7.52	1.20	31.39
70%	65.00	25.00	6.36	3.19	65.37	3.95	0.58	8.65	1.37	36.07
80%	65.00	25.00	6.58	3.23	73.31	4.09	0.61	9.67	1.55	40.62
40%	65.00	30.00	5.97	3.34	52.28	3.62	0.55	7.1	0.84	27.56
60%	65.00	30.00	6.42	3.42	72.74	3.88	0.60	9.71	1.20	39.24
70%	65.00	30.00	6.98	3.88	80.65	4.08	0.77	10.95	1.37	45.08
80%	65.00	30.00	7.21	3.92	90.39	4.21	0.79	12.23	1.55	50.78
40%	65.00	40.00	6.36	3.73	63.54	3.70	0.64	8.19	0.84	33.07
60%	65.00	40.00	7.40	4.53	84.45	4.04	0.91	11.21	1.20	47.09
70%	65.00	40.00	7.72	4.70	95.51	4.19	0.98	12.71	1.37	54.09
80%	65.00	40.00	7.94	4.74	106.88	4.32	1.00	14.12	1.55	60.94
40%	75.00	25.00	6.11	3.04	48.18	4.04	0.47	6.23	0.96	25.62
60%	75.00	25.00	6.93	3.55	65.06	4.35	0.65	8.67	1.38	36.16
70%	75.00	25.00	7.17	3.59	74.00	4.50	0.67	9.83	1.57	41.33
80%	75.00	25.00	7.43	3.63	82.94	4.65	0.7	10.98	1.77	46.50
40%	75.00	30.00	6.67	3.70	59.65	4.11	0.63	8.10	0.96	32.02
60%	75.00	30.00	7.55	4.23	80.27	4.47	0.83	10.98	1.38	45.19
70%	75.00	30.00	7.80	4.28	91.24	4.62	0.86	12.43	1.57	51.66
80%	75.00	30.00	8.68	4.95	102.22	4.77	0.89	13.87	1.77	58.13

Table 32.1
OVERHEAD SIGN SUPPORT
LOADS AT BOTTOM OF BASEPLATE

SS (%)	span (ft)	height (ft)	Pdl,max (kips)	Pdl,min (kips)	Pwind (kips)	Pice,max (kips)	Pice,min (kips)	Hwind (kips)	Ht,wind (kips)	Mt,wind (kips-ft)
40%	75.00	40.00	7.36	4.43	70.72	2.24	0.83	9.23	0.98	38.42
60%	75.00	40.00	8.28	5.06	95.07	4.58	1.05	12.71	1.38	54.23
70%	75.00	40.00	8.53	5.10	107.82	4.73	1.07	14.34	1.57	61.99
80%	75.00	40.00	9.63	6.00	120.69	4.87	1.10	15.97	1.77	69.75
40%	85.00	25.00	6.96	3.53	54.41	4.57	0.58	7.06	1.12	29.33
60%	85.00	25.00	8.07	4.33	72.73	4.95	0.85	9.81	1.57	41.19
70%	85.00	25.00	8.35	4.38	82.39	5.12	0.89	11.07	1.78	46.86
80%	85.00	25.00	8.82	4.69	90.30	5.31	1.01	12.30	2.00	52.56
40%	85.00	30.00	7.56	4.23	67.36	4.65	0.77	9.15	1.12	36.66
60%	85.00	30.00	8.7	5.02	89.69	5.08	1.04	12.40	1.57	51.48
70%	85.00	30.00	9.21	5.42	99.32	5.24	1.19	14.11	1.78	58.58
80%	85.00	30.00	9.49	5.47	110.90	5.40	1.22	15.71	2.00	65.70
40%	85.00	40.00	8.25	5.98	79.80	4.78	0.97	10.41	1.12	44.00
60%	85.00	40.00	9.43	5.85	106.11	5.18	1.26	14.31	1.57	61.78
70%	85.00	40.00	10.57	6.77	119.98	5.34	1.29	16.10	1.78	70.30
80%	85.00	40.00	10.85	6.83	133.87	5.51	1.33	17.89	2.00	78.85
40%	95.00	25.00	8.20	4.56	59.07	5.11	0.86	8.01	1.26	33.16
60%	95.00	25.00	8.83	4.67	80.57	5.48	0.93	10.83	1.74	45.80
70%	95.00	25.00	9.74	5.46	88.65	5.74	1.18	12.26	1.99	52.36
80%	95.00	25.00	10.56	6.04	101.26	5.92	1.22	13.96	2.29	60.02
40%	95.00	30.00	8.59	4.94	74.49	5.19	0.94	10.22	1.26	41.45
60%	95.00	30.00	9.69	5.71	97.14	5.59	1.24	13.81	1.74	57.24
70%	95.00	30.00	10.41	6.25	108.91	5.83	1.39	15.65	1.99	65.45
80%	95.00	30.00	11.45	7.04	124.26	6.01	1.43	17.79	2.29	75.02
40%	95.00	40.00	9.57	6.08	86.53	5.31	1.27	11.78	1.26	49.74
60%	95.00	40.00	11.04	7.07	117.36	5.70	1.35	15.76	1.74	68.69
70%	95.00	40.00	11.77	7.60	131.48	5.94	1.50	17.83	1.99	78.54
80%	95.00	40.00	12.59	8.30	145.43	6.15	1.69	20.10	2.29	90.02
40%	105.00	25.00	8.71	4.71	64.43	5.53	0.86	8.72	1.38	36.30
60%	105.00	25.00	10.06	5.63	85.82	6.02	1.17	11.87	1.93	50.64
70%	105.00	25.00	10.92	6.22	99.40	6.22	1.21	13.71	2.24	58.88
80%	105.00	25.00	12.26	7.42	108.71	6.54	1.50	15.37	2.53	66.31
40%	105.00	30.00	9.34	5.40	79.50	5.64	1.05	11.03	1.38	45.38
60%	105.00	30.00	10.73	6.42	105.47	6.11	1.90	15.17	1.93	63.30
70%	105.00	30.00	11.80	7.22	121.99	6.31	1.43	17.47	2.24	73.60
80%	105.00	30.00	13.14	8.43	133.34	6.74	1.72	19.55	2.53	82.89
40%	105.00	40.00	10.07	6.24	94.21	5.74	1.28	12.77	1.38	54.46
60%	105.00	40.00	12.09	7.78	121.34	6.22	1.50	17.29	1.93	75.95
70%	105.00	40.00	12.94	8.49	142.78	6.44	1.69	19.74	2.24	88.32
80%	105.00	40.00	14.30	9.70	156.13	6.76	1.98	22.09	2.53	99.47
40%	115.00	25.00	10.14	5.90	68.82	6.11	1.18	9.57	1.54	40.32
60%	115.00	25.00	11.98	7.27	92.25	6.68	1.53	13.08	2.14	56.08
70%	115.00	25.00	12.86	7.87	106.33	6.90	1.57	15.04	2.45	64.86
80%	115.00	25.00	13.23	7.94	118.38	7.12	1.63	16.72	2.76	72.38

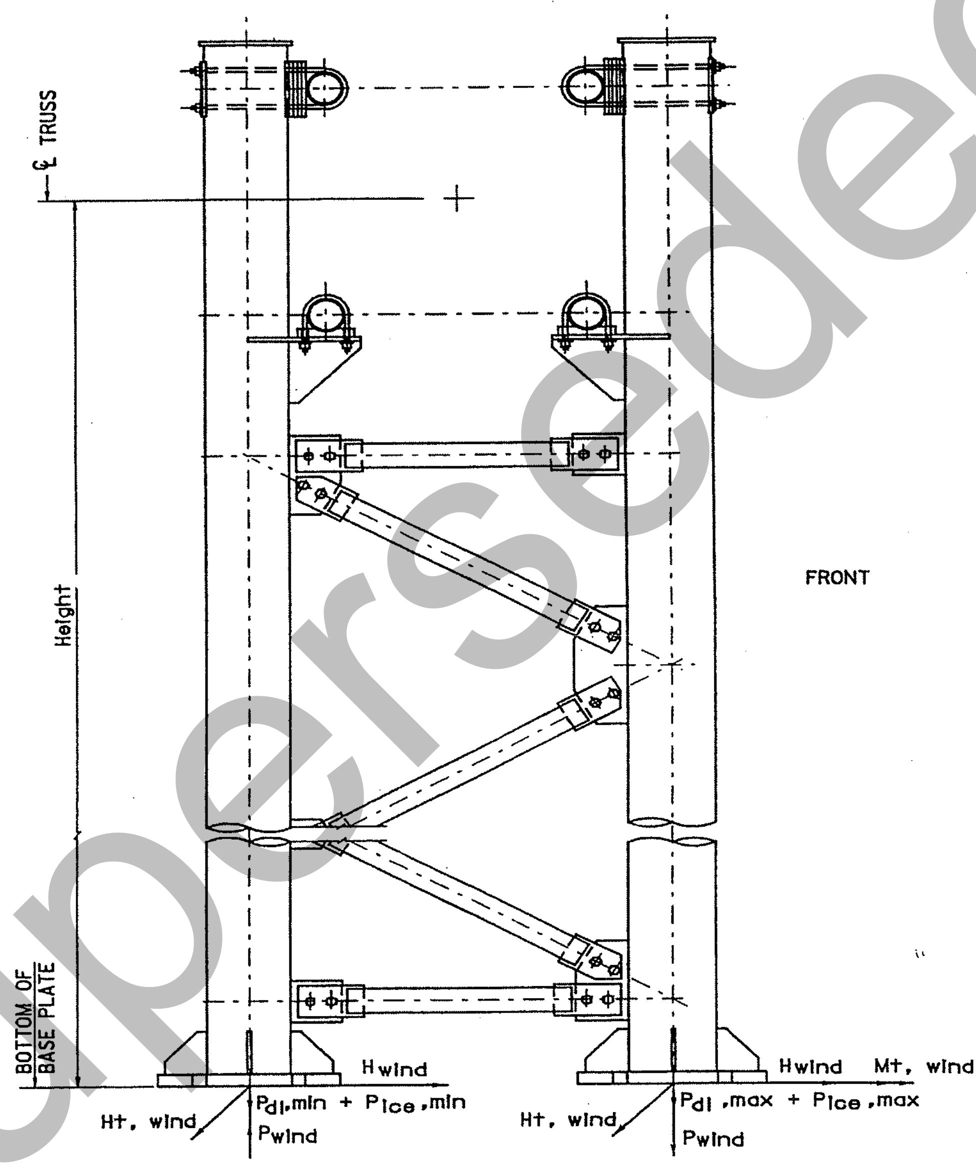
Table 32.1
OVERHEAD SIGN SUPPORT
LOADS AT BOTTOM OF BASEPLATE

SS (%)	span (ft)	height (ft)	Pdl,max (kips)	Pdl,min (kips)	Pwind (kips)	Pice,max (kips)	Pice,min (kips)	Hwind (kips)	Ht,wind (kips)	Mt,wind (kips-ft)
40%	115.00	30.00	10.58	6.34	86.61	6.21	1.28	12.16	1.54	50.40
60%	115.00	30.00	12.65	8.07	113.34	6.77	1.75	16.69	2.14	70.10
70%	115.00	30.00	13.74	8.88	130.49	6.98	1.80	19.14	2.47	81.08
80%	115.00	30.00	14.10	8.96	145.17	7.20	1.85	21.25	2.76	90.47
40%	115.00	40.00	11.31	7.18	102.53	6.31	1.51	14.04	1.54	60.49
60%	115.00	40.00	13.56	9.09	132.75	6.90	2.02	18.86	2.14	84.45
70%	115.00	40.00	14.89	10.15	152.81	7.12	2.07	21.63	2.47	97.30
80%	115.00	40.00	15.25	10.23	169.96	7.34	2.12	24.00	2.76	108.56
40%	125.00	25.00	12.02	7.55	74.37	6.72	1.53	10.60	1.71	44.93
60%	125.00	25.00	13.33	8.23	101.95	7.20	1.63	14.43	2.37	62.13
70%	125.00	25.00	13.73	8.32	114.99	7.44	1.67	16.25	2.68	70.26
80%	125.00	25.00	14.37	8.79	125.04	7.65	1.85	18.15	2.99	78.40
40%	125.00	30.00	12.69	8.34	91.58	6.81	1.75	13.57	1.71	56.17
60%	125.00	30.00	14.21	9.24	125.16	7.28	1.85	18.38	2.37	77.67
70%	125.00	30.00	14.60	9.33	141.03	7.52	1.90	20.66	2.68	87.83
80%	125.00	30.00	15.41	9.97	152.56	7.76	2.10	22.83	2.99	98.01
40%	125.00	40.00	14.05	9.70	110.66	6.92	1.86	15.49	1.71	67.40
60%	125.00	40.00	15.36	10.52	146.58	7.41	2.12	20.77	2.37	93.20
70%	125.00	40.00	15.75	10.61	165.14	7.65	2.17	23.33	2.68	105.40
80%	125.00	40.00	16.52	11.22	179.70	7.88	2.36	26.03	2.99	117.61
40%	135.00	25.00	12.66	7.86	79.67	7.16	1.56	11.33	1.84	48.24
60%	135.00	25.00	14.97	10.31	107.91	7.83	1.99	15.69	2.58	67.76
70%	135.00	25.00	16.07	10.40	121.24	8.08	2.04	15.60	2.91	76.31
80%	135.00	25.00	16.73	10.89	131.48	8.30	2.23	19.59	3.23	84.86
40%	135.00	30.00	13.34	8.65	98.03	7.24	1.79	14.50	1.84	60.30
60%	135.00	30.00	16.53	11.33	132.48	7.91	2.22	19.96	2.58	84.70
70%	135.00	30.00	17.37	11.98	144.67	8.16	2.43	22.24	2.91	95.39
80%	135.00	30.00	17.78	12.08	160.51	8.41	2.49	24.13	3.23	106.08
40%	135.00	40.00	14.69	10.01	118.40	7.35	1.90	16.53	1.84	72.35
60%	135.00	40.00	17.68	12.61	155.24	8.04	2.49	22.54	2.58	101.64
70%	135.00	40.00	18.48	13.23	170.55	8.28	2.68	25.37	2.91	114.47
80%	135.00	40.00	18.90	13.33	189.10	8.53	2.75	28.06	3.23	127.29
40%	145.00	25.00	16.05	11.04	86.49	8.07	2.24	12.63	2.06	54.02
60%	145.00	25.00	17.47	11.76	116.30	8.62	2.36	16.89	2.79	73.14
70%	145.00	25.00	18.16	12.25	127.38	8.85	2.55	18.99	3.13	82.16
80%	145.00	25.00	18.61	12.35	141.10	9.12	2.61	21.00	3.48	91.19
40%	145.00	30.00	16.72	11.84	106.38	8.15	2.47	16.11	2.06	67.52
60%	145.00	30.00	18.35	12.77	142.70	8.69	2.60	21.69	2.79	91.43
70%	145.00	30.00	19.25	13.44	155.51	8.96	2.81	23.88	3.13	102.71
80%	145.00	30.00	19.66	13.55	172.24	9.23	2.86	26.40	3.48	113.99
40%	145.00	40.00	18.08	13.20	128.39	8.26	2.58	18.35	2.06	81.03
60%	145.00	40.00	19.50	14.06	167.21	8.82	2.87	24.24	2.79	109.71
70%	145.00	40.00	20.32	14.69	183.25	9.08	3.07	29.21	3.13	123.25
80%	145.00	40.00	20.77	14.81	202.83	9.34	3.14	30.05	3.48	136.79

Table 32.1
OVERHEAD SIGN SUPPORT
LOADS AT BOTTOM OF BASEPLATE

SS (%)	span (ft)	height (ft)	Pdl,max (kips)	Pdl,min (kips)	Pwind (kips)	Pice,max (kips)	Pice,min (kips)	Hwind (kips)	Ht,wind (kips)	Mt,wind (kips-ft)
40%	155.00	25.00	14.92	11.57	91.97	8.56	2.33	13.41	2.19	57.54
60%	155.00	25.00	20.03	14.23	119.52	9.27	2.93	18.27	3.01	78.98
70%	155.00	25.00	20.51	14.35	133.43	9.56	3.00	20.37	3.37	88.37
80%	155.00	25.00	20.98	14.47	147.34	9.84	3.07	22.46	3.73	97.76
40%	155.00	30.00	18.31	13.10	113.06	8.63	2.57	17.10	2.19	71.92
60%	155.00	30.00	21.09	15.43	146.00	9.38	3.19	22.99	3.01	98.72
70%	155.00	30.00	21.56	15.55	162.98	9.66	3.26	25.61	3.37	110.46
80%	155.00	30.00	22.34	16.13	176.06	9.93	3.47	28.34	3.73	122.19
40%	155.00	40.00	19.47	14.39	132.51	8.76	2.84	19.32	2.19	86.30
60%	155.00	40.00	20.12	16.60	172.18	9.48	3.43	26.21	2.19	118.47
70%	155.00	40.00	22.59	16.72	192.07	9.76	3.50	29.16	2.19	132.55
80%	155.00	40.00	23.44	17.37	207.56	10.03	3.72	32.26	2.19	146.63
40%	165.00	25.00	19.69	14.16	97.31	9.19	2.75	14.54	2.39	62.58
60%	165.00	25.00	20.95	14.79	126.65	9.76	3.02	19.35	3.19	83.79
70%	165.00	25.00	22.26	15.82	140.08	10.18	3.32	21.69	3.59	94.30
80%	165.00	25.00	23.07	16.42	154.52	10.46	3.54	23.82	3.97	104.14
40%	165.00	30.00	20.57	15.17	119.61	9.27	2.98	18.51	2.39	78.23
60%	165.00	30.00	22.00	15.99	154.71	9.87	3.29	24.33	3.19	104.74
70%	165.00	30.00	23.31	17.02	171.14	10.29	3.59	27.27	3.59	117.88
80%	165.00	30.00	24.11	17.61	184.63	10.56	3.80	30.13	3.97	130.18
40%	165.00	40.00	21.73	16.42	140.26	9.39	3.26	20.91	2.39	93.87
60%	165.00	40.00	23.02	17.16	183.38	9.96	3.53	27.72	3.19	125.69
70%	165.00	40.00	24.72	18.72	197.59	10.37	3.97	31.17	3.59	141.46
80%	165.00	40.00	25.21	18.85	217.66	10.66	4.06	3.47	3.97	156.22

Refer to the following sketch for the location of the load applications for the Overhead Sign Support structure.

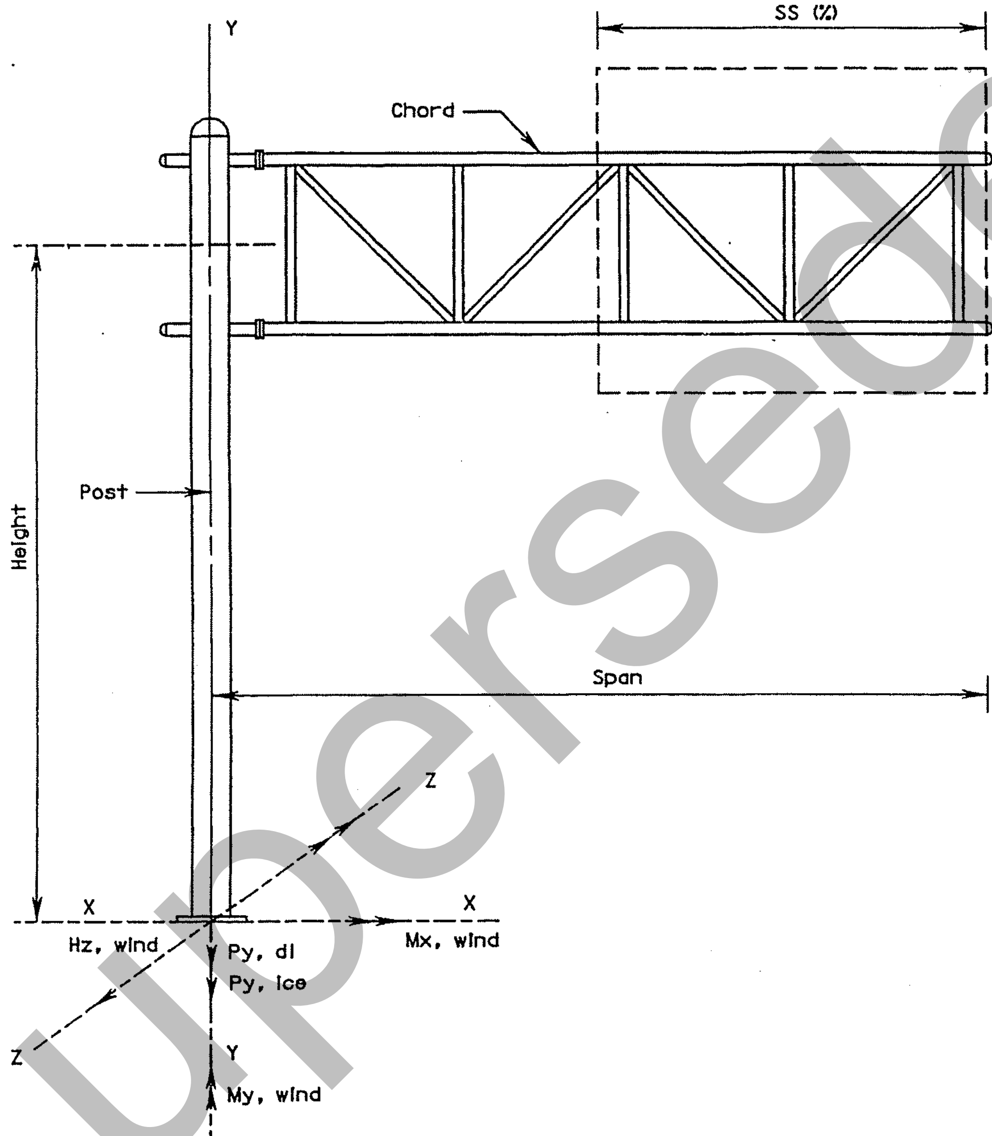


TOWER ELEVATION

Table 32.2
CANTILEVER SIGN SUPPORT
LOADS AT BOTTOM OF BASEPLATE

SS (%)	span (ft)	height (ft)	Hz, wind (kips)	Py,dl (kips)	Py,ice (kips)	Mx,wind (kips-ft)	My,wind (kips-ft)	Mz.dl (kips-ft)
40%	20.00	25.00	5.30	4.86	1.92	133.73	68.29	30.23
50%	20.00	25.00	6.25	5.91	2.05	157.78	77.81	37.59
60%	20.00	25.00	7.13	6.06	2.14	180.89	85.61	38.90
70%	20.00	25.00	8.08	6.52	2.27	204.98	91.67	39.93
80%	20.00	25.00	9.46	6.67	2.36	241.37	101.98	40.65
40%	30.00	25.00	8.41	8.64	3.08	213.04	158.02	89.68
50%	30.00	25.00	9.70	9.97	3.24	246.90	178.51	109.65
60%	30.00	25.00	11.56	10.51	3.42	294.99	206.55	112.62
70%	30.00	25.00	12.89	10.73	3.55	329.71	220.23	114.90
80%	30.00	25.00	14.28	11.27	3.73	365.41	229.99	116.57
40%	40.00	25.00	12.10	13.68	4.49	308.26	302.37	209.78
50%	40.00	25.00	13.86	16.09	4.71	353.76	339.12	251.64
60%	40.00	25.00	15.56	17.38	4.89	398.38	369.23	256.87
70%	40.00	25.00	17.26	17.68	5.06	442.99	392.66	260.94
80%	40.00	25.00	19.11	17.97	5.24	491.39	412.80	263.85
40%	20.00	30.00	5.49	5.72	2.04	170.28	68.27	30.24
50%	20.00	30.00	6.37	6.45	2.13	199.17	77.81	37.59
60%	20.00	30.00	7.33	6.99	2.28	229.51	85.60	38.91
70%	20.00	30.00	8.21	7.14	2.36	258.42	91.67	39.93
80%	20.00	30.00	9.68	7.67	2.51	305.38	101.98	40.67
40%	30.00	30.00	8.56	9.32	3.28	268.73	158.02	89.68
50%	30.00	30.00	9.93	11.04	3.40	312.46	178.48	109.68
60%	30.00	30.00	11.81	11.65	3.59	372.83	206.54	112.65
70%	30.00	30.00	13.13	11.87	3.72	416.26	220.22	114.94
80%	30.00	30.00	14.54	12.49	3.91	461.15	229.99	116.61
40%	40.00	30.00	12.36	14.89	4.67	389.60	302.31	209.84
50%	40.00	30.00	14.06	18.20	4.84	445.37	339.12	251.64
60%	40.00	30.00	15.76	18.50	5.02	501.13	369.23	256.87
70%	40.00	30.00	17.46	19.99	5.20	556.90	392.66	260.94
80%	40.00	30.00	19.30	20.29	5.38	617.40	412.80	263.85
40%	20.00	40.00	5.70	6.72	2.19	208.68	68.25	30.25
50%	20.00	40.00	6.58	7.46	2.28	243.37	77.80	37.60
60%	20.00	40.00	7.56	8.06	2.43	280.08	85.59	38.92
70%	20.00	40.00	8.44	8.21	2.52	314.79	91.66	39.94
80%	20.00	40.00	9.93	8.82	2.68	371.46	101.97	40.68
40%	30.00	40.00	8.81	10.46	3.35	327.36	157.99	89.71
50%	30.00	40.00	10.19	12.25	3.58	380.15	178.46	109.70
60%	30.00	40.00	11.99	12.48	3.71	450.92	206.54	112.65
70%	30.00	40.00	13.41	13.16	3.91	505.04	220.21	114.97
80%	30.00	40.00	14.73	14.81	4.04	557.19	229.99	116.61
40%	40.00	40.00	12.55	17.22	4.80	471.33	302.31	209.84
50%	40.00	40.00	14.25	19.32	4.98	538.25	339.12	251.64
60%	40.00	40.00	15.95	21.03	5.15	605.17	369.23	256.87
70%	40.00	40.00	17.65	21.32	5.33	672.09	392.66	260.94
80%	40.00	40.00	19.50	22.98	5.51	744.94	412.80	263.85

Refer to the following sketch for the location of the load applications for the Cantilever Sign Support structure.


SS (%)
Y
Chord
Post
Height
Span
Z
X
X
Hz, wind
Py, dl
Py, ice
Mx, wind
Z
Y
My, wind

SECTION 33

BRIDGE MOUNTED SIGNS

1.33.1 GENERAL

a. Bridge mounted sign support structures shall be designed and detailed on an individual structure basis.

b. When bridge mounted signs are to be installed on grade separation structures, close liaison between Structural Design and Traffic Signal and Safety Engineering is essential. The overhead signs should be located as near to the most advantageous position for traffic operation as possible, but where structurally adequate support structure details can be provided.

While the type of bridge mounted sign structure is not preferred, the best locations from a structural standpoint are usually near an abutment, bent cap, or other support. This will reduce the effect of live load vibrations. Where the sign does not extend above the top of parapet or railing, the installation of a sign on an overpass is generally not objectionable aesthetically.

c. Support structures for bridge mounted signs shall be designed with the use of hot-dipped galvanized steel tubes or hot dipped galvanized structural steel members.

d. The provision of maintenance walkways for bridge mounted signs is not required. If deemed necessary, a maintenance walkway, as approved by the Manager, Bureau of Structural Engineering, may be provided.

e. Design and details of support structures shall be such as to provide space for painting and inspection of stringers.

f. Normally, signs should be placed parallel with the structure for skews up to 10 degrees. At greater angles of skew, support structures shall be detailed to position the sign at approximately right angles to the roadway.

When the roadway is on a tangent, horizontal curve or there is a horizontal curve within the normal sight distance, the Traffic Signal and Safety Engineering Unit shall determine the appropriate skew angle for the traffic based on the traffic speed and horizontal curve angle.

g. Support structures shall be detailed to position the sign and maintenance walkway in a horizontal position regardless of the grade of the stringers.

h. Support structures shall be detailed to position the lower limit of the maintenance walkway and lighting 1'-3" minimum above the underside of the fascia stringer.

i. Proposed overhead bridge mounted signs shall be shown on preliminary bridge plans.

If information concerning signs is not available at the time of preliminary bridge plan submission, revised plans shall be submitted for approval at a later date.

The same procedure shall apply to bridge mounted signs proposed for existing bridges within the limits of any design contract. Design calculations indicating the influence of the additional loading stresses on the existing structural elements shall be included. Installation of additional diaphragms from the fascia to the first and second girders may be required.

j. Drilling for inserts into prestressed concrete beams will not be permitted.

SECTION 34

UTILITIES

1.34.1 GENERAL

(a) The Design Unit shall determine the utilities that will be affected by the construction of any bridge structure at the earliest possible stage. It shall be their responsibility to deal with these utilities and to provide location plans or any other required sketches for their information. When the utility has to be accommodated on the structure, the Design Unit shall secure approval from the representative of the utility and the Bureau of Structural Engineering for the location and method of support.

(b) Due consideration shall be given to the weight of the pipes, ducts, etc. in the design of the beams and diaphragms. Utilities shall be assumed to be placed prior to placing the concrete deck slab, but pipes need not be considered full.

(c) To insure that the function, aesthetics, painting and inspection of stringers of a structure are maintained, the following applies to the installation of utilities on structures:

  (1) Permanent installations, which are to be carried on and parallel to the longitudinal axis of the structure, shall be placed out of sight, between the fascia beams and above the bottom flanges, on the underside of the structure.

  (2) Conglomeration of utilities in the same bay shall be avoided in order to facilitate maintenance painting and future inspection of steel stringers in a practical manner.

  (3) In those instances where the proposed type of superstructure is not adaptable to carrying utilities in an out-of-sight location in the underside of the structure, an early determination must be made as to whether or not utilities are to be accommodated and, if so, the type of superstructure must be selected accordingly.

1.34.2 SUPPORTS

(a) Utilities shall not be supported by a system which requires inserts in the concrete deck slab. They shall be supported directly on structural beams. Also, utilities shall not be supported by a system that requires drilling into prestressed concrete beams. Welding onto structural steel beams is not permitted.

(b) It shall be the responsibility of the design unit to obtain approval of support details from the individual utility companies prior to the Final submission.

1.34.3 PLANS

(a) Preliminary and final General Plan and Elevation drawings shall show information about all existing and proposed utilities carried under the superstructure or in the vicinity of foundations. Complete information as to the name of owner, size, type, abandonment, proposed relocation, material to be furnished by utility company, etc. shall be noted.

1.34.4 DEPARTMENT POLICY

Department Policy is promulgated in the New Jersey Administrative Code (N.J.A.C.) Title 16, Chapter 25, entitled Utility Accommodation.

The following guidance in regard to utility installations on bridges should be followed:

General Considerations

(a) In most cases, attachment of utility facilities to highway structures, such as bridges, is a practical arrangement and considered to be in the public interest. However, attaching utility lines to a highway structure can materially affect the structure, the safe operation of traffic, the efficiency of maintenance as well as the appearance and therefore must be provided for during the design stage.

(b) Since highway structure designs and site conditions vary, the adoption of a standard method to accommodate utility facilities is not feasible; however, the method employed should conform to logical engineering considerations for preserving the highway, its safe operation, maintenance and appearance. Generally, acceptable utility installations are those which will occupy a position beneath the structure's floor, between the outer girders of beams or within a cell, and at an elevation above low superstructure steel or masonry.

(c) The general controls for providing encasement, allied mechanical protection and shut-off valves to pipeline crossings of highways and for restriction against varied use shall be followed for pipeline attachments to bridge structures, except that sleeves are required only through the abutment backwalls. Where a pipeline attachment to a bridge is encased, the casing should be effectively opened or vented at each end to prevent possible buildup of pressure and to detect leakage of gases or fluid.

(d) Since an encasement is not normally provided for a pipeline attachment to a bridge, additional protective measures shall be taken. Such measures shall employ higher factor of safety in the design, construction, and testing of the pipeline than would normally be required for cased construction.

(e) Communication and electric power line attachments shall be suitably insulated, grounded, and carried in protective conduit or pipe from the point of exit from the ground to re-entry. The cable shall be carried to a manhole located beyond the backwall of the structure. Carrier pipe and casing pipe should be suitably insulated from electric power line attachments.

(f) Guy wires in support of any utility will never be allowed to attach to a bridge structure.

(g) Cell phone or other type antennas shall not be mounted from or on any bridge or sign support structure.

1.34.5 PIPELINES ON RAILROAD BRIDGES AND PROPERTY

(a) Design and detail of pipelines on railroad property, bridges over railroad tracks, or bridges carrying railroad tracks shall be in accordance with Specifications for Pipeline Occupancy of Consolidated Rail Corporation Property dated September 2, 1976.

1.34.6 PIPELINE EXPANSION JOINTS (WATER MAINS)

(a) Allowances must be made for changes in pipe length due to thermal expansion and alternate contraction. While Dresser type couplings will take care of the normal amount of expansion and contraction in each length of pipe, Dresser type expansion joints are required where no flexible joints are used in the pipeline or when the amount of concentrated movement at one point is in excess of the amount that can be safely absorbed by the standard coupling.

(b) A Dresser type expansion joint should be located in the pipeline adjacent to every point where expansion means are provided in the superstructure.

(c) Use Dresser type couplings to accommodate the differential movement between the structure and the line itself, and to provide flexibility to accommodate vibrations of the structure. Each coupling can safely accommodate up to 3/8" longitudinal movement. This is equivalent to the amount of movement resulting from a 120° F temperature variation in a 40 foot length of steel pipe.

(d) Proper alignment is important to insure free and concentric movement of the slip-type expansion joint. Alignment guides should be designed to allow free movement in only one direction along the axis of the pipe and to prevent any horizontal or vertical movement of the pipe. Suitable pipe alignment guides may be obtained from reliable pipe alignment guide manufacturers. Alignment guides should be fastened to some rigid part of the installation, such as the framework of the bridge. Alignment guides should be located as close to the expansion joint as possible, up to a maximum of 4 pipe diameters. The distance from the first pipe guide to the second should not exceed a maximum of 14 pipe diameters from the first guide. Where an anchor is located adjacent to an expansion joint, it too, should be located as close to the expansion joint as possible - to a maximum of 4 pipe diameters from the expansion joint. Additional pipe supports are usually required. It must be kept in mind that pipe supports should not be substituted for alignment guides.

(e) The main pipe anchors must be designed to withstand the full thrust resulting from internal line pressure; also, the force required to collapse the slip pipe, and the frictional forces due to guides and supports.

SECTION 35

COFFERDAMS AND SHEET PILING

1.35.1 COFFERDAMS

a. When identified by the Designer as a project requirement, the use of Cofferdams shall be scheduled in a project. As per the provisions of Subsection 206.08 of the NJDOT Standard Specifications, Cofferdams shall be constructed to protect a foundation and its construction against damage from a rise in water elevation. Except at locations where sheet piling is required, use of dikes, well points or other means for dewatering are permitted.

b. When a steel sheet piling cofferdam system is required, the Designer shall clearly identify at the Preliminary submission its limits. Necessary dewatering, and the bracing that is needed to withstand external forces that are to be sustained during construction of a project's substructure unit(s), should be evaluated to make this determination.

When this has been determined, the Designer shall provide on the plans, Plan and Section Views to denote the following criteria:

- Strength or grade of material to be used
- Minimum Section Modulus
- Minimum Tip Elevation
- Horizontal limits of the sheeting in relationship to the footing location(s).
- Mean high water elevation.

The availability of domestically produced hot rolled steel sheet piling is limited. Designation of a PZ section shall only be indicated after the Designer has ascertained its domestic availability.

If it is determined, due to site condition requirements, that domestically available steel sheet piling cannot be used, a waiver request to procure the sheeting from a foreign source shall be prepared. The Bureau of Materials may be contacted for guidance on the preparation of the waiver.

c. Cofferdam systems consisting of dikes, well points or other means with all falsework, sheeting and bracing, shall be removed after the completion of the substructure unit's construction.

d. When the flow of water can not be controlled, a cofferdam system that utilizes a concrete seal shall be provided. The concrete seal shall be placed below the water and below the bottom elevation of the footing.

Sheet piling below the top of seal concrete shall be designated to be left-in-place. (See Guide Sheet Plate 3.13-1 for typical details).

1.35.2 TEMPORARY SHEETING

a. The use of Temporary Sheeting shall be based on conditions where protection of property (embankment control), traffic (stage construction), utilities, construction safety code requirements, etc. is a construction consideration. When a project's construction is governed by such considerations, Temporary Sheeting shall be scheduled in the Contract documents.
The proposed horizontal limits of the Temporary Sheeting shall be detailed in the Plan view of the structure.

b. Ordinarily the design and type of temporary sheeting is the choice of the Contractor. However, it shall be the responsibility of the Designer to review borings and subsurface soil reports so that any adverse subsurface conditions can be identified. In such cases, the Project's Special Provisions shall provide guidance as to type of sheeting that can be used and any driving and pulling directions that must be followed.

c. Payment limits for Temporary Sheeting must be shown in schematic outline on the plans. The following guidelines are provided:

- Lower Limit: Bottom of excavation.
- Upper Limit: Existing ground line, or 3 feet above existing ground line if additional height is deemed necessary for safety reasons.
- Horizontal Limits: Determined by the Design Engineer based on extent of construction.

1.35.3 SHEETING LEFT IN PLACE

a. When it is identified by the Designer that steel sheet piling is warranted and is the only means to facilitate any phase of a project's construction, the use of Sheeting Left In Place shall be scheduled in the Contract Documents.

b. The Designer shall provide a complete design of the steel sheet piling system. The upper portion of the sheeting shall be detailed to be removed to 1 foot below the finished ground line.

c. The bottom tip elevation of the sheeting shall be noted on the plans. The following payment limit provisions, as applicable, shall also be designated on the plans:

1.) The lower payment limit of sheeting left in place shall be the bottom tip elevation of the sheeting.

2.) The upper payment limit shall be the top elevation of the seal concrete.

1.35.4 CONSTRUCTION REQUIREMENTS

a. Material for steel sheet piling shall conform to AASHTO M202/M202M or AASHTO M270/M270M, Grade 50.

b. Sheet piling that is to be used in a marine environment shall conform to AASHTO M270/M 270M, Grade 50. For such instances, it shall be coated with a 16 mil application of coal tar epoxy as per SSPC Paint Specification No. 16.

c. The design requirements of Subsection 513.04 of the NJDOT Standard Specifications shall be adhered to in the design of Temporary Sheeting and Sheeting Left In Place.

d. The Basis of Payment provisions of Section 513 of the NJDOT Standard Specifications establish use of pay items for "Temporary Sheeting" and "Sheeting Left In Place". The Designer shall provide for the use of the proper Pay Item in meeting the project requirements.

SECTION 36

SUBSURFACE EXPLORATIONS

1.36.1 GENERAL

(a) Required borings shall be located on the plan of the structure by station and offset from the base line. Five copies of the print shall be enclosed with the memorandum of transmittal. Request for borings shall be made as early as possible in the preliminary design stage.

(b) At least two borings shall be made for each bridge substructure unit. For long retaining walls and culverts, borings should be spaced not less than 50 feet to not greater than 100 feet apart. One boring shall be provided at each footing location for both overhead and cantilever sign structures and high-level light tower foundations.

(c) Where piles are anticipated, depths of borings shall be determined accordingly. The borings shall be deeper than any anticipated pile lengths.

(d) Location of borings and identification numbers shall be shown both on preliminary and final General Plan and Elevation sheets for each bridge and structure.

(e) Subsurface soil profiles and boring log information shall not be shown on the contract plans. Copies of boring logs are available to bidders as separate documents. The format of a typical boring log is illustrated on Page 1.36-2.

1.36.2 BORING LOG FORM

FORM SO-2M

NEW JERSEY DEPARTMENT OF TRANSPORTATION

ROUTE: | LOCAL NAME: | NJDOT BORING NO.:

SECTION: | FIELD BORING NO.:

STATION: | OFFSET: | REFERENCE LINE: | GROUND ELEVATION:

BORINGS BY: | DATE STARTED: | Ground Water Elevation

INSPECTOR: | DATE COMPLETED: | 0 Hr. | Date:

24 Hr | Date:

P.P. Installed

DEPTH (ft)	NO	DEPTH	Blows on Spoon 0	150	300	450	REC	SOIL DESCRIPTION & STRATIGRAPHY
5								
10								
15								
20								
25								
30								
35								
40								

Nominal I.D. of Drive Pipe	2½"	4"
Nominal I.D. of Split Barrel Sampler	1⅜"	
Weight of hammer on Drive Pipe	300 lb	
Weight of hammer on Split Barrel Sampler	140 lb	
Drop of hammer on Drive Pipe	24"	
Drop of hammer on Split Barrel Sampler	30"	

The subsurface information shown hereon was obtained for State design and estimate purposes. It is made available to authorized users only that they may have access to the same information available to the State. It is presented in good faith, but is not intended as a substitute for investigations, interpretation or judgement of such authorized users.

NEW JERSEY DEPARTMENT OF TRANSPORTATION

Geotechnical Engineering Unit

Core Size: __________

Soil descriptions represent a field identification after D.M. Burmister unless otherwise noted

Approximate Change in Strata: __________

Driller: __________

Inferred Change in Strata: - - - - - - - - - -

1.36.3 PILE FOUNDATIONS

(a) To provide a general idea for the proper use of the following methods, the following guidelines for jetting and pre-boring are given. A review and recommendations by the Bureau of Structural Engineering's Geotechnical Engineering Unit may be warranted on a project to project basis.

(1) Jetting

- Not to be used where a disturbance to existing foundations or utilities would result.
- Not to be used where disposal of jet water and soil would be a problem.
- In general, jetting would be used in very dense granular or silty soils where displacement piles are being driven in water.

(2) Pre-Boring

- To be used when displacement piles are to be driven through a compacted fill over 10 feet high.
- To be used where driving piles full depth would disturb adjacent structures or utilities. Additionally, a survey, with photographs, should be performed before and after pre-boring and pile driving operations to verify occurrence of any damage to structures or utilities.
- Pre-drilling should not be used below bearing soils for friction piles.
- In loose granular soils or soft cohesive soils drilling mud may be necessary to keep the hole open.

SECTION 37

NJDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION

1.37.1 STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION

(a) Reference is directed to the New Jersey Department of Transportation Standard Specifications for Road and Bridge Construction.

(b) The provisions of the above Specifications are amended or added to, on a project to project basis, by Special Provisions.

(c) The following notes are required on plans to compliment requirements of the Construction Specifications:

(1) Subsection 1.20.9(a) of this Manual requires that a placing sequence for concrete deck slabs be shown on plans for arch, truss, continuous, and cantilevered construction.

(2) Subsection 1.20.10(b) and Subsection 1.9B.3 of this Manual requires a note on plans about machine finishing of bridge decks where excluded because of adverse geometrics.

(3) Subsection 1.24.2(b) requires type of steel and notch-toughness requirements to be noted on structural steel plans.

(4) Subsection 1.24.5 of this Manual requires that member or member components under the Fracture Control Plan be noted on the plans as FCM's.

(5) Subsection 1.24.14 of this Manual requires that plans show nondestructive testing welding symbols to prescribe weldments subject to mandatory quality control inspection.

(6) Subsection 1.24.18 (h) of this Manual requires the coating system and finish coat color to be noted on structural steel plans.

(7) Subsection 1.25.2 of this Manual requires certain deletions and additions to the standard drawings (Division 2) for prestressed concrete beams.

(8) Subsection 1.25.6 Item 3 of this Manual requires that the total transverse tie force per duct, and the individual strand forces, if applicable, for prestressed concrete adjacent box beams and voided slabs shall be shown on the plans.

(9) Guide Sheet Plates 3.15-1 to 3.15-5 require that pay item limits for excavation be noted on plans.

SECTION 38

ENGINEER'S CONSTRUCTION COST ESTIMATE

1.38.1 GENERAL

(a) A preliminary Engineer's construction cost estimate is required in the preliminary plan submission.

(b) The cost estimate shall be based on contract estimated quantities and unit prices from the Department's current Bid Price Report for Standard Items.

(c) However, estimators shall be aware that the size of contract, location, complexity, staging, continuity of operations and other such factors influence the unit prices. These factors shall also be considered in order to produce a realistic cost estimate.

(d) The ideal estimate would be where the Engineer's estimate is approximately the median between the actual low and high contract bid.

SECTION 39

PLAN REVISIONS

1.39.1 GENERAL

(a) No revisions shall be made to contract tracings between the time of advertising and award of contract. During the advertising period, additions, deletions or corrections to contract plans shall be accomplished by addendum. Refer to subsection 4.4 of the NJDOT Procedures Manual for procedural guidelines. Revisions to plans, in compliance with addenda, shall be made immediately after award of contract.

(b) Revisions to contract tracing shall be made in accordance with the illustration shown on Guide Sheet Plate 3.2-1. Erasures on contract tracings are not allowed.

(c) Where revisions are necessary on a Consultant's contract plans, the Consultant shall mark up a white print in red with changes in accordance with the illustration shown on Guide Sheet Plate 3.2-1 The same print shall be submitted for approval with a transmittal letter detailing the changes. Drafting work for the approved changes on the tracings shall be done by the Consultant.

(d) Where changes are so extensive that new drawings are necessary, the following procedure shall be used:

(1) Mark original contract tracing:

"VOID - SEE SUPPLEMENTARY SHEET B _______ S"

(2) Mark new tracing:

"SUPPLEMENTARY SHEET B _______ S"

(e) If contract plans have been submitted in an electronic media, a submission should be provided to include the original submission and all changes.

(f) If changes during construction are needed, refer to Subsection 5.2 of the NJDOT Procedures Manual for procedural guidelines.

SECTION 40

STRUCTURE NUMBERS AND NAMES

1.40.1 STRUCTURE NUMBERS

The record retention and retrieval microfilm filing system for as-built bridge plans is based on a seven digit number system.

The first four digits are the control section number.

1. The first two digits of the section number identify the county in which this section appears.

Atlantic	01	Gloucester	08	Ocean	15
Bergen	02	Hudson	09	Passaic	16
Burlington	03	Hunterdon	10	Salem	17
Camden	04	Mercer	11	Somerset	18
Cape May	05	Middlesex	12	Sussex	19
Cumberland	06	Monmouth	13	Union	20
Essex	07	Morris	14	Warren	21

2. The second two digits of the section number indicates the number within the county.

EXAMPLE:	Section Number:	0101
	First two digits	01 = Atlantic County
	Second two digits	01 = The first section in Atlantic County

The last three digits identify the individual structures in a particular control section number. They will be assigned during the Final plan review, or earlier, when feasible.

The structure numbers shall be shown in the upper right hand corner of all bridge and structure plan sheets (See Guide Sheet Plate 3.1-1). They shall also be shown Index of Structures tabulation of the Key Plan to Structures sheet.

3. The Bureau of Maintenance Engineering and Operations should be contacted for assigning of Structure numbers. This includes all drainage structures; such as, culverts and drainage pipes. When contacted, this Bureau will determine, when informed of the structure's size, if a number is not warranted.

1.40.2 STRUCTURE NAMES

The names of bridges and structures shown on contract plans shall be based on the principal route under which the contract is to be constructed, river or stream name, name of railroad, local street name, and other readily identifiable designations.

The following examples illustrate the concept:

Rt. 280 over Newark Turnpike

Rt. 280 under Rt. 85 WB

Rt. 280 Ramp D over Sunset St.

Rt. 280 Culvert at Frank's Creek

Rt. 280 over Erie-Lackawanna RR

Pedestrian Bridge over Rt. 280 at Kenvil St.

Cantilever Sign Structure No.

Bridge Mounted Sign Structure No.

Overhead Sign Structure No.

1.40.3 OVERHEAD AND CANTILEVER SIGN STRUCTURES

Structure numbers, similar to the designations described in Subsection 1.40.1, are also assigned to overhead and cantilever sign support structures. The assigned structure numbers shall be indicated on the contract plans.

SECTION 41

HIGHWAY BRIDGE EVALUATION PROGRAM

1.41.1 GENERAL

For a comprehensive treatment of this Section's criteria, reference is directed to the Bridge Inspector's Training Manual published by the U.S. Department of Transportation, Federal Highway Administration.

1.41.2 EVALUATION CRITERIA

The Current AASHTO Manual for Condition Evaluation of Bridges shall govern inspection and rating of existing bridges with the following amendments and modifications:

1. (Page 69) 6.7.2 Rating Live Load:

   In addition to the HS20 truck, ratings shall be determined for the Type 3, NJDOT 3S2 and Type 3-3 legal load trucks.

2. (Page 71) 6.7.3 Distribution of Loads:

   In rating the fascia or curb stringers, the distribution of truck loads to these members shall be based on a simple beam action instead of the AASHTO formula. For the above members taking no truck loads, give only the dead load and sidewalk live load stresses (no vehicle ratings).

3. (Page 74) Figure 7.4.3.1 Typical Legal Loads Used for Posting:

   Substitute the loadings for the NJDOT Type 3S2 truck shown on Page 1.41-3 of this Manual for the values shown for the Type 3S2 truck.

4. (Page 53) Table 6.6.2.1-1 Inventory Rating Allowable Stresses:

   Substitute the values shown below for the allowable stresses shown in the subject table.

Steel-Unknown	Allowable Inventory Rating Stress
Prior to 1905	14,500 psi instead of 14,000 psi
1905 to 1936	16,500 psi instead of 16,000 psi

5. (Page 66) 6.6.2.4 Concrete:

   Under Section 6.6.2.4.1 Bending, the allowable stresses for compression due to bending should be 0.40 f'_c for inventory and 0.55 f'_c for operating ratings provided that the field investigation indicates that the concrete is sound and that contract plans and controls specified and furnished compressive strengths of 2,400 psi or more.

6. (Page 67) 6.6.2.5 Prestressed Concrete

   The allowable stress in the precompressed tensile zone of prestressed concrete members is specified in the AASHTO Design Specifications (Article 9.15.2.2). For calculating inventory rating by the working stress or load factor (serviceability) methods, an allowable tension stress of $3\sqrt{f'c}$ shall be utilized for members with bonded reinforcement.

7. (Page 80) Appendix A3 Live Load Moments on Longitudinal Stringers or Girders:

   Substitute the values shown for the Type 3S2 truck with the values for the NJDOT Type 3S2 truck shown in the table on Page 1.41-3.

   It should be noted that the values shown for the Type 3S2 truck in Appendices A4, A5, A6, A7 and A9 require revisions to conform to the NJDOT Type 3S2 truck.

8. General Comments:

   The allowable stresses listed in Tables 6.6.2.1-2 and 6.6.2.1-1 (for Operating and Inventory Ratings respectively) are not absolutes. They are intended to provide general guidance. These allowable stresses may be modified if other values can be justified by test results, more detailed information of the materials, more refined structural analysis, consideration of traffic types and volumes, frequency of interim inspection and other related factors.

   These given allowable stresses do not necessarily include all the allowable stresses required for a bridge rating. Values not given in these instructions should be obtained from appropriate sources (e.g. original design plans and specifications; current and past editions of the Standard Specifications for Highway Bridges, AASHO and AASHTO; historical records; ASTM Specifications; etc.).

   The Designer of a new or replacement highway carrying bridge is advised that an initial (1st cycle) inspection and rating analysis shall be performed by him within 90 days of the bridge being opened to traffic. The inspection shall be performed according to the provisions of this Section.

REVISIONS TO APPENDIX A3
Live Load Moments on Longitudinal Stringers or Girders
Live Load Moments per Wheel line

NJDOT Type 3S2 Truck

Span C/C Feet	Without Impact ft. kips	With Impact ft. kips	Span C/C Feet	Without Impact ft. kips	With Impact ft. kips
5	10.6	13.8	32	134.3	174.7
6	12.8	16.6	34	145.9	189.7
7	15.2	19.7	36	157.3	204.5
8	19.1	24.9	38	168.8	219.5
9	23.1	30.1	40	180.4	234.5
10	27.2	35.4	42	191.6	249.3
11	31.3	40.7	44	203.3	263.5
12	35.4	46.0	46	214.8	277.6
13	39.6	51.4	48	226.2	291.6
14	43.7	56.8	50	244.1	313.8
15	47.9	62.3	52	263.8	338.2
16	52.1	67.7	54	283.3	362.5
17	56.3	73.1	56	303.0	386.7
18	60.4	78.6	58	322.8	411.0
19	64.6	84.0	60	342.2	434.9
20	68.9	89.5	70	441.2	554.3
21	73.1	95.0	80	540.3	672.1
22	77.3	100.5	90	639.6	788.3
23	82.8	107.6	100	739.1	903.3
24	88.5	115.0	120	938.2	1129.7
25	94.2	122.5	140	1137.6	1352.3
26	100.0	129.9	160	1337.2	1571.8
27	105.7	137.4	180	1536.7	1788.6
28	111.4	144.9	200	1736.5	2003.6
29	117.2	152.4	250	2236.0	2534.2
30	122.9	159.8	300	2736.2	3057.9

1.41.3 EVALUATION SURVEY REPORT FORMAT - A -

The report of the results of a first cycle bridge survey and rating of an existing bridge, performed by or for the Department, shall adhere to the following format:

(A). **REPORT COVER SHEET:** The report's cover sheet shall include the bridge number, name, route number, municipality, county, bridge survey cycle number and the month and the year of the bridge survey (see attached sample).

The cover sheet colors for various cycles shall be: First cycle: White; Second cycle: Pink; Third cycle: Green; Fourth cycle: Yellow; Fifth cycle: Orange; Sixth cycle: Red; Seventh cycle: Blue; Eighth cycle: White; Ninth cycle: Pink; Tenth cycle: Green, etc.

The report shall be bound using a standard 3-hole punch type binding.

(B). **LETTER OF TRANSMITTAL (CONSULTANT PROJECTS ONLY):** The letter of transmittal shall be addressed as follows (see attached sample):

Manager, Structural Evaluation
New Jersey Department of Transportation
1035 Parkway Avenue, PO Box 615
Trenton, New Jersey 08625-0600
ATTN: Project Manager (Name)

Re: Bridge Survey and Rating of ("Bridge Number, Name, BR-NBIS/BR-Z-NBIS ( ) and Route Number").

In addition, the letter should include the date of the agreement with the New Jersey Department of Transportation and any disclaimer and/or restrictions on the information contained in the report and its use and the due date for the submission of the particular report (preliminary or final). Also, include a Quality Assurance Statement for the structure.

(C). **TABLE OF CONTENTS:** One page indicating items 1 thru 11 in order shown as follows and providing the page number in the report on which each item starts. All pages in the report shall be numbered (i.e. Cycle No.- Page No.) at the bottom and centered.

Page No.

1. Maps ....
2. Structural Data ....
3. Controlling Ratings ....
4. Conclusions and Recommendations..........
5. Historical Information ....
6. Bridge Description ....
7. Appendix 1 - a. Structure Inventory & Appraisal Sheets..........
   b. Pontis Data ....
   c. Seismic Data

1. **Maps:** Two maps, are required: one "General Location Map" and the other, a more detailed and specific "Local Map". Each map shall be on a separate 8½ by 11 inch sheet.

   a. **General Location Map:** For **State** owned bridges a map of the entire state of New Jersey, scale approximately 1: 1 000 000 "pin pointing" the location of the structure being reported on (by bridge number, name and route number). This map should show county boundaries and names, principal cities, main roads (Interstate, U.S., State and Toll Roads) and the roads or the road and waterway involved in the structure being reported.

      For reports on **County** or **Municipality** owned bridges, the general location map shall be of those territories and of a suitable scale.

   b. **Local Map:** A current U.S.G.S map of the immediate vicinity of the "reported" structure; scaling 1: 20 000 with the structure centered on the page. Include roads, railroads, waterways, county and township names and a north arrow. Features intersecting the bridge should be clearly labeled.

2. **Structural Data:** A summary of findings shall be included as per the attached format. The items in this format are self-explanatory, however, further explanation for some items is provided as follows:

   a. **Component/Material:** The components shall be as listed in Format "A" only. Type of material used for majority of construction shall be given below the component in the same vertical column. Delete the components which are not applicable.

   b. **Condition Rating:** The condition rating of various components shall be the overall rating of the component as per the current Recording and Coding Guides for the Structural Inventory and Appraisal of Bridges by FHWA & NJDOT and should be consistent with the ratings given on field notes and the SI&A sheet.

   c. **General Remarks:** Summarize the significant defects and give a brief account of what was found during the bridge survey, as it relates to the structural integrity of the bridge. Defects for which repairs are recommended must be mentioned. Photos of these defects should be referenced in this section.

The Deck section should include the condition of the top and underside of the deck, sidewalks, deck joints, bridge railing, etc. For reinforced concrete decks give the percentage of spalled area (open or concrete/asphalt patched) and estimated contaminated area (underdeck).

The Superstructure section should include the condition of main load carrying members and diaphragms (include percent loss of section if any) and the bearings.

The Substructure section should include the condition of the abutments, pier(s), retaining walls, etc., and information on scour or undermining.

The Safety Features section should include the adequacy of bridge railing and approach guide rails.

The Deck Geometry section should comment on the adequacy of the traffic lanes and shoulder widths on the bridge. Also, comment on the continuity of the approach roadway (lanes and shoulders) across the bridge.

Field measured minimum clearances and where they occur should be provided (minimum vertical clearance above and below, and lateral underclearance left and right as per SI&A coding requirements). For bridges over waterways, horizontal and vertical clearances of the major waterway opening should also be given as per field measurements.

3. **Controlling Ratings:** The ratings should include the controlling member and controlling Inventory and Operating Ratings of the bridge. Also, comment on why the ratings are low, if it is the case and give the maximum calculated percent overstress for the operating or inventory ratings of the critical live load only (for prestressed beams overstressed in tension, give tensile stress in concrete). If the bridge is load posted, state so, giving the posted weight limit (this should be referenced to photos clearly showing the posted weight limits). Also, when applicable, if the inventory ratings are below the weight of the legal trucks, state that load posting is not required if the operating ratings are high.

4. **Conclusions and Recommendations:** Conclusions resulting from the bridge evaluation survey regarding the adequacy (structural, alignment, clearances, etc.) of the bridge should be given here. Also, include possible explanation of the causes of any inadequacies found. If the bridge is speed posted, state so, giving the posted speed limit and refer to photos included to clearly show the posted speed limit.

   For bridges over waterways, include a statement relative to the scour potential of the bridge based on the Bridge Scour Evaluation. The statement should specify if the bridge is scour critical or not based on the Bridge Scour Evaluation. If the bridge has not yet been evaluated, the Priority Category as determined in the Bridge Scour Evaluation should be specified. If the Prioritization Category is 2 or less, the statement should include which low ratings (2 or less) led to this rating. Where the bridge has not yet been evaluated for scour potential, include a statement that the bridge is or is not potentially scour critical based on engineering judgment along with the reasons for this determination.

Make specific recommendations for safety improvements, major repair work (i.e. structure rehabilitation and/or replacement, raising superstructure, bridge widening, etc. to correct Structurally Deficient/ Functionally Obsolete conditions) and other repair work to correct significant defects, deterioration and inadequacies found during this bridge survey. The recommendations should be specific about the location of defects and the methods of repair. The recommendations for other repair work should be listed in the order of priority. Each recommendation should be referenced to the photos. For major repair/ rehabilitation work, provide cost estimates, however, for other repair work, provide quantities only.

In addition, list all areas of deterioration or structural members which should be inspected at frequencies of less than two years and indicate the inspection cycle in months for each area or member. Be very specific about locations to be inspected.

5. **Historical Information:** If available, this information should include when and under what agency the structure was built; when and by whom any subsequent alterations were made, their nature and extent, etc. Historical significance of the structure, if applicable, should be indicated.

6. **Bridge Description:** Furnish a brief description of the structure. Include the type of construction, materials in the deck, superstructure and substructure components, and important dimensions. Also, comment on the substructure foundation design if based on FHWA Hydraulic Engineering Circular (HEC-18). A more detailed description should be given if plans are not available.

7. **Appendix 1 - Structure Inventory & Appraisal Sheet/PONTIS/Seismic Data:** This section should contain a 8½ by 11 inch computer print out of the "Structure Inventory and Appraisal Sheet" (two or more sheets for structures carrying highways over highways). This sheet will be developed by the Department from the Computer Input sheets submitted with the preliminary report and coded in accordance with the current FHWA Recording and Coding Guide for the Inventory and Appraisal of the Nations Bridges and Recording and Coding Guide for the Structure Inventory and Appraisal of New Jersey bridges.

   Also, include a computer print out of the Elemental Inspection and Seismic data developed from the computer input sheets submitted with the preliminary report and coded in accordance with the current PONTIS Manual. For the final report, include only the computer printout (supplied by the State).

   Examples of SI&A/Pontis/Seismic data forms are included in Format A.

8. **Appendix 2 - Computations:** In this section, include computations of ratings for various major bridge components. The ratings shall be computed in accordance with the current AASHTO "Manual for Condition Evaluation of Bridges" (as modified in this Manual) and all current AASHTO interims. Include a summary as the first page of the computations listing <u>all</u> ratings with references and the allowable stresses used (see attached samples). Also, include the name of any rating computer program used and indicate any noteworthy assumptions made (such as section loss location(s), top or bottom flange in tension or compression controls, etc.). Include a CADD drawing, 8½ by 11 inches, showing the location of the controlling member and other members rated in the summary.

9. **Appendix 3 - Drawings, Soundings & Photographs:** A plan sketch indicating the direction and location of the photographs should be included. Bridge drawings (plan, elevation and cross section) etc. and color photographs (35mm print) plus color slides of unique defects should be included in this section of the report. Also, sounding sketches done in accordance with the current edition of the "Underwater Inspection and Evaluation of New Jersey Bridges Guidelines Manual" should be included.

   Photographs of both <u>full</u> elevations and plan views, upstream and downstream views (if applicable), all significant defects, any repairs made and any special equipment used (Snooper, cherry picker, maintenance and protection of traffic, special ladders, etc.) should be included in the report. The photographs should be placed in the report in the following order: Elevations, Plan Views, Stream Views, Deck, Approaches, Superstructure, Substructure, Channel, Safety Features and Special Equipment.

10. **Appendix 4 - Field Notes:** Detailed clear hand written field notes using the Department's current Field Note Format for the type of structure being surveyed and/or CADD field sketches should be included as back-up data for the report. Include an 11 by 17 inch CADD drawing showing the deck and approach plan and elevation showing lateral and vertical clearances, span lengths, highway safety, lane, shoulder and sidewalk widths, curb to curb widths, median barrier, etc. Field notes should include measurements taken during the bridge survey and Pontis Core element condition evaluation data. A sample of the current Field Note forms and CADD sketches can be obtained from the Structural Evaluation and Bridge Management Unit.

11. **Appendix 5 - Underwater Inspection:** In this section, include the diver's inspection report (if applicable) done in accordance with the current edition of the "Underwater Inspection and Evaluation of New Jersey Bridges Guidelines Manual". Also, include as additional appendices any special reports such as fatigue analysis, ultrasonic testing, chemical analysis, coupon testing, hydraulic analysis, geotechnical streambed analysis, etc. Provide photographs showing the equipment used.

Sample Letter of Transmittal
(Preliminary/Final Report)

_________________________, Manager
Structural Evaluation
New Jersey Department of Transportation
Engineering and Operations Building
1035 Parkway Avenue
PO Box 615 - 5th Floor
Trenton, New Jersey 08625-0600

Attn: Mr. __________, Project Manager

Evaluation Bridge
Survey & Rating of
Structure No.
Route No.
Structure Name
BR-NBIS (   )

Gentlemen:

In accordance with our Agreement No. BI with the New Jersey Department of Transportation, dated , we are pleased to submit this PRELIMINARY REPORT/ FINAL REPORT for the above referenced bridge. A scanned and indexed report will be submitted on CD by a separate transmittal.

The report covers the results of a field inspection of the structure and recommendations for repair or replacement of major defects found. The inspection was made according to generally recognized standards and procedures, but it is not implied that all defects were or could have been disclosed by this inspection.

The inspection findings and recommendations in this report were reviewed to ensure a proper level of quality and uniformity. The report adheres to State practices for inspections and current NJDOT standards.

Very truly yours,

Consultant XYZ

Sample - For State Bridges
(Consultant Report Cover Sheet)

NEW JERSEY DEPARTMENT OF TRANSPORTATION

BRIDGE EVALUATION SURVEY REPORT OF THE

Structure No. 0226-152
Route I-80
South Summit Avenue over I-80
Hackensack Township
Bergen County

CYCLE NO. 1
AUGUST, 1996

XYZ ENGINEERS, INC.
100 Lincoln Place
East Orange, New Jersey 07018

(FORMAT "A")

NEW JERSEY DEPARTMENT OF TRANSPORTATION
STRUCTURAL EVALUATION AND BRIDGE MANAGEMENT
EVALUATION BRIDGE SURVEY REPORT

CYCLE NO. 1

STRUCTURAL DATA

Bridge No.____________________ Year Built:_______ Reconstr/Widening:_______

Route No.__________ Mile Post ______ Length: __________ Width :__________

Name:____________________ Date of This Eval.: __________

____________________ By:____________________

____________________ Date of FCM/Pin Hanger Insp.: __________

By: ____________________
(Only When Special Inspections are applicable)

Municipality:____________________

Structure Type:____________________ County:____________________

____________________ Special Equipment Used:__________
(Include Photo)

____________________ Date of Underwater Insp:__________

____________________ Date of Special Testing:__________

____________________ Date of Electr./Mech. Insp.:__________
(Movable Bridges Only)

Overall Condition:__________ Scour Critical: yes/no
(If yes give reasons in Conclusions Section)

Component/ Material	Cond. Rating	General Remarks
DECK/TOP OF ROADWAY		
APPROACHES		

Superseded

Component/ Material	Cond. Rating	General Remarks
SUPERSTRUCTURE		
SUBSTRUCTURE		
CHANNEL/ WATERWAY/ COUNTERMEASURES		
SAFETY FEATURES		
DECK GEOMETRY		
UTILITIES		

The minimum vertical underclearance is ________________ under ____________.

The lateral clearance are: Left:__________ Right:__________

For waterways include horizontal and vertical clearances of the main channel span.

CONTROLLING RATINGS

Computer Program Used:______________

Based on the *load factor method of analysis, the following load ratings have been computed:

Truck Type Tons

Controlling Member		HS20	3	3S2	3-3
		36	25	40	40
End Floorbeam	Inventory Ratings	XX	XX	XX	XX
Interior Stringer	Operating Ratings	XX	XX	XX	XX

The inventory/operating ratings are low due to (give explanation/reasons).

*Working Stress or load factor/working stress could also be substituted depending on the method used to calculate the ratings.

CONCLUSIONS AND RECOMMENDATIONS:

The overall condition of the structure is ______________ due to ____________________.

((Provide a brief description and location of the fracture critical members or pin hanger details (specify when FCM's are internally redundant - i.e., riveted)).

A. **If the bridge is Structurally Deficient or Functionally Obsolete - Major work required:**

Due to the condition of the ________________ and/or inadequate ____________, we recommend the following repairs and/or remedial action:

(List recommendations for major repair work with quantities and cost estimates)

In the interim, until the structure is replaced/widened/lengthened/raised/etc., the following repairs/rehabilitation should be made to retard further deterioration, preserve the structural integrity of the bridge, improve safety and extend its useful life:

(List recommendations for interim repair work with quantities only)

Or if the primary recommendation [major work] is for rehabilitation only:

We also recommend that the following interim repairs be made, until the rehabilitation is implemented, to retard further deterioration, preserve the structural integrity of the bridge, improve safety and extend its useful life:

(List recommendations for interim repair work with quantities only)

If the bridge is Scour Critical - Include recommendations for providing countermeasures if not already provided or if monitoring devices are required or installed.

B. **If the bridge is not Structurally Deficient or Functionally Obsolete - No major work required:**

We recommend that the following repairs be made to retard further deterioration, preserve the structural integrity of the bridge, improve safety and extend its useful life:

(List recommendations for other repair work with quantities only)

For **Major Work** (to correct Structurally Deficient/Functionally Obsolete Conditions) include repairs with quantities and cost estimate.

For **Other Repairs** include quantities only.

Note: The following area(s) or structural member(s) should be inspected on an interim basis at the frequency indicated:

A.

B.

C.

FORMAT A - When ratings are calculated by both load factor and working stress

Structure No.: ____________________ Project: ________________________________

Name: ____

Rated By: __________ Date: _______________ Checked By: _________ Date: ____________

SUMMARY OF RATING

The Load Factor and Working Stress ratings, computed in the _______ and updated in the _______ cycle report in accordance with the FHWA directive dated November 1993 and AASHTO Manual for Condition Evaluation of Bridges, 1994, are as follows:

Note:
Include details of the analysis such as section losses, any assumptions made and the computer program used, etc.

Computer Program Used: ____

Allowable Stresses MPa (psi)

Material	**Yield**	**Inventory**	**Operating**
Concrete	XX ($f=_c$)	XX	XX
Reinforcing Steel	XX	XX	XX
Structural Steel	XX	XX	XX

Rating - Tons

	Truck Type	Load Factor		Working Stress	
Member	Tons	Inventory	Operating	Inventory	Operating
	Type HS20 – 36T	XX	XX	XX	XX
	Type 3 – 25T	XX	XX	XX	XX
	Type 3S2 – 40T	XX	XX	XX	XX
	Type 3-3 – 40T	XX	XX	XX	XX

FORMAT B - When ratings are calculated by load factor only

Structure No.: ______________________ Project: ____________________

Name: ____

Rated By: __________ Date: __________ Checked By: _________ Date: ________

SUMMARY OF RATING

The Load Factor ratings, computed in the ______ and updated in the ______ cycle report in accordance with the FHWA directive dated November 1993 and AASHTO Manual for Condition Evaluation of Bridges, 1994, are as follows:

Note:
Include details of the analysis such as section losses, any assumptions made and the computer program used, etc.

Computer Program Used: ______________________________________

Allowable Stresses - psi

Material	**Yield**
Concrete	XX (f'_c)
Reinforcing Steel	XX
Structural Steel	XX

		Rating - Tons	
	Truck Type	Load Factor	
Member	Tons	Inventory	Operating
	Type HS 20 - 36T	XX	XX
	Type 3 - 25T	XX	XX
	Type 3S2 - 40T	XX	XX
	Type 3-3 - 40T	XX	XX

FORMAT C - When ratings are calculated by working stress only

Structure No.: ____________________ Project: ________________________

Name: ____

Rated By: __________ Date: __________ Checked By: __________ Date: _______

SUMMARY OF RATING

The Working Stress ratings, computed in the ______ and updated in the _______ cycle report in accordance with the FHWA directive dated November 1993 and AASHTO Manual for Condition Evaluation of Bridges, 1994, are as follows:

Note:
Include details of the analysis such as section losses, any assumptions made and the computer program used, etc.

Computer Program Used : __________________________________

Allowable Stresses - psi

Material	**Yield**	**Inventory**	**Operating**
Concrete	XX (f'_c)	XX	XX
Reinforcing Steel	XX	XX	XX
Structural Steel	XX	XX	XX

		Rating - Tons	
		Working Stress	
Member	Truck Type (Tons)	Inventory	Operating
	Type HS 20 - 36T	XX	XX
	Type 3 - 25T	XX	XX
	Type 3S2 - 40T	XX	XX
	Type 3-3 - 40T	XX	XX

SAMPLE S I & A SHEET

DP. PT'S. 44.767 02/26/02

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF BRIDGE DESIGN - STRUCTURE INVENTORY AND APPRAISAL

PAGE 1
STATE ERROR NO
FEDERAL ERROR NO
LAST UPDATE 021102

AA ROUTE 295 8 STR. NO. 0429159 AB STRUCTURE NAME I-295 NB OVER NJ ROUTE 70

IDENTIFICATION

1 STATE NEW JERSEY
2 HIGHWAY DISTRICT 04
3 COUNTY CAMDEN
4 PLACE CODE 12280
A TOWN CHERRY HILL TWP.
5 INVENTORY ROUTE 111002950
6 FEATURES INTERSECTED NJ ROUTE 70
7 FACILITY CARRIED I-295 NB
9 LOC AT RT 70 INTERCHANGE
10 VERTICAL CLEAR 99 FT 99 IN
11 MILEPOINT 034.800
100 DEFENSE HIGHWAY YES
101 PARALLEL STRUCTURE R
102 DIRECTION OF TRAFFIC 1-WAY
103 TEMPORARY STRUCTURE
16 LATITUDE 39 D 54.5 M
17 LONGITUDE 074 D 59 .0 M
19 BYPASS DETOUR LENGTH 01 MI
20 TOLL 3 ON FREE ROAD
21 MAINTENANCE 01 NJDOT
22 OWNER 01 NJDOT

CLASSIFICATION

104 HIGHWAY SYSTEM INVENTORY ROUTE (1) ON NHS
26 FUNCTIONAL CLASS 11 INTERSTATE URBAN
98 BORDER BRIDGE
99 BORDER BRIDGE STRUCTURE NO

AC NON-INV.FEATURE
AD ADMINISTATIVE
AE ALTERNATE AGENCY
AF ALTERNATE STRUCTURE NO.

27 YEAR BUILT 1963
106 YEAR RECONSTR 0000
28 LANES ON/UNDER 04/06
29 ADT 052400
30 YR OF ADT 01
109 TRUCK ADTT 09 %
31 DESIGN LOAD HS-20
32 APP.RDWY WIDTH 052 FT
33 BR.MEDIAN NONE
34 SKEW 00 D
35 STRUC.FLARED NO
36 SAFETY FEATURES 1011
AG BR.RAILING TYPE 24
AH RAILING HT. 3 FT 06 IN
37 HISTORIC SIG 4
38 NAVIG. CONTROL N/A
39 NAV.VERT.CLEAR 000 FT
40 NAV.HOR.CLEAR 0000 FT
116 MIN.NAV.VRT.CL FT

STRUCTURE DATA

41 OPEN/CLOSE/POSTED A OPEN-NO RESTRICTION
42 TYPE OF SERVICE HIGHWAY/HWY W/WO PD
43 STRUC TYPE MAIN SPAN PRS CONC/STR/MB GR
44 STRUC TYPE APPR SPANS NONE
45 NUMBER OF SPANS MAIN 002
46 NUMBER OF APPROACH SPANS 0000
47 INVENT. ROUTE HORIZ. CLEAR 52.0 FT
48 MAXIMUM SPAN LENGTH 0063 FT
49 STRUCTURE LENGTH 000135 FT
50 SIDEWALK / CURB LEFT 01.5 FT RIGHT 01.5 FT
51 BRIDGE RDWY. WIDTH CURB TO CURB 052.0 FT
52 DECK WIDTH OUT TO OUT 057.0 FT
53 VERTICAL CLEARANCE OVER DECK 99 FT 99 IN
54 MIN. VERTICAL UNDERCLEARANCE H 15 FT 01 IN
DJ MIN.VERT.UNDER.(INC. SHOULDERS) 15 FT 01 IN
55 MIN.LAT.UNDERCLEARANCE RIGHT H 22.0 FT
56 MIN.LAT.UNDERCLEARANCE LEFT 08.5 FT
108 WEARING SURFACE/PROTECTIVE SYSTEM 100
A TYPE WEARING SURFACE 1 CONCRETE
B TYPE MEMBRANE 0 NONE
C TYPE DECK PROT 0 NONE

AI SPEED POSTING MPH
AJ SLOPE PROT. NONE
AK ABUT. FULL HEIGHT
AL PIER HAMMER HEAD
AM FILL OVER STRUCTURE . FT
AN PLAN AVAIL YES
AO UTILITY
AP FENDER SYSTEM NONE
AQ CHLK FNC HT FT IN
AR SPECIAL EQUIP.
AS SPECIAL TESTING
AT SPECIAL MATERIAL
AU ADD. STRUCT.TYPE
AV WIDENING TYPE
107 DECK STRUCT. TYPE 1
110 DESIG.NAT.NETWK YES
111 NAVIGATION PROT.
112 NBIS BRIDGE YES
92 CRITICAL FEATURE INS
A FRACT.CRIT.DET. NO
INSP.FREQUENCY MO
B UNDERWATER INSP NO
INSP.FREQUENCY MO
C OTHER SPEC.INSP. NO
INSP.FREQUENCY MO

CONDITION RATINGS

58 DECK 6
59 SUPERSTRUCTURE 5
60 SUBSTRUCTURE 5
61 CHANNEL AND CHAN. PROTECTION N
62 CULVERT N
BA APPROACH RDWY CONDITION 6
64 OPER.RATING 299
66 INV.RATING 230

APPRAISAL RATINGS

67 STRUCTURAL EVALUATION 5
68 DECK GEOMETRY 2
69 UNDERCLEARANCE VERT. & LAT. 6
70 BRIDGE POSTING 5
71 WATERWAY ADEQ. N
72 APPR. RDWAY ALIGNMENT 8

RAILROAD ITEMS

BB ORPHAN BRIDGE
BC USRA LINE CODE
BD RR TRKS ON/UNDR /
BE RR. MILEPOST

REMARKS

BF (58) DET DECK JOINTS
LESS THAN 2% SPALLS
MEDIUM TO WIDE CRACKS
DETERIORATED CURBS
EXPOSED REBARS
BG (59) COLLISION DAMAGE
EXPOSED STRANDS
RUSTED BEARINGS
BH (60) MEDIUM/WIDE CRACKS
SEVERE SPALLING
BI (61)
BJ (62)
LOAD FACTOR

REMARKS

BK PERCENT OVERSTRESS
113 SCOUR CRITICAL N N/A

PROGRAMMING

BL DISCRETIONARY FUNDS
BM FED.JOB NO. BR NBIS737
BN STATE JOB NUMBER 2203371
STATUS 2

PROPOSED IMPROVEMENTS (COSTS IN THOUSANDS)

75 TYPE OF WORK 331
76 IMPROVEMENT LENGTH 000135 FT
94 BRIDGE IMPROVEMENT COSTS $000119
95 ROADWAY IMPROVEMENT COST $000050
96 TOTAL PROJECT COST $000274
97 YEAR OF IMPROVEMENT COST ESTIMATE 99
114 FUTURE ADT 062800
115 YEAR OF FUTURE ADT 21
BO STATE MAINTENANCE COST $
BP BRIDGE TO BE DEMOLISHED/NO REPLACEMENT
DA DESCRIPTION OF PROPOSED IMPROVEMENTS
WIDEN STRUCT;INTERIM:UPGRD SFTY FTRS;PTCH DK SPLS;SL
APR SLB CRKS;CLN&SL PR DK JOINT;PTCH SUPRSTR
SPLS;CLN&PNT PIRE&ABUT BRNGS; PTCH SUBSTR SPLS;RMV
HVY VEG GRWTH FROM NEWW;RPLC MISING UTLTY POLE
SCREWS

OTHER INSP. DATES
93A FRAC.CRIT.INSP /
93B UNDERWATR INSP /
93C SPECIAL INSP. /
AW ME./EL. INSP. /
AX DECK COND SURV /
AY SPEC. TESTING /

RATINGS (TONS)

ITEMS	INV. BQ-BV	OPER. CA-CG
H TRUCK/LD1		
HSTRUCK/LD2	30	99
TYPE 3 /LD3	28	99
TY.3S2 /LD4	40	99
TY.3-3 /LD5	47	99
MIL.LD /LD8		
POSTED LOAD		
CH MISC. RATING		L
ADJ.INV. TONNAGE		
DEDUCT CODE		A

INSPECTION DATA

90 LATEST INSPECTION 01/02
CI CYCLE NUMBER 12
CJ TYPE INSPECTION S
91 DESIG.INSP. FREQ 24 MO
CK INSP. CREW 001 P
CL NEXT INSP. DATE 01/04
CM CONSUL. ARORA & ASSOC.
CN PREV.INSP. DATE S 01/00
CO PREV CONS ARORA & ASSOC.
CP FEDERAL REPORT YES
CQ BRIDGE LIST
CR OFF ROUTE BRIDGE

AZ FATIGUE DETAILS
LOC. 1
LOC. 2
LOC. 3

SUFFICIENCY RATING (FUNC OBS) 057.4

New Jersey Department of Transportation

SAMPLE - SUPPLEMENTAL BRIDGE INSPECTION FORM: ITEMS 58-62

Bridge No.	Bridge Name	Inspection Date
1418-154	Rt. I-280 EB over Passaic River	05/17/96

ELE #	ELEMENT DESCRIPTION	ENV	TOTAL QUANTITY	UNITS	QUANT CONDITION STATE 1	QUANT CONDITION STATE 2	QUANT CONDITION STATE 3	QUANT CONDITION STATE 4	QUANT CONDITION STATE 5
012	CONCRETE DECK	3		(SF)	000000	000000	000000	000000	009415
107	OPEN GIRDER STEEL	3		(LF)	000000	000000	000000	000000	000000
210	PIER WALL REINFORCED	3		(LF)	000028	000001	000000	000000	000000
215	ABUTMENT REINFORCED	3		(LF)	000074	000005	000003	000000	000000
234	PIER CAP REINFORCED	3		(LF)	000042	000000	000000	000000	000000
302	COMPRESSION JOINT SEAL	3		(LF)	000040	000030	000060	00000	00000
334	BRIDGE RAILING - METAL	3		(LF)	000426	000000	000000	000000	000000
359	SOFFIT (UNDERSUR) OF	3		EA	000000	000001	000000	000000	000000
361	SCOUR (SUBSTRUCTURE)	3		EA	000001	000000	000000	000000	000000
374	STEEL ROCKERS MOVEABLE	3		EA	000000	000008	000002	000000	000000
375	PINNED BEARING - FIXED	3		EA	000007	000003	000000	000000	000000
503	CURBS/SIDE-WALKS	3		(LF)	000411	000015	000000	000000	000000
506	WINGWALLS ABUTMENT	3		(LF)	000072	000000	000000	000000	000000

Traffic Accidents	On Structure	Under Structure
Avg Bypass Detour Speed	MPH	MPH
Avg Travel Speed	MPH	MPH
Avg Annual Accident Count		
School Bus Route		
Public Transit Route		
Critical Travel Facility		

CoRe Element Remarks

SEISMIC STRUCTURE REPORT (SAMPLE)

Structure Identification

Route: ____________ Structure Number: ____________ Mile Post: ________________

Structure Name: ____

Seismic Deck Information

Deck Thickness:

Abutment Joint Width:

Pier Joint Width:

Seismic Superstructure Information

Beams Main Span:

Structure Type:

Seismic Substructure Information

Abutment Seat Width:
Pier Seat Width:
Column Reinforcement:
Column Cross Section:
Column Height:
Column F'c:
Longitudinal Reinforcement:
Pile Embedment:
Type of Pier:
Type of Abutment:

Seismic Bearing Information

Bearing Height:
Number of Anchor Bolts:
Anchor Bolt dimensions:
Pin Diameter:
Shoulder Dimensions:
Alignment Bearing:
Transverse Restraint:

PONTIS ELEMENTS CODED FOR STRUCTURE

Element Number	Category	Material	Description
012	DECK	CONCRETE	CONCRETE
359	SMART FLAGS	OTHER	SOFFIT (UNDERSUR) OF DECKS & SLABS (DECK ELEMENTS)
334	DECK	METAL	BRIDGE RAILING - METAL COATED
503	DECK	CONCRETE	CURBS/SIDEWALKS CONCRETE
302	JOINTS	OTHER	COMPRESSION JOINT SEAL
107	SUPERSTRUCTURE	STEEL	OPEN GIRDER STEEL PAINTED
374	BEARINGS	STEEL	STEEL ROCKERS MOVEABLE - EXPANSION
375	BEARINGS	STEEL	PINNED BEARING - FIXED
234	SUBSTRUCTURE	CONCRETE	PIER CAP REINFORCED CONCRETE
210	SUBSTRUCTURE	CONCRETE	PIER WALL REINFORCED CONCRETE
215	SUBSTRUCTURE	CONCRETE	ABUTMENT REINFORCED CONCRETE
506	SUBSTRUCTURE	OTHER	WINGWALLS ABUTMENT (CONC MASONRY TIMBER)
361	SMART FLAGS	OTHER	SCOUR (SUBSTRUCTURE ELEMENTS)

1.41.4 RE-EVALUATION SURVEY REPORT FORMAT - B -

The report of the results of a re-evaluation bridge survey and rating of an existing bridge, performed by or for the Department, shall adhere to the following format:

(A). **REPORT COVER SHEET:** The report's cover sheet shall utilize the same form as indicated in Format A (see attached sample in Format B).

The cover sheet colors shall be the same as specified under Format A.

The report shall be bound using a standard 3-hole punch type binding.

(B). **LETTER OF TRANSMITTAL (CONSULTANT PROJECTS ONLY):** The letter of transmittal shall be addressed as shown in Format A (see sample in Format A).

(C). **TABLE OF CONTENTS:** One page indicating items 1 thru 9 in order shown as follows and providing the page number in the report on which each item starts. All pages in the report shall be numbered (i.e. Cycle No.- Page No.) at the bottom and centered.

Page No.

1. **Maps:** Two maps, are required as specified in Format A. If the previous bridge survey report contains up-to-date General Location and Local Maps done to the required specifications, no maps are required.

2. **Structural Data:** A summary of findings and work done shall be included as indicated in Format A.

3. **Controlling Ratings:** The ratings shall be provided as indicated in Format A (give reference to the bridge survey report cycle where the detailed rating computations were made if not calculated in the current cycle report).

4. **Conclusions & Recommendations**: Conclusions shall be provided as indicated in Format A. Also, comment on any major changes in the condition of all components since the previous bridge survey report cycle. If no changes have occurred, include a statement to that effect.

5. **Appendix 1 - Structure Inventory & Appraisal Sheet/PONTIS/Seismic Data:** This section should contain the above listed data forms as indicated in Format A.

6. **Appendix 2 - Computations:** In this section, include computations of ratings for various major bridge components as indicated in Format A.

7. **Appendix 3 - Drawings, Soundings & Photographs:** This section shall contain bridge drawings, sounding sketches, photo location plan sketch and photographs as indicated in Format A.

8. **Appendix 4 - Field Notes:** Provide field notes or CADD sketches as specified in Format A in this section.

9. **Appendix 5 - Underwater Inspection:** In this section, include the diver's inspection report (if applicable) or other additional appendices as specified in Format A.

Sample - For State Bridges
(Consultant Report Cover Sheet)

NEW JERSEY DEPARTMENT OF TRANSPORTATION

BRIDGE RE-EVALUATION SURVEY REPORT OF THE

Structure No. 0226-152
Route I-80
South Summit Avenue over I-80
Hackensack Township
Bergen County

CYCLE NO. 2
AUGUST, 1996

XYZ ENGINEERS, INC.
100 Lincoln Place
East Orange, New Jersey 07018

(FORMAT "B")

NEW JERSEY DEPARTMENT OF TRANSPORTATION
STRUCTURAL EVALUATION AND BRIDGE MANAGEMENT
RE-EVALUATION BRIDGE SURVEY REPORT

CYCLE NO._______

STRUCTURAL DATA

Bridge No.____________________ Year Built: _______ Reconstr/Widening:______

Route No.______ Mile Post_______ Length: ____________ Width:____________

Name:________________________ Date of This Eval.:____________________

By:________________________________

Date of FCM/Pin Hanger Insp.: ____________

By: ________________________________
(Only when Special Inspections are applicable)

Date of Prev. Eval.:____________________

Structure Type:________________ By:________________________________

Special Equipment Used:__________________
(Include Photo)

Date of Underwater Insp:_________________

Date of Special Testing:__________________

Date of Electr./Mech. Insp.:_______________
(Movable Bridges Only)

Overall Condition:______________ Scour Critical: yes/no

Work Done:____

Component/ Material	Cond. Rating	General Remarks
DECK/TOP OF ROADWAY		
APPROACHES		

Component/ Material	Cond. Rating	General Remarks
SUPERSTRUCTURE		
SUBSTRUCTURE		
CHANNEL/ WATERWAY		
SAFETY FEATURES		
DECK GEOMETRY		
UTILITIES		

The minimum vertical underclearance is ____________ under _________________

The lateral clearance are: Left:_________ Right:__________

For waterways include horizontal and vertical clearances of the main channel span.

<u>CONTROLLING RATINGS</u> (From ________ Cycle Report):

Computer Program Used: ____

Based on the <u>*load factor</u> method of analysis, the following load ratings have been computed:

		Truck Type - Tons			
Controlling Member		<u>HS 20</u>	<u>3</u>	<u>3S2</u>	<u>3-3</u>
		36T	25T	40T	40T
End Floorbeam	Inventory Ratings	XX	XX	XX	XX
Interior Stringer	Operating Ratings	XX	XX	XX	XX

The inventory/operating ratings are low due to <u>(give explanation/reasons).</u>

- Working Stress or load factor/working stress could also be substituted depending on the method used to calculate the ratings.

CONCLUSIONS AND RECOMMENDATIONS:

For explanation of the requirements for this section, refer to Format A.

Note: The following area(s) or structural member(s) should be inspected on an interim basis at the frequency indicated:

A.

B.

C.

1.41.5 RE-EVALUATION SURVEY REPORT FORMAT - C -

The report of the results of a re-evaluation bridge survey and rating of an existing bridge, performed by or for the Department, shall adhere to the following format:

(A). **REPORT COVER SHEET:** The report's cover sheet shall utilize the same form as indicated in Format A (see attached sample in Format B).

The cover sheet colors shall be the same as specified under Format A.

The report shall be bound using a standard 3-hole punch type binding.

(B). **LETTER OF TRANSMITTAL (CONSULTANT PROJECTS ONLY):** The letter of transmittal shall be addressed as shown in Format A (see sample in Format A).

(C). **TABLE OF CONTENTS:** The table of contents shall utilize the same form as shown under Format B.

1. **Maps:** Two maps are required as specified in Format A. If the previous bridge survey report contains up-to-date General Location and Local Maps done to the required specifications, no maps are required.

2. **Structural Data:** A summary of the work done since the previous bridge survey shall be included as per the attached format. The remaining items in this format are self-explanatory.

3. **Controlling Ratings:** The ratings shall be provided as indicated in Format A (give reference to the bridge survey report cycle where the detailed rating computations were made).

4. **Conclusions & Recommendations:** State the overall condition of the structure (consistent with SI&A Item 67) and include a paragraph summarizing the conditions of the various components to justify their being coded as they are. For large or complex structures, it may be necessary to include one paragraph for each component rather than one long paragraph. If an underwater inspection has been conducted and no repairable defects were discovered, the underwater inspection should be noted here. If repairable defects were discovered by the diver, appropriate remedial repairs should be included in the report.

   Conclusions shall be provided as indicated in Format A. Also, comment on any major changes in the condition of all components since the previous bridge survey report cycle. If no changes have occurred, include a statement to that effect.

5. **Appendix 1 - Structure Inventory & Appraisal Sheet/PONTIS/Seismic Data:** This section should contain the above listed data forms as indicated in Format A.

6. **Appendix 2 - Computations:** In this section, include computations of ratings for various major bridge components as indicated in Format A.

7. **Appendix 3 - Drawings, Soundings & Photographs:** This section shall contain bridge drawings, sounding sketches, photo location plan sketch and photographs as indicated in Format A.

8. **Appendix 4 - Field Notes:** Provide field notes or CADD sketches as specified in Format A in this section.

9. **Appendix 5 - Underwater Inspection:** In this section, include the diver's inspection report (if applicable) or other additional appendices as specified in Format A.

(FORMAT "C")

NEW JERSEY DEPARTMENT OF TRANSPORTATION
STRUCTURAL EVALUATION AND BRIDGE MANAGEMENT
RE-EVALUATION BRIDGE SURVEY REPORT

CYCLE NO._______

STRUCTURAL DATA

Bridge No.________________________ Year Built:_______ Reconstr/Widening:________

Route No.________ Mile Post_____ Length: ____________Width:_______________

Name:___________________________ Date of This Eval.:________________________

___________________________ By:____________________________________

___________________________ Date of FCM/Pin Hanger Insp.: _____________

By: __________________________________
(Only when Special Inspections are applicable)

Structure Type:_____________________ Date of Prev. Eval.:________________________

___________________________ By:____________________________________

___________________________ Special Equipment Used:____________________
(Include Photo)

Date of Underwater Insp:____________________

Date of Special Testing:_____________________

Date of Electr./Mech. Insp.:__________________
(Movable Bridges Only)

Overall Condition:___________________ Scour Critical: yes/no

Work Done:____

CONTROLLING RATINGS (see Format B for the requirements of this section)

CONCLUSIONS AND RECOMMENDATIONS:

The overall condition of the structure is _______________ due to _____________________.

The deck is in __________ condition due to ________________. The approaches are in ___________ condition due to ___________. The superstructure is in _____________ condition due to _____________. The substructure is in __________________ condition due to ________________. The channel is in _____________ condition due to _____________. (List the significant defects which are the main reasons for the condition ratings of the above structural elements. If an element has no significant defects - i.e., coded 6 or higher, it should be deleted from the above).

Since the previous inspection ____
(Give brief description of significant changes in the condition of the various components. Do not include work done in this section.)

((Give a brief description and location of the fracture critical members or pin hanger details (specify when FCM's are internally redundant - i.e., riveted)). Also, comment if bridge is scour critical and if countermeasures or monitoring devices have been provided/installed.

For an explanation of the remainder of this section, refer to Format A.

1.41.6 INTERIM SURVEY REPORT FORMAT - D -

The report of the results of an interim bridge survey and rating of an existing bridge, performed by or for the Department, shall adhere to the following format:

(A). **REPORT COVER SHEET:** The report's cover sheet shall include the bridge number, name, route number, municipality, county and the month and the year of the bridge survey (see attached sample in Format D).

The report shall be bound using a standard 3-hole punch type binding.

(B). **LETTER OF TRANSMITTAL (CONSULTANT PROJECTS ONLY):** The letter of transmittal shall be addressed as shown in Format A (see sample in Format A):

(C). **TABLE OF CONTENTS:** One page indicating items 1 thru 8 in order shown on the following page and providing the page number in the report on which each item starts. All pages in the report shall be numbered at the bottom and centered.

Page No.

1. **Structural Data:** A summary of findings and work done shall be included as per the attached format. The items in this format are self-explanatory.

2. **Controlling Ratings:** The ratings should include the controlling member and controlling Inventory and Operating Ratings of the bridge.

3. **Reasons for Interim Survey:** Indicate specifically the areas or members of the bridge requiring an interim inspection. These areas could be locations of deterioration such as loss of concrete under a bearing or a tilted wingwall. They also could be structure members with low operating ratings (list all members with low operating ratings) or fracture critical members.

4. **Current Condition:** Indicate the current condition of the items identified in the previous section. Also, state if any changes have occurred since the last survey (in-depth or interim).

5. **Conclusions & Recommendations:** Conclusions resulting from the interim bridge evaluation survey regarding the items inspected should be given here. Also, include possible explanation of the causes of any inadequacies found. If the bridge is posted, state so, giving the posted limits (load or speed) and should be referenced to photos clearly showing the posted weight or speed limits.

   Make specific new recommendations for safety improvements, major repair work (i.e. structure rehabilitation and/or replacement, raising superstructure, bridge widening, etc. to correct Structurally Deficient/Functionally Obsolete conditions) and other repair work to correct significant defects, deterioration and inadequacies found during this interim bridge survey. The intent is to list any new repairs which are needed, not to repeat the recommendations from the latest bridge evaluation survey report. If no new repairs are necessary, this should be stated.

   The recommendations should be specific about the location of defects and the methods of repair. The recommendations for other repair work should be listed in the order of priority. Each recommendation should be referenced to the photos. For major repair work, provide cost estimates. For other repair work, provide quantities only.

6. **Appendix 1 - Structure Inventory & Appraisal Sheet/PONTIS/Seismic Data:** This section should contain the above listed data forms as indicated in Format A.

7. **Appendix 2 - Computations:** In this section, include computations of ratings for various major bridge components as indicated in Format A.

8. **Appendix 3 - Drawings, Soundings & Photographs:** This section shall contain bridge drawings, sounding sketches, photo location plan sketch and photographs as indicated in Format A with the following exceptions:

   Photographs of one elevation and plan view plus all areas of the bridge inspected during the interim bridge evaluation survey are required.

Sample - For State Bridges
(Consultant Report Cover Sheet)

NEW JERSEY DEPARTMENT OF TRANSPORTATION

INTERIM EVALUATION SURVEY REPORT
OF THE

Structure No. 0226-152
Route I-80
South Summit Avenue over I-80
Hackensack Township
Bergen County

AUGUST, 1996

XYZ ENGINEERS, INC.
100 Lincoln Place
East Orange, New Jersey 07018

(FORMAT "D")

NEW JERSEY DEPARTMENT OF TRANSPORTATION
STRUCTURAL EVALUATION AND BRIDGE MANAGEMENT
INTERIM BRIDGE SURVEY REPORT

FREQUENCY:______ MONTHS

STRUCTURAL DATA

Bridge No.________________________

Year Built:________
Reconstr/Widening:_________

Route No.________ Mile Post______

Length: ____________Width:______________

Name:____________________________
____
____

Date of This Eval.:______________________

By:__________________________________

*Date of Previous Interim Survey:___________

Structure Type:__________________
____
____
____

*By:___________________________________
(*Use only if there was another interim survey after the last routine survey.)

Date of Last Routine Eval:_________________

By:__________________________________

Special Equipment:_______________________
(Include Photos)

Overall Condition:_________________

Scour Critical: yes/no

Work Done:____

REASONS FOR INTERIM SURVEY:

CURRENT CONDITION OR CHANGES IN ITEMS INSPECTED:

CONCLUSIONS AND RECOMMENDATIONS:

We recommend that the following repairs or rehabilitation be made to retard further deterioration, preserve the structural integrity of the bridge, improve safety and extend its useful life: ____

In addition to any recommendations noted here, all of the recommendations from the previous reports (routine or interim) are still in effect if not already completed.

Next interim inspection is recommended at _________ month intervals.

1.41.7 GUIDELINES FOR CADD BRIDGE EVALUATION SURVEY FIELD INSPECTION DRAWINGS

A. GENERAL

Recording of the field bridge survey data on computer generated drawings/sketches are intended to essentially replace the existing handwritten field notes and sketches.

The purpose of utilizing CADD drawings in bridge inspection is two fold:

1. To provide a visual representation of the bridge conditions in place of verbal descriptions in the bridge survey report (field notes).

2. To facilitate Electronic Storage and updating of bridge conditions and clearances observed during subsequent bridge survey cycles.

Using the existing bridge plans, base plans for various bridge components will be developed for the purpose of taking notes during the field inspection as well as for final report presentation. All base plans will be prepared on 11 by 17 inch sheets, or for small bridges, on 8½ by 11 inch sheets and made appropriately proportioned taking advantage of CADD flexibilities. For example, varying scales can be used lengthwise and widthwise, etc. North arrows should be oriented vertically or to the left when the CADD drawing is placed in the report.

The Department's CADD system is based on Intergraph Microstation. Therefore, it is required that CADD drawings be developed using Intergraph Microstation or Intergraph Microstation PC software programs. However, it is acceptable to use other CADD software submitted in Intergraph Microstation. All CADD drawing files must be submitted to the Department with the final report and each bridge must be submitted on a separate diskette. The diskette size must be 3½ inches and formatted on DOS. Two (2) copies of each diskette are required.

B. TYPICAL DRAWINGS

It is recommended that the same approximate scale be used for the base plan of the following drawing categories 1, 2 and 3:

1. Clearances, Soundings and Photo Locations:

Use one sheet for any bridge up to approximately 492 feet in length. The plan will show the general bridge plan (roadway), elevation view and all features it crosses (highways, waterways, railroad, etc.). All the measurements such as minimum and maximum vertical and lateral underclearances, lane widths, curb-to-curb deck width, span length, sidewalk or median widths, etc. should be field verified and recorded. All clearances and photo locations should be shown on the plan view while the soundings should be shown on the elevation view. The sounding plot should also include the plot from the initial sounding survey and a statement as to whether or not the channel profile has changed since the previous survey. When the length of the structure makes the scale of the drawing too small for plotting soundings or showing clearances, separate drawings should be provided. NOTE: Soundings must bedone in accordance with the current edition of the "UnderwaterInspection and Evaluation of New Jersey Bridges Guidelines Manual" and subsequent modifications.

2. Deck:

Approaches, approach guide rails and at least two (2) end spans (deck) should be shown on one sheet. For multi-span bridges (viaducts), use additional sheets for the top of the deck as necessary.

Underdeck CADD sheets should also show the framing (thin or dashed line) when applicable to facilitate the location of defects relative to the stringers, floorbeams, diaphragms, etc.

3. Superstructure:

Layered framing, if applicable, should be used to clearly show the deterioration of a member in each layer (stringer, floorbeams, etc.). The number of sheets required will depend on the length of the structure, number of spans and the complexity of the superstructure. Bearings should be shown on the bridge seat plan.

For movable bridges, CADD drawings for trusses and/or towers should be part of the superstructure.

4. Substructure:

These drawings should show the breastwall, bridge seat with (or without) bearing pedestals, wingwalls (projected), backwall, slope protection or all four faces of a pier to a suitable approximate scale. Any other substructure features (retaining walls, etc.) should be included as a vertical (or horizontal) projection adjacent to wingwalls.

For abutments, 1 (one) sheet per bridge should be used.

For piers, the number of sheets required will depend on the configuration and the number of piers. Normally three (3) piers can be shown on each sheet.

Abutment and pier plans will be prepared individually by taking advantage of similarities, if any.

For bridges with complex framing, bridges over five spans, or structures with severe deterioration, a summary sheet should include the description of the major findings of each component (deck, superstructure, substructure, channel, etc.) to supplement the CADD information. Also, the maximum length of bridge covered per sheet should be in the range of 45 meters or one to three spans as determined by the Engineer with the approval of the Project Manager.

Examples of typical CADD drawings which are deemed to be acceptable to the Department are attached following the Standard Defect Codes. These drawings are provided to show a representation of what the Department expects in CADD drawings.

C. STANDARD DEFECT CODES

The following guidance is provided to indicate common defects with codes on sketches. Codes used on a sheet should have their description given at the bottom left hand part of the sheet.

Defect codes shall be a three digit code. The first digit shall correspond to the material category based on the following:

C - Concrete
S - Steel
T - Timber
M - Misc.

The second digit describes the type of defect, e.g. scaling, rusting, erosion, etc.

The third digit shall indicate the severity of the defect.

Codes will begin with the letter "A" indicating less severe or minor defects with alphabetically increasing severity, e.g.:

a. Cracks:	A = Fine B = Medium C = Wide
b. Spalls	A = Incipient Spall B = Small Spall C = Large Spall
c. Scaling	A = Light B = Moderate C = Severe

The following is a list of codes developed for each category which by no means should be considered as a complete listing. It only serves as a guide and covers the most common defects and should be supplemented by full descriptions of other defects not easily categorized.

Also, where the bridge inspector believes further elaboration of a defect designated by the code is necessary, an additional sketch of the noted location (i.e. cross section of a beam, measurement of the defect, % loss of bearing area, etc.) should be provided to illustrate the defect observed. Inspectors are encouraged to use additional notes as needed to describe other defects or to further elaborate and locate defects described with codes.

It is very important to quantify the defects such as indicating the length of medium and wide cracks or areas of spalled and scaled concrete to facilitate comparison in future surveys and preparation of estimates. Make sure to include concrete patched spalled areas in the deck separately.

DEFECT SUMMARY

CONCRETE (C)

Defect Code	Type Defect	Severity A	B	C
1	Cracking	Fine	Medium	Wide
2	Cracking with Efflorescence	Fine	Medium	Wide
3	Efflorescence/ Exudation	Light	Moderate	Heavy
4	Scaling	Light	Moderate	Severe
5	Spalling	Small	Large	Large (+)

6	Spalling with Exposed Steel	Small	Large	Large (+)
7	Encasement Deterioration	Minor spalls	Det. w/ cracks	Det. w/ Exposed Steel

DEFECT SUMMARY

STEEL (S)

Defect Code	Type Defect	Severity A	B	C	D
1	Paint Failure	Random Peeling	Up to 3%	Up to 10%	>10%
2	Rusting	Spot	Light	Moderate	Severe
3	Corrosion with Section Loss	Up to 10%	Up to 20%	Up to 30%	>30% (Specify %)
4	Collision Damage	Minor Scrapes	Local Buckling	Major Deform. No need for NDT.	Major Deform. NDT required

Please provide location and description of Fatigue Details. Use letters as per AASHTO Details.

DEFECT SUMMARY

TIMBER (T)

Defect Code	Type Defect	Severity A	B	C
1	Decay/Rotting	Minor	Moderate	Severe
2	Checks	Fine	Medium	Wide
3	Splits	Minor	Moderate	Severe
4	Section Loss	Up to 10%	Up to 20%	Over 20% (Specify %)
5	Deflection	Minor	Moderate	Severe

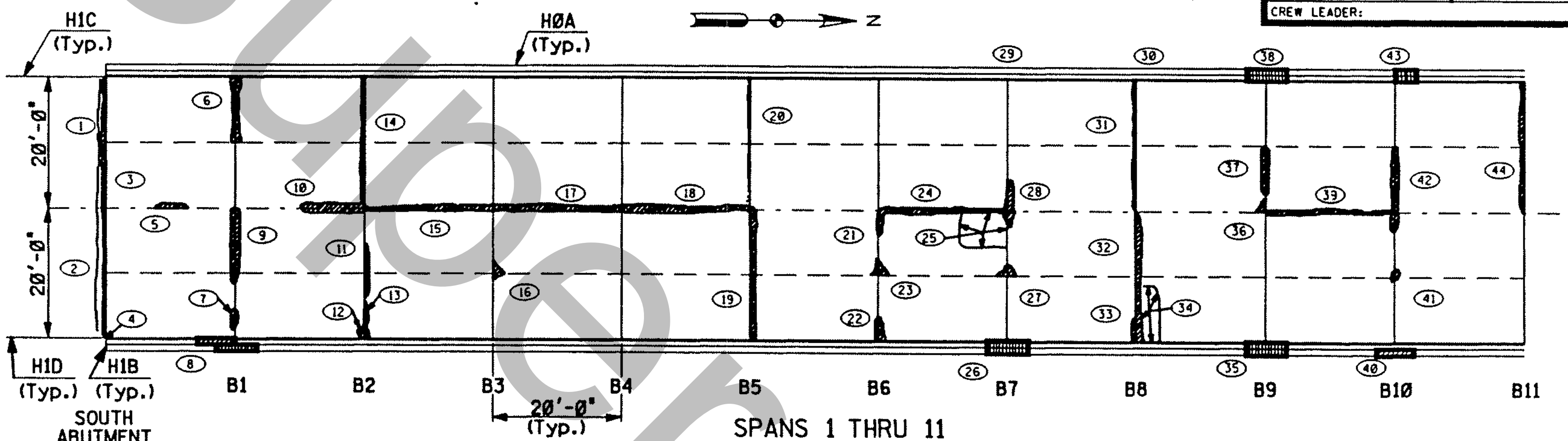
DEFECT SUMMARY

MISCELLANEOUS (M)

Defect Code	Type Defect	Severity A	B	C
1	Approach Settlement	Up to ½ inch	Up to 1 inch	> 2 inches (Specify Amt.)
2	Appr. Railing Broken/Damaged	Minor	Moderate	Severe
3*	Excessively Expanded Bearing	Minor	Moderate	Severe
4*	Excessively Contracted Bearing	Minor	Moderate	Severe
5	Joint Deterioration	Minor	Moderate	Severe

*Specify degree of tilt on rocker bearings and temperature of steel

ROUTE: NJ 52	STRUCTURE NO. Ø511-152	
DATE OF INSP: 1Ø/92	CYCLE NO. 7	
CREW LEADER:		



SPANS 1 THRU 11

DEFECT SUMMARY					
NO.	CODE	REMARKS	NO.	CODE	REMARKS
1	M7C	FULL ROADWAY WIDTH	23	C5A	< 1 S.F.
2	M1A	¾" ACROSS FULL ROADWAY	24	C5A	FULL SPAN LENGTH
3	C5A	FULL ROADWAY WIDTH	25	C4B	7'-6" W/SM. POPOUTS
4	C5A	6"×3" HOLE	26	M3B	4" W/C6A IN NF RAIL
5	C5A	< 1 S.F.	27	C5B	4"
6	C5A	2 S.F. TOTAL	28	C5B	8" W/M4C
7	C5B	1 S.F.	29	C1C	FULL HEIGHT OF POST, BOTH E & W FACES
8	C6B	3 S.F. ALONG CURB W/4" C4C BEHIND RAIL	30	M2B	COLLISION DAMAGE
9	C5A	3 S.F. TOTAL	31	C5A	FULL WIDTH, SB ROADWAY
10	C5B	5 S.F. TOTAL	32	C5A	4" TOTAL
11	C5A	1 S.F. TOTAL	33	C5A	1'-Ø" TOTAL
12	C6A	< 1 S.F.	34	C8A	2'-7" W/ISO C8B
13	C5B	2 S.F.	35	C6A	< 4" OF RAIL POST
14	C5A	FULL WIDTH, SB ROADWAY	36	C5B	8"
15	C5A	FULL SPAN LENGTH	37	C5A	8" TOTAL
16	C5B	1 S.F.	38	C6A	< 4" OF RAIL POST
17	C5A	FULL SPAN LENGTH	39	C5A	FULL SPAN LENGTH
18	C5A	FULL SPAN LENGTH	40	C5A	< 4"
19	C5B	1Ø S.F. TOTAL	41	C5A	< 4"
20	C5A	FULL WIDTH, SB ROADWAY	42	C5A	1'-Ø" TOTAL
21	C5A	< 1 S.F.	43	C6A	< 4" OF RAIL POST
22	C5B	1 S.F.	44	C5A	FULL WIDTH, SB ROADWAY

CRACK SUMMARY					
	FINE	MEDIUM		WIDE	
SPAN	GENERAL COMMENTS	NUMBER OF CRACKS	TOTAL LENGTH	NUMBER OF CRACKS	TOTAL LENGTH
1	ISOLATED	—	—	—	—
2	ISOLATED	5(1 DIAG.)	4Ø FT	—	—
3	SCATTERED	—	—	—	—
4	SCATTERED	—	—	—	—
5	SCATTERED	—	—	—	—
6	ISOLATED	—	—	—	—
7	ISOLATED	—	—	—	—
8	SCATTERED	—	—	—	—
9	ISOLATED	—	—	—	—
1Ø	ISOLATED	2	15 FT	—	—
11	SCATTERED	1	1Ø FT	—	—

LEGEND

- ○ INDICATES OPEN DRAIN
- ◎ INDICATES CLOGGED DRAIN
- ● INDICATES ASPHALT PATCH
- INDICATES SPALL
- INDICATES SCALING/DISINT.

100 0 100 200 400

1:100

NOTES:

a). All Cracks are Transverse Unless Otherwise Noted.

b). Moderate To Heavy Debris (Typical) Throught Gutterlines.

c). Light Scaling (Typical) Throughout Wheel Lines

d). Fine Pattern Cracks Scattered Throughout.

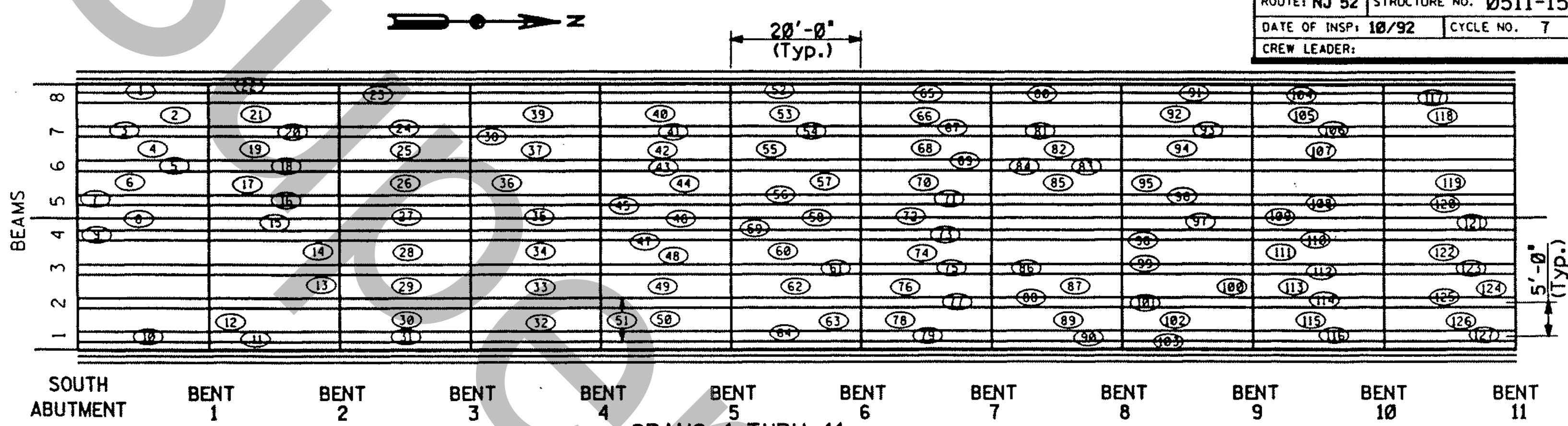
e). For Defect Legend and Number Sequence, See "DEFECT CODES" Sheet.

INSPECTED BY:	
CADD OPERATOR:	
CHECKED BY:	
SUPERVISED BY:	

RTE. 52 OVER ELBOW THOROFARE

DECK PLAN - 1

ROUTE: NJ 52	STRUCTURE NO. Ø511-152	
DATE OF INSP: 1Ø/92		CYCLE NO. 7
CREW LEADER:		



SPANS 1 THRU 11

DEFECT SUMMARY

NO.	CODE	REMARKS
1	C5C	5 -3/8" LONGIT CRKS EACH SIDE & BTM
2	C5C	10 S.F. W/ 3 S.F. C5B IN BMS 7 & 8
3	C2C	3/8" LONGIT W/ADJ SPALLS (5 S.F.)
4	C5C	25 S.F.
5	C6B	3'-0" x 1'-0", 2" DEEP W FACE
6	C6A	15 S.F. TOTAL W/ 10 S.F. C5C
7	C8B	ALONG SIDES
8	C3C	1/8" LONGIT W/ MOD TO HVY EFFL
9	C8B	BTM W/ 1'-0" x 3'-0", 1" DEEP C5B @ ABUT
10	C2B	1/16". FULL LENGTH E FACE
11	C2C	1" LONGIT W/ ADJ RUST STAINS
12	C6B	2'-0" DIA. W/ HVY EFFL
13	C6A	1'-0" x 1'-0", 1" DEEP W/ HVY EFFL
14	C5A	< 1 S.F.
15	C3C	TYP SEEPAGE THRU LONGIT JT
16	C2C	1", FULL LENGTH
17	C6B	25 S.F. W/ 40% REBAR LOSS
18	C2C	TWO 3/8" LONGIT (BTM & SIDES)
19	C6A	5 S.F. TOTAL W/ ISO DELAM
20	C2C	3/8" FULL LENGTH ON BTM
21	C6B	10 S.F. W/ ISO SPALLS & DELAM
22	C2C	3/8" LONGIT ON W FACE
23	C2C	1" LONGIT ON W FACE & BTM
24	C6B	2", FULL LTH, E FACE W/50% REBAR LOSS
25	C6A	5 S.F. TOTAL
26	C6B	45 S.F. (GENERAL SPALLS & DELAM)
27	C3C	TYP SEEPAGE THRU LONGIT JT
28	C6B	30 S.F. (GENERAL SPALLS & DELAM)
29	C6B	30 S.F. (GENERAL SPALLS & DELAM)
30	C6B	30 S.F. (GENERAL SPALLS & DELAM)
31	C6B	2'-6"x17'-9", 2" DEEP W FACE BM, 100% STIRRUP LOSS
32	C5C	41 S.F. DELAM
33	C6A	10 S.F. CORE LOCATION & RND DELAM
34	C5C	15 S.F. DELAM
35	C3C	TYP SEEPAGE THRU LONGIT JT
36	C6B	25 S.F. TOTAL
37	C6A	10 S.F. TOTAL
38	C2C	3/8" ON S HALF, E FACE
39	C6A	5 S.F. TOTAL
40	C6A	< 1 S.F. (CORE LOCATION)
41	C5C	2" LONGIT/10 S.F. BTM & E FACE
42	C5C	10 S.F. TOTAL
43	C0C	1-3/8", FULL LENGTH CRK @ BTM 2" BM
44	C5C	15 S.F. TOTAL
45	C2C	TWO LONGIT (BTM&SIDES) W/ADJ 5 S.F. C5B
46	C3B	MOD SEEPAGE THRU LONGIT JT
47	C2C	1" LONGIT 10 S.F. (I) EDGE SPALLS
48	C6A	10 S.F. TOTAL
49	C6B	20 S.F. TOTAL
50	C6B	30 S.F. TOTAL
51	C2C	3/8" LONGIT, BTM BMS 1& 2
52	C6B	1'-0"x10'-0", 2" DEEP, 50% E FACE FROM B5
53	C6A	5 S.F. TOTAL
54	C5C	1" LONGIT CRK, 50% E & W FACES @ MIDSPAN
55	C6A	3 SPALLS, 10 S.F. TOTAL
56	C5C	0.3x3.0 M, 50 MM DEEP @ B6 W/ 25 MM LONGIT CRK
57	C6A	5 S.F. TOTAL
58	C6A	1'-0"x3'-0", 3" DEEP W/ TYP C3C THRU LONGIT JT
59	C2B	6'-0", 1/16" LONGIT (ALL SIDES) W/ ADJ RUST STAINS
60	C6B	16 S.F. W/ ADDT'L 2'-0" DIA C5B
61	C2C	3/8" LONGIT ON 75% OF E FACE
62	C6B	5 S.F.
63	C6B	27 S.F.
64	C2B	1/16" LONGIT, W FACE W/ LT EFFL
65	C2C	3/8" FULL LENGTH BTM W/ ADJ RUST STAINS
66	C6A	2'-0" DIA
67	C5C	SEVERAL 1/16" BTM LONGIT CRKS, BTM 2" (I) SP
68	C6B	10 S.F. TOTAL, MOSTLY @ B6
69	C0A	1/16" E FACE LONGIT CRKS
70	C6A	10 S.F. TOTAL
71	C5C	TWO 1/16" BTM LONGIT CRKS, BTM 1" (I) SP
72	C3B	TYP SEEPAGE THRU LONGIT JT
73	C5C	1'-0"x17'-9", 2" DEEP ON E FACE
74	C6A	(<1 S.F.) DUE TO LACK OF REBAR COVER
75	C2C	1", FULL LENGTH, W FACE
76	C6A	5 S.F. TOTAL
77	C2C	TWO 3/8" BTM FULL LENGTH
78	C6A	10 S.F. TOTAL
79	C2C	3/8" FULL LENGTH
80	C2C	1-3/8" E SIDE & BTM, FULL LENGTH
81	C2C	1" W SIDE & BTM, FULL LENGTH
82	C5C	10 S.F. TOTAL (HOLLOW)
83	C6B	1'-0"x5'-0", 4" DEEP BTM BM W/ 40% REBAR LOSS
84	C5C	50% BTM & ALL E FACE
85	C6A	10 S.F. TOTAL
86	C2C	1" FULL LENGTH E FACE & BTM
87	C6A	10 S.F. TOTAL
88	C2B	1/16" LONGIT ON E & W FACES
89	C6A	<1 S.F. (CORE LOCATION)
90	C2C	3/8" FULL LENGTH W FACE & BTM
91	C5C	1'-0" x FULL LENGTH, 3" DEEP OF BTM
92	C6A	5 S.F. TOTAL
93	C5C	2'-0" x FULL LENGTH, 4" DEEP OF BTM
94	C6B	10 S.F. @ B8 & MIDSPAN
95	C5C	5 S.F. BELOW GUNITE REPAIR
96	C2C	3/4" FULL E FACE LENGTH
97	C3B	TYP SEEPAGE THRU LONGIT JT
98	C2C	TWO 3/8" FULL LENGTH BTM
99	C6B	1'-0"x7'-0", 3" DEEP W FACE CORNER @ B8
100	C6B	1'-8" ADJ B9
101	C5C	TWO 1" FULL LENGTH BTM CRKS
102	C5A	<1 S.F. @ B8
103	C5C	1'-0" FULL LENGTH, 2" DEEP OF BTM
104	C5C	FULL LENGTH E FACE (1" LONGIT CRK)
105	C6A	9 S.F. TOTAL
106	C6B	FULL LENGTH x 3" DEEP
107	C0D	5 S.F. POOR GUNITE W/ REBAR EXPOSED
108	C5C	FULL LENGTH E FACE (1" LONGIT CRK)
109	C3C	TYP SEEPAGE THRU LONGIT JT
110	C6B	1'-0"x12'-0", 2" DEEP E FACE CORNER
111	C6A	5 S.F. @ B9
112	C5C	FULL LENGTH E FACE & BTM
113	C6A	2 S.F. TOTAL
114	C0C	1/16" FULL LENGTH E FACE GUNITE
115	C6A	2 S.F. TOTAL
116	C2B	3'-0", 1/16" LONGIT @ B10
117	C2C	TWO 1" FULL LENGTH W/ ADJ 2 S.F. C5B
118	C6A	3 S.F. TOTAL
119	C0D	5 S.F. POOR GUNITE W/ REBAR EXPOSED
120	C2B	1/16" FULL LENGTH E FACE, 8" FROM BTM
121	C3C	TYP SEEPAGE THRU LONGIT JT
122	C5C	10 S.F. @ B8
123	C0C	3/8" LONGIT CRK, 75% W FACE & BTM
124	C6B	TWO SPALLS, 32 S.F. TOTAL, W/ 40% REBAR LOSS
125	C2B	1/16" LONGIT ON E & W FACES
126	C6B	15 S.F. TOTAL
127	C2B	1/16" FULL LENGTH E & W FACES

INSPECTED BY:	
CADD OPERATOR:	
CHECKED BY:	
SUPERVISED BY:	

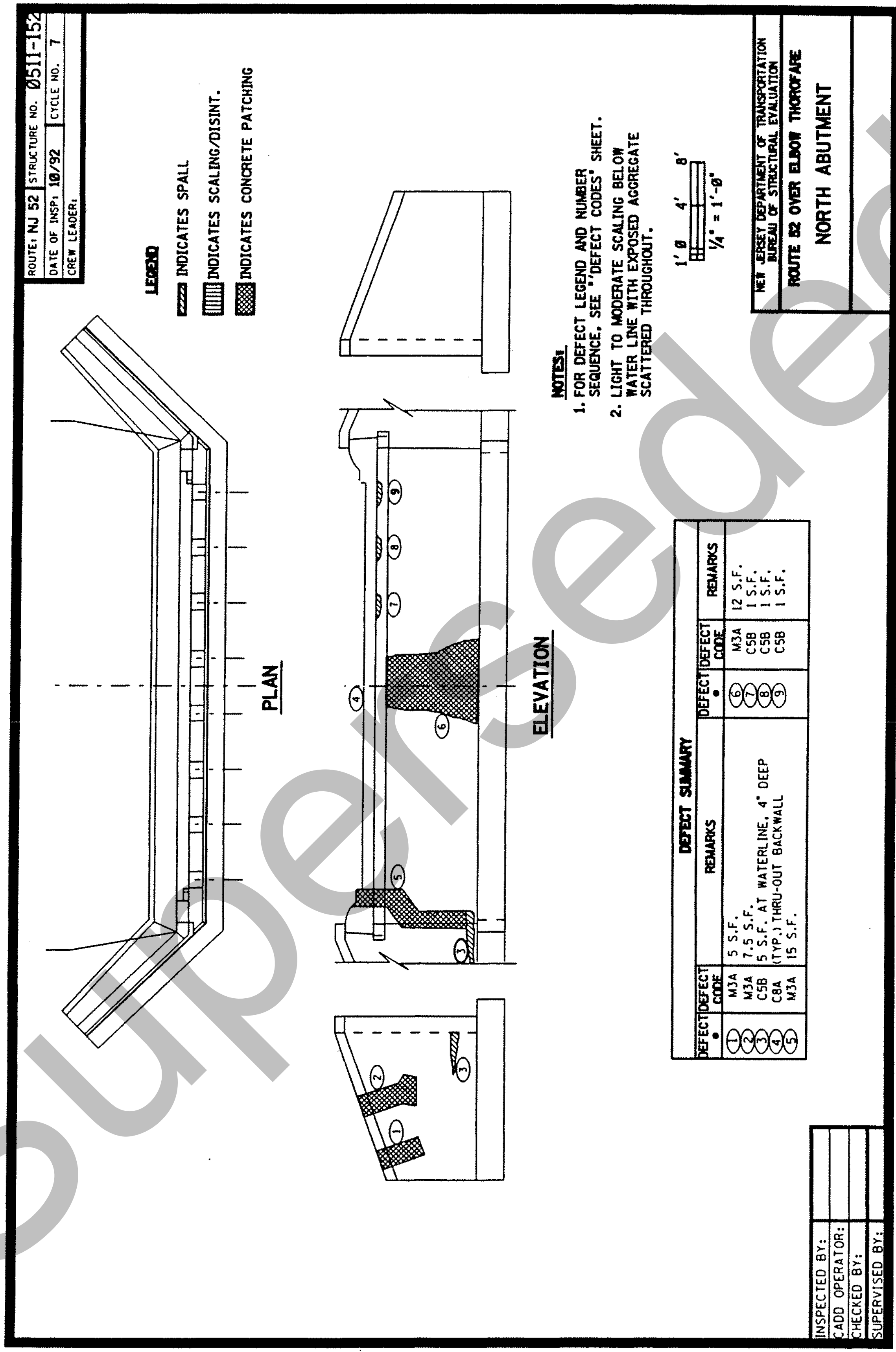
NOTE:
FOR DEFECT LEGEND AND NUMBER SEQUENCE, SEE "DEFECT CODES" SHEET.

1'Ø 8' 16'
1/8" = 1'-Ø"

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL EVALUATION

RTE. 52 OVER ELBOW THOROFARE

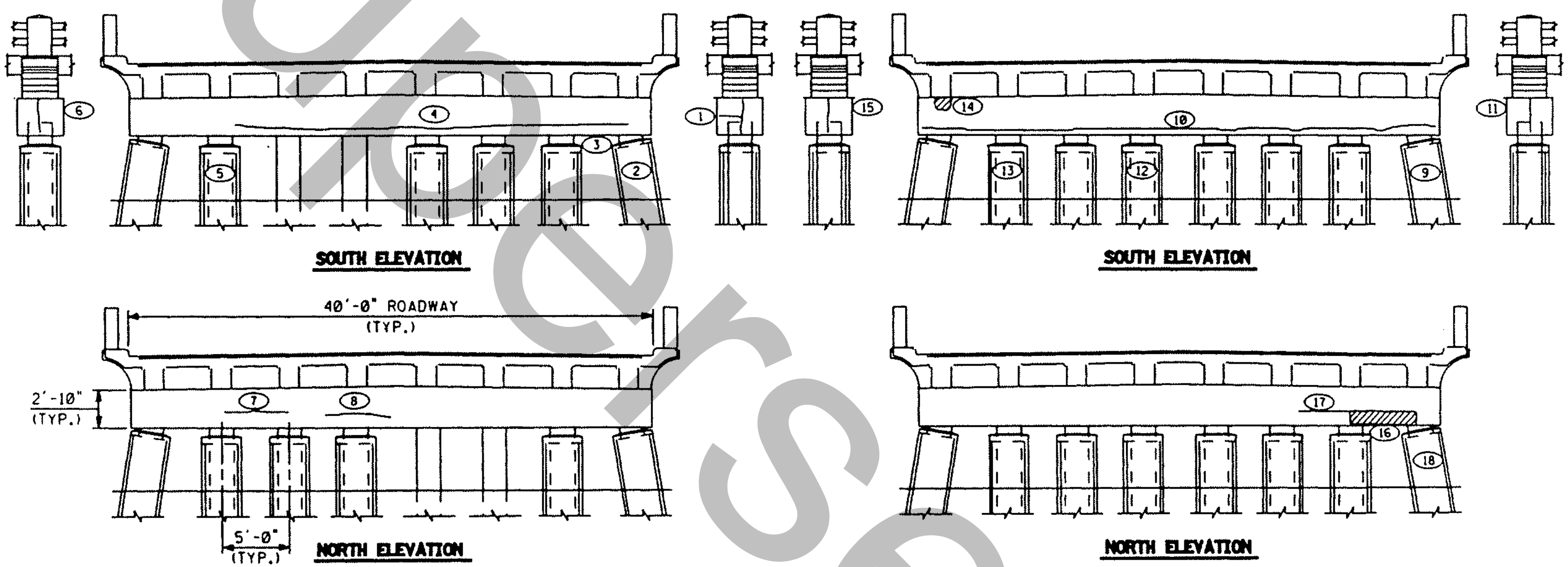
FRAMING PLAN - 1



DEFECT SUMMARY

DEFECT #	DEFECT CODE	REMARKS	DEFECT #	DEFECT CODE	REMARKS
1	M3A	5 S.F.	6	M3A	12 S.F.
2	M3A	7.5 S.F.	7	C5B	1 S.F.
3	C5B	5 S.F. AT WATERLINE, 4" DEEP	8	C5B	1 S.F.
4	C8A	(TYP.) THRU-OUT BACKWALL	9	C5B	1 S.F.
5	M3A	15 S.F.			

ROUTE: NJ 52	STRUCTURE NO. Ø511-152
DATE OF INSP: 1Ø/92	CYCLE NO. 7
CREW LEADER:	



NOTES:

1. FOR DEFECT LEGEND AND NUMBER SEQUENCE, SEE "DEFECT CODES" SHEET.
2. FINE MAP CRACKING WITH LIGHT EFFLORESCENCE SCATTERED THROUGHOUT PILE CAPS.

DEFECT SUMMARY

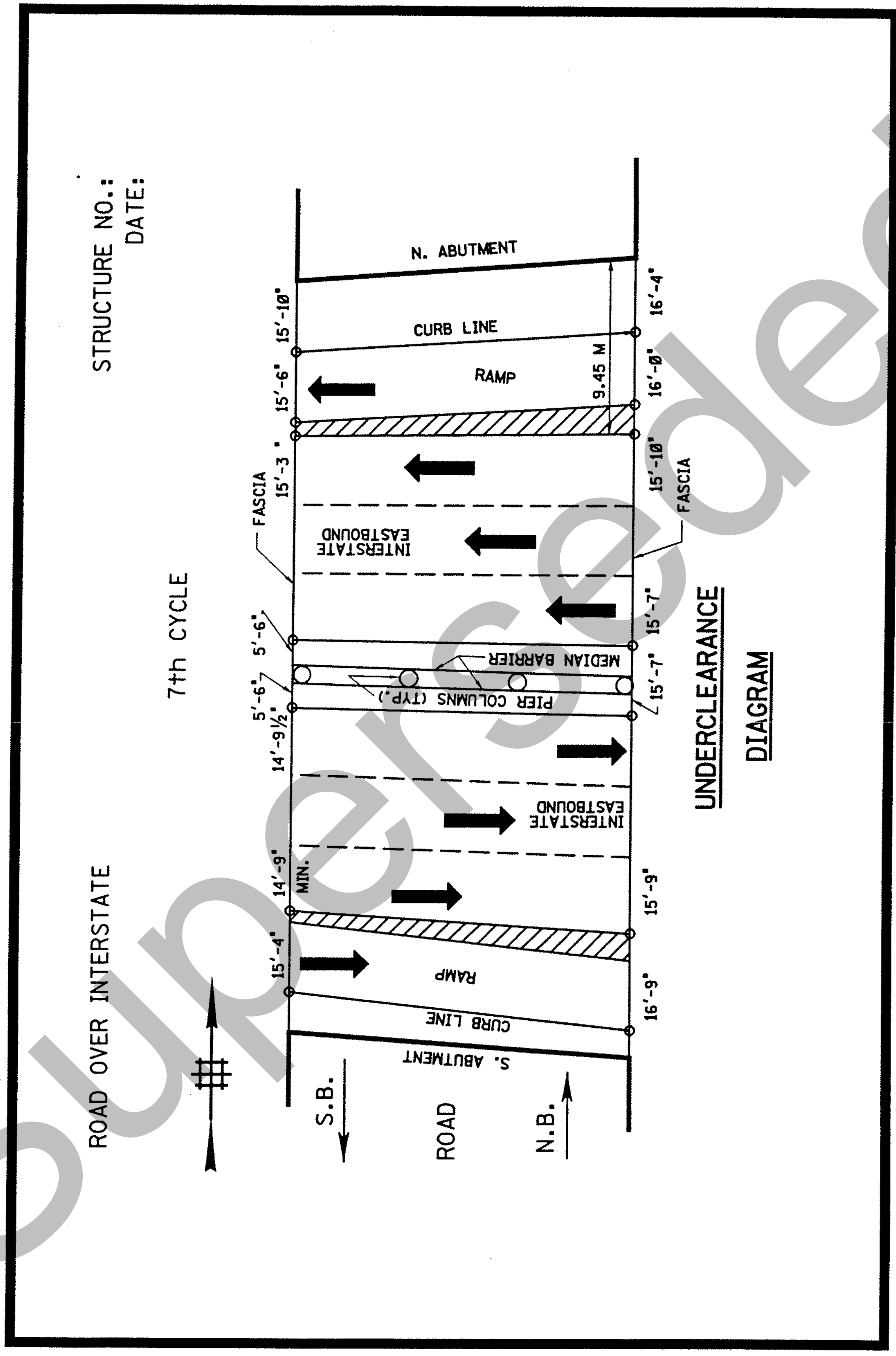
DEFECT #	DEFECT CODE	REMARKS	DEFECT #	DEFECT CODE	REMARKS
1	C1B	HORIZ AND VERT	10	C1A	HORIZ, FULL LENGTH OF CAP
2	C7B	1'-0"X2'-0" AREA	11	C1A	FULL HEIGHT VERT
3	C6B	8"	12	C7C	80% OF ENCASEMENT
4	C1A	30' HORIZ	13	C7C	90% OF ENCASEMENT
5	C7C	2'-0" MX FULL CIRCUM	14	C5B	1 S.F., 1" DEEP
6	C1A	3'-0" VERT	15	C1A	FULL HEIGHT VERT
7	C1B	5'-0" HORIZ	16	C6B	1'-0"x1'-0"x5'-0" LONG
8	C1B	5'-0" HORIZ	17	C1B	4'-0" HORIZ
9	C7C	90% OF ENCASEMENT	18	C7B	30% OF ENCASEMENT

INSPECTED BY:	
CADD OPERATOR:	
CHECKED BY:	
SUPERVISED BY:	

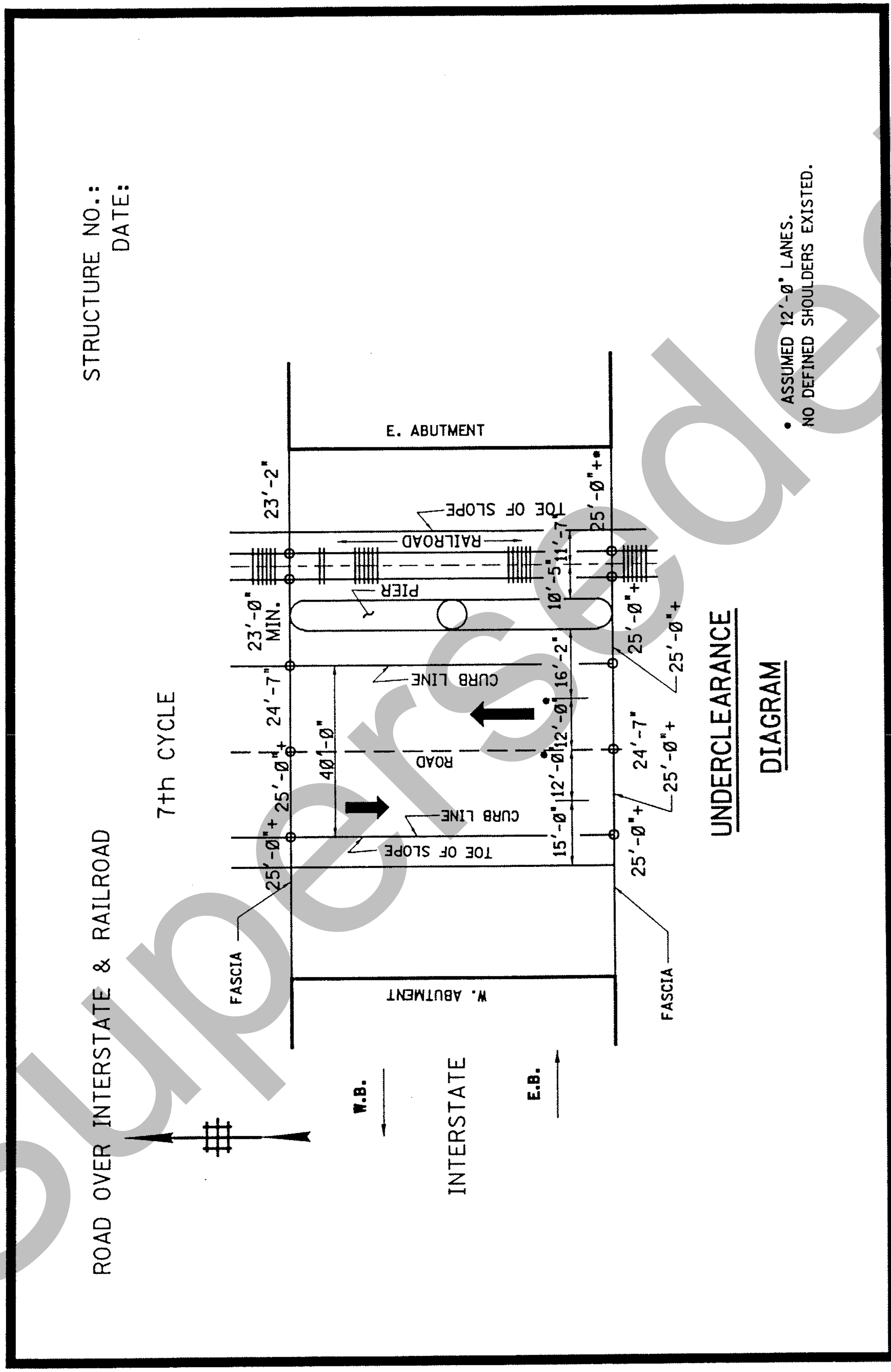
NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL EVALUATION

ROUTE 52 OVER ELBOW THOROFARE

BENTS 1 AND 2



STRUCTURE NO.:
DATE:
7th CYCLE
ROAD OVER INTERSTATE
N. ABUTMENT
CURB LINE
RAMP
9.45 M
15'-10"
16'-4"
15'-6"
16'-0"
15'-3"
15'-10"
FASCIA
FASCIA
INTERSTATE EASTBOUND
5'-6"
15'-7"
MEDIAN BARRIER
PIER COLUMNS (TYP.)
5'-6"
15'-7"
14'-9½"
INTERSTATE EASTBOUND
14'-9" MIN.
15'-9"
15'-4"
RAMP
16'-9"
CURB LINE
S. ABUTMENT
S.B.
ROAD
N.B.
UNDERCLEARANCE DIAGRAM


STRUCTURE NO.:
DATE:
ROAD OVER INTERSTATE & RAILROAD
7th CYCLE
E. ABUTMENT
W. ABUTMENT
TOE OF SLOPE
RAILROAD
PIER
CURB LINE
ROAD
FASCIA
INTERSTATE
W.B.
E.B.
UNDERCLEARANCE
DIAGRAM
• ASSUMED 12'-Ø" LANES.
NO DEFINED SHOULDERS EXISTED.
23'-2"
23'-Ø" MIN.
24'-7"
25'-Ø"+
4Ø'-Ø"
16'-2"
12'-Ø"
15'-Ø"
10'-5"
11'-7"

SECTION 42

RAILROAD CARRYING BRIDGE EVALUATION PROGRAM

1.42.1 EVALUATION SURVEY REPORT FORMAT - AR - (FOR RAILROAD CARRYING BRIDGES)

The report of the results of a Bridge survey and rating of an existing railroad bridge, performed by or for the Department, shall adhere to the following format:

(A). **REPORT COVER SHEET:** The report's cover sheet shall include the bridge number, name, railroad milepost, route number, USRA. line code, municipality, county, bridge survey cycle number and the month and the year of the bridge survey (see attached sample).

The cover sheet colors for various cycles shall be: First cycle: White; Second cycle: Pink; Third cycle: Green; Fourth cycle: Yellow; Fifth cycle: Orange; Sixth cycle: Red; Seventh cycle: Blue; Eighth cycle: White; Ninth cycle: Pink; Tenth cycle: Green, etc.

The report shall be bound using a standard 3-hole punch type binding.

(B). **LETTER OF TRANSMITTAL (CONSULTANT PROJECTS ONLY):** The letter of transmittal shall be addressed as follows (see attached sample):

Manager, Structural Evaluation
New Jersey Department of Transportation
1035 Parkway Avenue
PO Box 615
Trenton, New Jersey 08625-0600
ATTN: Project Manager (Name)

Re: Bridge Survey and Rating of Bridge Number, Name, Railroad Milepost and Route Number

In addition, the letter should include the date of the agreement with the New Jersey Department of Transportation and any disclaimer and/or restrictions on the information contained in the report and its use and the due date for the submission of the particular report (preliminary or final). Also, include a Quality Assurance Statement for the structure.

(C). **TABLE OF CONTENTS:** One page indicating items 1 thru 11 in order shown as follows and providing the page number in the report on which each item starts. All pages in the report shall be numbered (i.e. Cycle No.- Page No.) at the bottom and centered.

Page No.

1. **Maps:** Two maps, are required: one "General Location Map" and the other, a more detailed and specific "Local Map". Each map shall be on a separate 8½ by 11 inches sheet and include the structure, name, railroad line, route number, railroad milepost and feature intersected (located in lower right corner).

   a. **General Location Map:** For **State** owned bridges a map of the entire state of New Jersey, scale approximately 1: 1 000 000, pin pointing the location of the structure being reported on (by bridge number, name, railroad milepost and route number). This map should show railroad lines, with their USRA Line Code number and principal cities and/or towns along each line.

   b. **Local Map:** A current map of the immediate vicinity of the reported structure; scaling 1: 20 000 with the structure centered on the page. Include roads, railroads, waterways, county and township names and a north arrow. Features intersecting the bridge should be clearly labeled.

2. **Structural Data:** A summary of findings shall be included as per the attached format. The items in this format are self-explanatory, however, further explanation for some items is provided as follows:

   a. **Component/Material:** The components shall be as listed in Format "AR" only. Type of material used for majority of construction shall be given below the component in the same vertical column. Delete the components which are not applicable.

   b. **Condition Rating:** The condition rating of various components shall be the overall rating of the component as per the current FHWA

Appraisal of Bridges along with NJDOT Railroad Coding Instructions and should be consistent with the ratings given on field notes and SI&A sheet.

c. **General Remarks:** Summarize the significant defects and give a brief account of what was found during the bridge survey, as it relates to the structural integrity of the bridge. Defects for which repairs are recommended must be mentioned. Photos of these defects should be referenced in this section.

The Deck section should include the condition of the top and underside of the deck (concrete slab, ties and ballast plate), walkways, bridge railing, etc. For reinforced concrete decks give the percentage of spalled area (open or patched) and estimated contaminated area (underdeck).

The Superstructure section should include the condition of main load carrying members and diaphragms (include percent loss of section if any) and the bearings.

The Substructure section should include the condition of the abutments, pier(s), retaining walls, crash walls etc., and information on scour or undermining.

The terminology used throughout the evaluation bridge survey report for various elements shall be in accordance with the following:

Concrete: Describing concrete conditions shall be as defined and illustrated in the ACI Journal, November 1968, Report of ACI Committee 201 "Guide for Making a Condition Survey of Concrete in Service".

Steel: Describing steel conditions shall be as defined and illustrated in "Bridge Inspector's Training Manual 90" as published by the U.S. Department of Transportation, Federal Highway Administration.

Timber: Describing timber conditions shall be as defined in accordance with AREMA Chapter 7, Part 1.

The Safety Features section should include the adequacy of the guard rails, guard members, alignment of approach rail, field measured minimum clearances and where they occur (minimum vertical clearance above and below the bridge, and lateral underclearance left and right as per SI&A coding requirements and AREA track clearances). For bridges over waterways, horizontal and vertical clearances of the waterway channel should also be given as per field measurements.

3. **Controlling Ratings:** In this section give the "As-Built" and "As-Inspected Ratings" of the controlling member and a speed restriction chart. The rating and chart shall be computed in accordance with the current "American Railway Engineering Association Manual for Railway Engineering", and all subsequent Interim AREMA Manual specifications, and as interpreted and modified in Subsection 1.42.5, "Rating of Existing Railroad Structures". Also, comment on why the ratings are low, if it is the case, and what controlled the ratings (e.g. bending, shear, horizontal shear, etc).

4. **Conclusions & Recommendations:** Conclusions resulting from the bridge evaluation survey regarding the adequacy (structural, clearances, etc.) of the bridge and any unusual or special conditions indicating higher expenditures required to uphold rail service on a given line should be given here. Also, include possible explanations of the causes of any inadequacies found.

   Make specific recommendations for safety improvements, major repair work (i.e. structure rehabilitation and/or replacement), and other repair work to correct significant defects, deteriorations and inadequacies found during this bridge survey.

   The recommendations should be specific about the location of defects and the methods of repair. The recommendations for other repair work should be listed in the order of priority. Each recommendation should be referenced to the photos. For major repair/ rehabilitation work, provide cost estimates, however, for other repair work, provide quantities only.

   All recommendations along with repair and/or replacement shall be based on upgrading all members to a level where inventory ratings are sufficient to sustain the maximum anticipated loading condition (Equivalent Cooper E).

   In addition, list all areas of deterioration or structural members which should be inspected at frequencies of less than two years and indicate the inspection cycle in months for each area or member. Be very specific about locations to be inspected.

5. **Historical Information:** If available, this information should include when and under what agency the structure was built; when and by whom any subsequent additions or improvements to the structure, trackline, waterway channels, clearances, track changes, etc. were made. A detailed description with reference to photographs and drawings if possible should be furnished for any of the above changes. Also include, if different from current designations, the railroad and branch in use when the bridge was built.

6. **Bridge Description:** Furnish a brief description of the structure. Include the type of construction, materials in the deck, superstructure and substructure components, and important dimensions. A more detailed description should be given if plans are not available.

7. **Appendix 1 - Structure Inventory & Appraisal Sheet:** This section should contain a 8½ by 11 inches computer print out of the "Structure Inventory and Appraisal Sheet" (two or more sheets for structures carrying railroads over highways). This sheet will be developed by the Department from the Computer Input sheets submitted with the preliminary report and coded in accordance with the current FHWA Recording and Coding Guide for the Inventory and Appraisal of the Nations Bridges and Recording and Coding Guide for the Structure Inventory and Appraisal of New Jersey Bridges and supplemented by the Railroad Coding Instructions. For the final report, include only the computer printout (supplied by the State).

8. **Appendix 2 - Computations:** In this section, include computations made in arriving at the various ratings given in Section 3 of the report. Include a summary as the first page of the computations listing all ratings with page number references and the allowable stresses used (see attached samples).

9. **Appendix 3 - Drawings, Soundings & Photographs:** A plan sketch indicating the direction and location of the photographs should be included. Bridge drawings (plan, elevation and cross section) etc. and color photographs (35mm prints) plus color slides of unique defects should be included in this section of the report. Also, sounding sketches completed in accordance with the current edition of the "Underwater Inspection and Evaluation of New Jersey Bridges Guidelines Manual " should be included.

   Photographs of both full elevations and track views, upstream and downstream views (if applicable), all significant defects, any repairs made and any special equipment used (Cherry Picker, maintenance and protection of traffic, special ladders, etc.) should be included in the report. The photographs should be placed in the report in the following order: Elevations, Track Views, Stream Views, Deck, Approaches, Superstructure, Substructure, Channel, Safety Features and Special Equipment.

10. **Appendix 4 - Field Notes:** Detailed clear hand written field notes using the Department's current Field Note Format for the type of structure being surveyed and/or CADD field sketches should be included as back-up data for the report. Field notes should include measurements taken during the bridge survey. A sample of the current Field Note forms and CADD sketches can be obtained from the Structural Evaluation/Bridge Management Unit.

11. **Appendix 5 Underwater Inspection:** In this section, include the diver's inspection report (if applicable) done in accordance with the current edition of the "Underwater Inspection and Evaluation of New Jersey Bridges Guidelines Manual". Also, include as additional appendices any special reports such as fatigue analysis, ultrasonic testing, chemical analysis, coupon testing, hydraulic analysis, geotechnical streambed analysis, etc. Provide photographs showing the equipment used.

Sample - For State Bridges
(Consultant Report Cover Sheet)

NEW JERSEY DEPARTMENT OF TRANSPORTATION

BRIDGE EVALUATION SURVEY REPORT
OF THE

Structure No. 1609-152
Boonton Line over Rt. 80
RR MP 20.18
Route 5080
USRA Line Code 6101
Wayne Township
Passaic County

CYCLE NO. 1
AUGUST, 1996

XYZ ENGINEERS, INC.
100 Lincoln Place
East Orange, New Jersey 07018

Sample Letter of Transmittal
(Preliminary/Final Report)

Manager
Structural Evaluation
New Jersey Department of Transportation
Engineering and Operations Building
1035 Parkway Avenue
PO Box 615- 5th Floor
Trenton, New Jersey 08625-0600

Attn: Mr. __________, Project Manager

Evaluation Bridge
Survey & Rating of
Structure No.
Route No.
Structure Name

Gentlemen:

In accordance with our Agreement No. BI with the New Jersey Department of Transportation, dated , we are pleased to submit this PRELIMINARY REPORT/FINAL REPORT for the above referenced bridge. A scanned and indexed report will be submitted on CD by a separate transmittal.

The report covers the results of a field inspection of the structure and recommendations for repair or replacement of major defects found. The inspection was made according to generally recognized standards and procedures, but it is not implied that all defects were or could have been disclosed by this inspection.

The inspection findings and recommendations in this report were reviewed to ensure a proper level of quality and uniformity. The report adheres to State practices for inspections and current NJDOT standards.

Consultant XYZ

(FORMAT "AR")

NEW JERSEY DEPARTMENT OF TRANSPORTATION
STRUCTURAL EVALUATION UNIT
EVALUATION BRIDGE SURVEY REPORT
FOR RAILROAD CARRYING BRIDGES

CYCLE NO._______

STRUCTURAL DATA

Bridge No.____________________________

Route No._______ RR Mile Post_______

Name:________________________________

Line/Branch:__________________________

USRA Line Code:______________________

Structure Type:_______________________

____

____

____

Year Built:_______
Reconstr/Widening:____________

Length:_____________Width:_________________

Date of This Eval.:__________________________

By:____

Date of FCM/Pin Hanger Inspection: __________

By: _______________________________________

(Only when special inspections are applicable)

Municipality:______________________________

County:____________________________________

Special Equipment Used:____________________
(Include Photo)

Date of Underwater Insp:____________________

Date of Special Testing:_____________________

Date of Electr./Mech. Insp.:__________________
(Movable Bridges Only)

Overall Condition:______________________

Component/ Material	Cond. Rating	General Remarks
DECK		

Component/ Material	Cond. Rating	General Remarks
APPROACHES (Condition of Rail & Track Bed)		
SUPERSTRUCTURE		
SUBSTRUCTURE		
CHANNEL/ WATERWAY		
RAILROAD SAFETY FEATURES		

The minimum vertical underclearance is ____________ under ___________________________.

The lateral clearances are: Left __________ Right ______________.

For waterways include horizontal and vertical clearances of the main channel span.

CONTROLLING RATINGS

Controlling Member		As Built	As Inspected	Remarks
End Floorbeam	Inventory Ratings			
Interior Stringer	Operating Ratings			

Controlling Live Load — Equivalent Cooper E

CONCLUSIONS AND RECOMMENDATIONS:

The overall condition of the structure is _______________ due to _____________________.

((Give a brief description and location of the fracture members or pin-hanger details (specify when FCM's are internally redundant - i.e., riveted)).

A. If the bridge does not meet current geometry and/or load standards - Major work required:

Due to the condition of the _________________ and/or inadequate _______________, we recommend the following repairs and/or remedial action:

(List recommendations for major repair work with quantities and cost estimates)
In the interim, until the structure is replaced/widened/lengthened/raised/etc., the following repairs/rehabilitation should be made to retard further deterioration, preserve the structural integrity of the bridge, improve safety and extend its useful life:

(List recommendations for interim repair work with quantities only)

Or if the primary recommendation (major work) is for rehabilitation only:

We also recommend that the following interim repairs be made, until the rehabilitation is implemented, to retard further deterioration, preserve the structural integrity of the bridge, improve safety and extend its useful life:

(List recommendations for interim repair work with quantities only)

B. If the bridge meets current geometry and load standards - No major work required.

We recommend that the following repairs be made to retard further deterioration, preserve the structural integrity of the bridge, improve safety and extend its useful life:

(List recommendations for other repair work with quantities only)

Note: The following area(s) or structural member(s) should be inspected on an interim basis at the frequency indicated:

A.

B.

C.

Route: __________________ Project: BR/BR-Z-NBIS (XXX)

Made By: ________________ Date: _________Checked By: _________Date: ___________

SUMMARY OF RATING

The ratings, computed in the _______ and updated in the _______ cycle report in accordance with the Current AREMA Manual as modified by the New Jersey Department of Transportation in the current Design Manual for Bridges and Structures:

Allowable Stresses - MPa (psi)

Material	**Yield**	**Inventory**	**Operating**
Concrete	XX (f'_c)	XX	XX
Reinforcing Steel	XX	XX	XX
Structural Steel	XX	XX	XX

(The summary of all ratings shall be listed in accordance with the following charts).

FOR STEEL AND CONCRETE MEMBERS

COOPER E RATING ANALYSIS
INVENTORY RATINGS

Structure Number ________________ Controlling Cooper E Rating ________________

Member	Capacity of Bridge Cooper E Load				Equivalent Cooper E Loading of Equipment (For Proper Span Length)										Remarks
	As Built		As inspected		Load # 1		Load # 2		Load # 3		Load # 4		Load # 5		
	E Moment	E Shear	E Moment	E Shear	E Moment	E Shear	E Moment	E Shear	E Moment	E Shear	E Moment	E Shear	E Moment	E Shear	

Note: E = Cooper Load

FOR STEEL AND CONCRETE MEMBERS

COOPER E RATING ANALYSIS
OPERATING RATINGS

Structure Number ____________________ Controlling Cooper E Rating ________________

Member	Capacity of Bridge Cooper E Load				Equivalent Cooper E Loading of Equipment (For Proper Span Length)										Remarks
	As Built		As inspected		Load # 1		Load # 2		Load # 3		Load # 4		Load # 5		
	E Moment	E Shear	E Moment	E Shear	E Moment	E Shear	E Moment	E Shear	E Moment	E Shear	E Moment	E Shear	E Moment	E Shear	

Note: E = Cooper Load

Superseded

FOR TIMBER MEMBERS

COOPER E RATING ANALYSIS
INVENTORY RATINGS
ASSIGNED LOCOMOTIVES

Structure Number ___________________ Controlling Cooper E Rating ________________

Member	Capacity of Bridge Cooper E Load				Equivalent Cooper E Loading of Equipment (For Proper Span Length)										Remarks
	As Built		As inspected		Load # 1		Load # 2		Load # 3		Load # 4		Load # 5		
	E	E	E	E	E	E	E	E	E	E	E	E	E	E	
	Moment	Shear	Moment	Shear	Moment	Shear	Moment	Shear	Moment	Shear	Moment	Shear	Moment	Shear	

Note: E = Cooper Load

FOR TIMBER MEMBERS

COOPER E RATING ANALYSIS
OPERATING RATINGS
NOT ASSIGNED LOCOMOTIVES

Structure Number ________________ Controlling Cooper E Rating ________________

Member	Capacity of Bridge Cooper E Load				Equivalent Cooper E Loading of Equipment (For Proper Span Length)										Remarks
	As Built		As inspected		Load # 1		Load # 2		Load # 3		Load # 4		Load # 5		
	E	E	E	E	E	E	E	E	E	E	E	E	E	E	
	Moment	Shear	Moment	Shear	Moment	Shear	Moment	Shear	Moment	Shear	Moment	Shear	Moment	Shear	

Note: E = Cooper Load

1.42.2 RE-EVALUATION SURVEY REPORT FORMAT - BR - (FOR RAILROAD CARRYING BRIDGES)

The report of the results of a re-evaluation Bridge survey and rating of an existing railroad bridge, performed by or for the Department, shall adhere to the following format:

(A). **REPORT COVER SHEET:** The report's cover sheet shall utilize the same form as indicated in Format AR (see attached sample in Format BR).

The cover sheet colors shall be the same as specified under Format AR.

The report shall be bound using a standard 3-hole punch type binding.

(B). **LETTER OF TRANSMITTAL (CONSULTANT PROJECTS ONLY):** The letter of transmittal shall be addressed as shown in Format AR (see sample in Format AR):

(C). **TABLE OF CONTENTS:** One page indicating items 1 thru 9 in order shown as follows and providing the page number in the report on which each item starts. All pages in the report shall be numbered (i.e. Cycle No.- Page No.) at the bottom and centered.

Page No.

1. **Maps:** Two maps, are required as specified in Format AR. If the previous bridge survey report contains up-to-date General Location and Local Maps done to the required specifications, no maps are required.

2. **Structural Data:** A summary of findings and work done shall be included as indicated in Format AR.

3. **Controlling Ratings:** The ratings shall be provided as indicated in Format AR (give reference to the bridge survey report cycle where the detailed rating computations were made if not calculated in the current cycle report).

4. **Conclusions & Recommendations:** Conclusions shall be provided as indicated in Format AR. Also, comment on any major changes in the condition of all components since the previous bridge survey report. If no changes have occurred, include a statement to that effect.

5. **Appendix 1 - Structure Inventory & Appraisal Sheet:** This section should contain the above listed data form as indicated in Format AR.

6. **Appendix 2 - Computations:** In this section, include computations of ratings for various major bridge components as indicated in Format AR (see samples in Format AR).

7. **Appendix 3 - Drawings, Soundings & Photographs:** This section shall contain bridge drawings, sounding sketches, photo location plan sketch and photographs as indicated in Format AR.

8. **Appendix 4 - Field Notes:** Provide field notes or CADD sketches as specified in Format AR in this section.

9. **Appendix 5 - Underwater Inspection:** In this section, include the diver's inspection report (if applicable) or other additional appendices as specified in Format AR.

Sample - For State Bridges
(Consultant Report Cover Sheet)

NEW JERSEY DEPARTMENT OF TRANSPORTATION

BRIDGE RE-EVALUATION SURVEY REPORT OF THE

Structure No. 1609-152
Boonton Line over Rt. 80
RR MP 20.18
Route 5080
USRA Line Code 6101
Wayne Township
Passaic County

CYCLE NO. 2
AUGUST, 1996

XYZ ENGINEERS, INC.
100 Lincoln Place
East Orange, New Jersey 07018

(FORMAT "BR")

NEW JERSEY DEPARTMENT OF TRANSPORTATION
STRUCTURAL EVALUATION UNIT
RE-EVALUATION BRIDGE SURVEY REPORT
FOR RAILROAD CARRYING BRIDGES

CYCLE NO.________

STRUCTURAL DATA

Bridge No.__________________________ Year Built:________
Reconstr/Widening:___________

Route No._____ RR Mile Post______ Length:_____________Width:______________

Name:_____________________________ Date of This Eval.:__________________________

Line/Branch:________________________ By:______________________________________

Date of FCM/Pin Hanger Inspection:__________

By: ______________________________________

(Only when special inspections are applicable)

USRA Line Code:____________________ Date of Prev. Eval.:__________________________

Structure Type:_____________________ By:______________________________________

__________________________ Special Equipment Used:____________________
(Include Photo)

__________________________ Date of Underwater Insp:____________________

__________________________ Date of Special Testing:____________________

__________________________ Date of Electr./Mech. Insp.:__________________
(Movable Bridges Only)

Overall Condition:______________________

Work Done:____________________________

Component/ Material	Cond. Rating	General Remarks
DECK/		
_APPROACHES (Condition of Rail & Track Bed)		
SUPERSTRUCTURE		
SUBSTRUCTURE		
CHANNEL/ WATERWAY		
RAILROAD SAFETY FEATURES		

The minimum vertical underclearance is ___________ under_____________

The lateral clearances are: Left:_______ Right:__________

For waterways include horizontal and vertical clearances of the main channel span.

CONTROLLING RATINGS (From________Cycle Report):

Controlling Member		As Built	As Inspected	Remarks
End Floorbeam	Inventory Ratings			
Interior Stringer	Operating Ratings			

Controlling Live Load | Equivalent Cooper E

CONCLUSIONS AND RECOMMENDATIONS:

For an explanation of the requirements for this section, refer to Format AR.

Since the previous inspection, ____________________________________
(Give brief description of the significant changes in the condition of the various components. Do not include work done in this section).

((Give a brief description and location of the fracture critical members or pin hanger details (specify when FCM's are internally redundant i.e., riveted)).

Note: The following area(s) or structural member(s) should be inspected on an interim basis at the frequency indicated:

A.

B.

C.

1.42.3 RE-EVALUATION SURVEY REPORT FORMAT - CR - (FOR RAILROAD CARRYING BRIDGES)

The report of the results of a re-evaluation bridge survey and rating of an existing railroad bridge, performed by or for the Department, shall adhere to the following format:

(A). <u>**REPORT COVER SHEET:**</u> The report's cover sheet shall include utilize the same form as indicated in Format AR (see attached sample in Format BR).

The cover sheet colors shall be the same as specified under Format AR.

The report shall be bound using a standard 3-hole punch type binding.

B). <u>**LETTER OF TRANSMITTAL (CONSULTANT PROJECTS ONLY):**</u> The letter of transmittal shall be addressed as shown in Format AR (see sample in Format AR).

(C). <u>**TABLE OF CONTENTS:**</u> Provide a table of contents sheet as specified under Format BR.

1. <u>**Maps:**</u> Two maps, are required as specified in Format AR. If the previous bridge survey report contains up-to-date General Location and Local Maps done to the required specifications, no maps are required.

2. <u>**Structural Data:**</u> A summary of findings and work done since the previous bridge survey shall be included as indicated in Format AR.

3. <u>**Controlling Ratings:**</u> The ratings shall be provided as indicated in Format AR (give reference to the bridge survey report cycle where the detailed rating computations were made if not calculated in the current cycle report).

4. <u>**Conclusions & Recommendations:**</u> State the overall condition of the structure (consistent with SI&A Item 67) and include a paragraph summarizing the conditions of the various components to be coded as they are. For large or complex structures, it may be necessary to include one paragraph for each component rather than one long paragraph. If an underwater diver inspection has been conducted and no repairable defects were discovered, the underwater inspection should be noted here. If repairable defects were discovered by the diver, appropriate remedial repairs should be included in the report.

   Conclusions shall be provided as indicated in Format AR. Also, comment on any major changes in the condition of all components since the previous bridge survey report cycle. If no changes have occurred, include a statement to that effect.

5. <u>**Appendix 1 - Structure Inventory & Appraisal Sheet:**</u> This section should contain the above listed data form as indicated in Format AR.

6. **Appendix 2 - Computations:** In this section, include computations of ratings for various major bridge components as indicated in Format AR (see samples in Format AR).

7. **Appendix 3 - Drawings, Soundings & Photographs:** This section shall contain bridge drawings, sounding sketches, photo location plan sketch and photographs as indicated in Format AR.

8. **Appendix 4 - Field Notes:** Provide field notes or CADD sketches as specified in Format AR in this section.

9. **Appendix 5 - Underwater Inspection:** In this section, include the diver's inspection report (if applicable) or other additional appendices as specified in Format AR.

(FORMAT "CR")

NEW JERSEY DEPARTMENT OF TRANSPORTATION
STRUCTURAL EVALUATION UNIT
RE-EVALUATION BRIDGE SURVEY REPORT
FOR RAILROAD CARRYING BRIDGES

CYCLE NO._______

STRUCTURAL DATA

Bridge No.____________________

Route No._____ RR Mile Post_____

Name:____________________

Line/Branch:____________________

USRA Line Code:____________________

Structure Type:____________________

____

____

____

____

Overall Condition:____________________

Work Done:____________________

Year Built:__________
Reconstr/Widening:__________

Length: __________Width:__________

Date of This Eval.:____________________

By:____________________

Date of FCM/Pin Hanger Inspection:__________

By: ____________________

(Only when special inspections are applicable)

Date of Prev. Eval.:____________________

By:____________________

Special Equipment Used:____________________
(Include Photo)

Date of Underwater Insp:____________________

Date of Special Testing:____________________

Date of Electr./Mech. Insp.:____________________
(Movable Bridges Only)

CONTROLLING RATINGS (see Format BR for the requirements of this section)

CONCLUSIONS AND RECOMMENDATIONS:

The overall condition of the structure is ____________________ due to _____________. The deck is in _________________ condition due to _____________. The approaches are in _____________ condition due to ____________. The superstructure is in ______________ condition due to ______________. The substructure is in _________________________ condition due to _____________. (List the significant defects which are the main reasons for the condition ratings of the above structural elements. If an element has no significant defects; i.e., coded 6 or higher, it should be deleted from the above).

Since the previous inspection,____
(Give brief description of significant changes in the condition of the various components. Do not include work done in this section.)

((Give a brief description and location of the fracture critical members or pin hanger details (specify when FCM"s are internally redundant - i.e., riveted)).

For an explanation of the requirements for this section, refer to Format AR.

Note: The following area(s) or structural member(s) should be inspected on an interim basis at the frequency indicated:

A.

B.

C.

1.42.4 INTERIM SURVEY REPORT FORMAT - DR - (FOR RAILROAD CARRYING BRIDGES)

The report of the results of an interim bridge survey and rating of an existing railroad bridge, performed by or for the Department, shall adhere to the following format:

(A). **REPORT COVER SHEET:** The report's cover sheet shall utilize the same form as indicated in Format AR (see attached sample in Format DR).

The report shall be bound using a standard 3-hole punch type binding.

(B). **LETTER OF TRANSMITTAL (CONSULTANT PROJECTS ONLY):** The letter of transmittal shall be addressed as shown in Format AR (see sample in Format AR):

(C). **TABLE OF CONTENTS:** One page indicating items 1 thru 8 in order shown as follows and providing the page number in the report on which each item starts. All pages in the report shall be numbered at the bottom and centered.

Page No.

1. Structural Data ....
2. Controlling Ratings ....
3. Reason for Interim Survey ....
4. Current Condition ....
5. Conclusions and Recommendations ....
6. Appendix 1 - Structure Inventory & Appraisal Sheets ....
7. Appendix 2 - Computations ....
8. Appendix 3 - Drawings, Soundings and Photographs ....

1. **Structural Data:** A summary of findings and work done shall be included as per the attached format. The items in this format are self-explanatory.

2. **Controlling Ratings:** The ratings should include the controlling member and controlling Inventory and Operating Ratings of the bridge and include a speed restriction chart (if applicable), as per Subsection 1.42.5, "Rating of Existing Railroad Structures".

3. **Reasons for Interim Survey:** Indicate specifically the areas or members of the bridge requiring an interim inspection. These areas could be locations of deterioration such as loss of concrete under a bearing or a tilted wingwall. They also could be structure members with low operating ratings (List all members with low operating ratings) or fracture critical members.

4. **Current Condition:** Indicate the current condition of the items identified in the previous section. Also, state if any changes have occurred since the last survey (in-depth or interim).

5. **Conclusions & Recommendations:** Conclusions resulting from the interim bridge evaluation survey regarding the items inspected should be given here. Also, include possible explanation of the causes of any inadequacies found.

Make specific new recommendations for safety improvements, major repair work (i.e. structure rehabilitation and/or replacement), and other repair work to correct significant defects, deteriorations and inadequacies found during this interim bridge survey. The intent is to list any new repairs which are needed, not to repeat the recommendations from the latest bridge evaluation survey report. If no new repairs are necessary, this should be stated.

The recommendations should be specific about the location of defects and the methods of repair. The recommendations for other repair work should be listed in the order of priority. Each recommendation should be referenced to the photos. For major repair work, provide cost estimates. For other repair work, provide quantities only.

6. **Appendix 1 - Structure Inventory & Appraisal Sheet:** This section should contain the above listed data form as indicated in Format AR.

7. **Appendix 2 - Computations:** In this section, include computations of ratings for various major bridge components as indicated in Format AR.

8. **Appendix 3 - Drawings, Soundings & Photographs:** This section shall contain bridge drawings, sounding sketches, photo location plan sketch and photographs as indicated in Format AR. If approved by the project manager, only one copy of the interim survey report may be required to have original photographs with the remaining copies black-and-white photocopies.

Sample - For State Bridges
(Consultant Report Cover Sheet)

NEW JERSEY DEPARTMENT OF TRANSPORTATION

INTERIM BRIDGE SURVEY REPORT OF THE

Structure No. 1609-152
Boonton Line over Rt. 80
RR MP 20.18
Route 5080
USRA Line Code 6101
Wayne Township
Passaic County

AUGUST, 1996

XYZ ENGINEERS, INC.
100 Lincoln Place
East Orange, New Jersey 07018

(FORMAT "DR")

NEW JERSEY DEPARTMENT OF TRANSPORTATION
STRUCTURAL EVALUATION UNIT
INTERIM BRIDGE SURVEY REPORT FOR RAILROAD CARRYING BRIDGES

FREQUENCY: __________ MONTHS

STRUCTURAL DATA

Bridge No. ______________________________ Year Built: ______________________________

Route No. ___________ RR Mile Post ________________

Length: ____________ Width: ________________

Name: ______________________________ Date of This Eval: ______________________

Line/Branch: ___________________ By: ______________________________

USRA Line Code: ____________________ *Date of Previous Interim Survey: ____________

Structure Type: ____________________ *By: ______________________

____

______________________________ Date of Last

______________________________ Routine Eval: ____________

______________________________ By: ____________________

Special Equipment:

____

(Include Photos)

Overall Condition: ____________________

Work Done:

Reason for Interim Survey:

Current Condition or changes in items inspected:

* Use only if there was another interim survey after the last routine survey.

CONCLUSIONS AND RECOMMENDATIONS:

We recommend that the following repairs or rehabilitation be made to retard further deterioration, preserve the structural integrity of the bridge, improve safety and extend its useful life:

In addition to any recommendations noted here, all of the recommendations from the previous reports (routine or interim) are still in effect if not already completed.

Next interim inspection is recommended at ______________ intervals.

1.42.5 RATING OF EXISTING RAILROAD STRUCTURES

The following instructions shall be incorporated with the current A.R.E.M.A. Manual for the above subject.

A. Steel and Concrete Structures

1. In rating railroad structures use 0.55fy for inventory (design stress) in all types of steel and wrought iron. Use 0.8fy for operating (rating stress) for A36, A7, open hearth steel, and wrought iron according to A.R.E.M.A. 7.3.4.3, Chapter 15; for other steel refer to A.R.E.M.A. 7.3.4.3, Chapter 15, for permissible operating (rating) stresses only.

2. Bridge ratings (inventory and operating) will be in terms of Cooper E loadings.

3. In rating existing concrete structures use the allowable service load stresses for inventory (design stresses) according to A.R.E.M.A. Chapter 8, Section 2.26, Page 8-2-29. Use the permissible unit stresses for operating (rating stresses according to A.R.E.M.A. Chapter 8, Page 8-19-4).

4. Structure members shall be rated for as-built and as-inspected condition using one of the Cooper E series in accordance with A.R.E.M.A.

5. For each controlling member equivalent Cooper E loads shall be computed for each live load shown in the attachment.

6. When any of the NJ Transit loads (1 thru 5) are applied at normal operating speed, and Conrail's anticipated freight load, load 6 applied at 40 mph, is greater in terms of Cooper E loading than a specific member's Cooper E Inventory rating, the speed restrictions must be introduced (see A.R.E.M.A. Chapter 15, 7.3.3.3., for steel; and Chapter 8, Part 19, for concrete).

   a. When the equivalent Cooper E for specific loading is greater than the Cooper E inventory rating of the structure with impact computed at 10mph, then 93% of the Cooper E operating rating of the structure will control (with impact computed at 10 mph) and no other trains except for the specific loading shall be allowed on the structure at the same time with a maximum speed of 10 mph.

   b. If the equivalent Cooper E for a specific loading at 10 mph exceeds 93% of the operating rating of the structure, then the loading shall be restricted from the structure until the structure can be rehabilitated to a satisfactory capacity rating.

7. All recommendations for rehabilitating the structure shall be based on upgrading all member's inventory ratings to a level sufficient to sustain the maximum anticipated loading condition (Equivalent Cooper E).

8. When the equivalent Cooper E load for a specific loading is greater than the controlling members equivalent Cooper E load rated for "REGULARLY ASSIGNED LOCOMOTIVES", the loading shall be restricted to 10 mph.

9. When speed restrictions are required, a speed chart shall be made for the controlling member's Cooper E inventory rating. The speed chart shall range as follows:

   Steel: from the equivalent Cooper E load at 60 mph for load 1 thru 5, and 40 mph for load 5, to the equivalent Cooper E load at 10 mph.

   Concrete: from the equivalent Cooper E load at 40 mph for all loads, to an equivalent Cooper E load 10 mph.

B. Timber Structures

1. Rating of wood structures shall be done in accordance with A.R.E.M.A. Chapter 7, Page 7-2-23.

2. Structure members shall be rated using one of the Cooper E Series.

3. In accordance with Chapter 7, Page 7-2-24, when the support under a rail consists of three or more stringers assembled as a chord or acting in unison and extending over two spans with staggered joints, a partially continuous beam action may be assumed to exist and the computations may be made for stringers based on the average stress as determined from single beam analysis and that for a fully continuous condition.

4. When analyzing notched beams the average live load and reaction as found from above shall be used and the allowable end reaction shall be computed using the formula in Chapter 7, Section E, Art. 4, Page 7-2-16.

5. The permissible unit stresses for rating shall be in accordance with Chapter 7, Art. 13, Page 7-2-25.

6. Structure members shall be rated for "LOCOMOTIVES NOT REGULARLY ASSIGNED" and for "REGULARLY ASSIGNED LOCOMOTIVES", and shall be in terms of equivalent Cooper E loads.

7. For each controlling member, equivalent Cooper E loads shall be made for each live load shown in the attachment.

8. When the equivalent Cooper E load for a specific loading is greater than the controlling members equivalent Cooper E load rated for "REGULARLY ASSIGNED LOCOMOTIVES", the loading shall be restricted to 10 mph.

9. When the equivalent Cooper E load for a specific loading is greater than the controlling members equivalent Cooper E load rated for "NOT REGULARLY ASSIGNED LOCOMOTIVES", the "K" coefficient shall not be increased to 15% as stated in A.R.E.A. Chapter 7, Art. 13, page 7-2-25 and the loading shall be restricted from the structure until the structure can be rehabilitated to a satisfactory capacity rating.

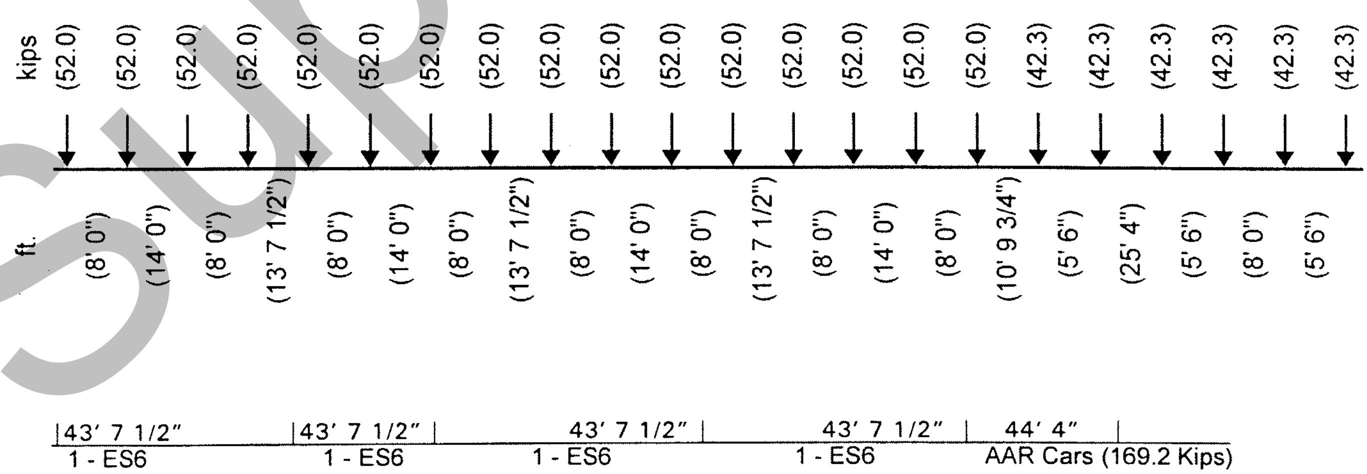
The following Tables are provided in English and Metric units.

MOMENT AND SHEAR TABLE

LOAD 1

4 ES6 DIESELS COUPLED TO AAR CARS

SPAN feet	BENDING ft-kips	END SHEAR kips	FLOOR BEAM REACTION kips
8	104.00	55.52	55.52
10	130.00	62.40	69.80
12	156.00	69.33	79.31
13	170.93	72.00	82.97
14	191.20	74.29	87.62
15	211.59	76.27	93.06
16	234.00	78.00	97.82
18	286.75	82.25	105.75
20	350.08	88.83	112.10
25	513.52	104.90	132.31
30	720.51	115..62	155.53
35	909.45	124.60	175.11
40	1,120.95	132.60	197.55
45	1,353.16	144.22	221.25
50	1,653.91	157.70	245.40
60	2,333.01	180.23	290.30
70	3,064.51	205.24	338.32
80	3,951.05	229.16	384.67
90	4,978.17	252.46	432.62
100	6,134.89	277.27	479.84
120	8,709.13	325.27	561.23
140	11,841.20	372.92	637.47
160	15,386.66	420.60	712.16
180	19,467.94	468.08	785.28
200	23,991.78	512.94	854.94
225	29,753.54	563.29	939.53
250	36,388.54	616.07	1,023.29
275	43,174.78	669.76	1,098.19
300	50,698.08	720.24	1,160.61
350	67,114.30	821.96	1,258.69
400	85,493.60	922.42	1,332.26

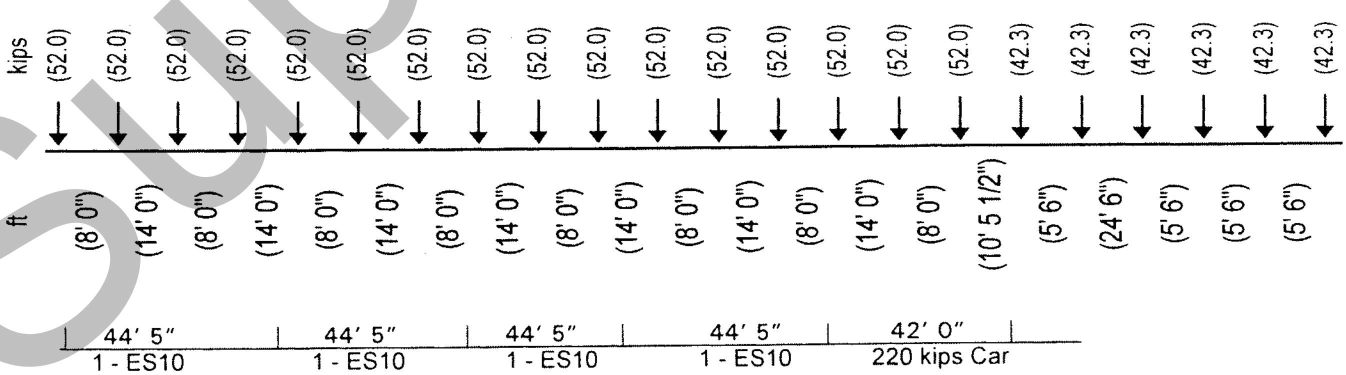


MOMENT AND SHEAR TABLE

LOAD 2

4 ES10 DIESELS COUPLED TO 220 KIPS CARS

SPAN ft.	BENDING ft-kips	END SHEAR kips	FLOOR BEAM REACTION kips
8	124.20	72.19	82.50
10	155.25	79.75	99.00
12	196.18	84.79	110.00
13	222.25	90.96	118.46
14	248.60	96.25	125.71
15	289.06	100.83	132.00
16	330.29	104.84	137.50
18	412.75	113.06	146.67
20	495.23	123.75	154.00
25	738.24	143.00	167.20
30	1,009.36	155.83	189.55
35	1,265.00	165.00	213.67
40	1,540.00	171.88	237.32
45	1,815.00	182.10	263.69
50	2,090.00	198.54	291.79
60	2,843.25	225.18	344.88
70	3,739.25	254.19	400.08
80	4,746.41	282.74	454.96
90	5,933.08	310.20	509.56
100	7,294.83	339.63	565.85
120	10,346.50	395.75	672.06
140	14,002.66	451.80	775.05
160	18,198.22	507.49	876.32
180	22,930.08	563.22	977.56
200	28,292.49	617.26	1,077.43
225	35,386.55	676.74	1,203.67
250	43,632.59	741.42	1,314.67
275	52,323.96	805.20	1,405.48
300	61,971.46	869.66	1,481.15
350	83,347.80	1,003.79	1,600.07
400	107,743.43	1,137.01	1,689.27

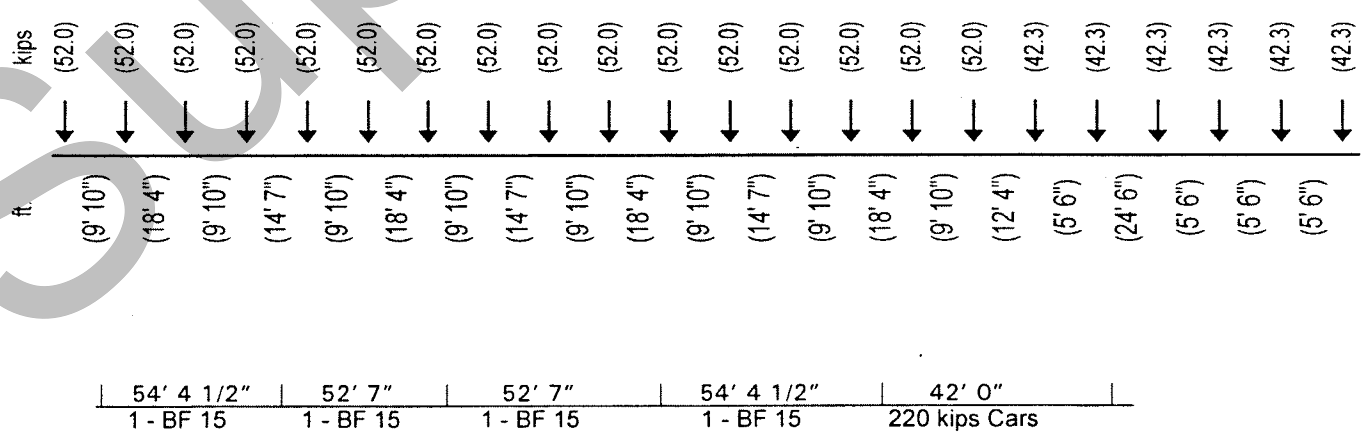


MOMENT AND SHEAR TABLE

LOAD 3

4-BF 15 DIESELS COUPLED TO 220 KIPS CARS

SPAN ft.	BENDING ft-kips	END SHEAR kips	FLOOR BEAM REACTION kips
8	136.00	72.19	82.50
10	170.00	79.75	99.00
12	204.00	84.79	110.00
13	222.25	90.96	118.46
14	248.60	96.25	125.71
15	289.06	100.83	132.00
16	330.29	104.84	137.50
18	412.75	113.06	146.67
20	495.23	123.75	154.00
25	738.24	143.00	167.20
30	1,009.36	155.83	176.00
35	1,265.00	165.00	190.14
40	1,540.00	171.88	212.49
45	1,815.00	180.89	238.33
50	2,090.00	193.05	268.40
60	2,640.00	221.83	330.00
70	3,327.50	253.00	377.14
80	4,249.82	276.38	420.75
90	5,362.50	298.53	473.31
100	6,710.00	325.88	532.40
120	9,900.00	380.87	629.98
140	13,200.00	430.37	731.23
160	16,830.00	485.37	831.63
180	21,298.75	534.87	929.59
200	26,620.00	589.88	1,024.63
225	33,495.00	652.54	1,149.16
250	40,947.50	717.26	1,265.00
275	49,354.27	780.85	1,365.09
300	53,600.16	844.89	1,448.50
350	79,233.59	971.01	1,579.57
400	102,462.96	1,096.34	1,677.87

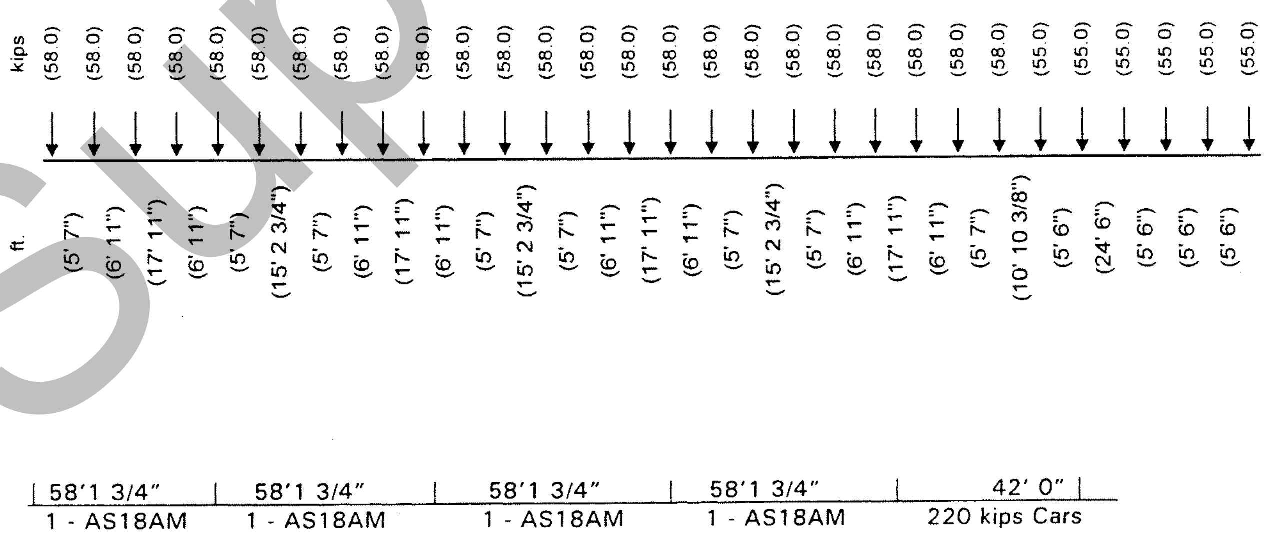


MOMENT AND SHEAR TABLE

LOAD 4

4–AS18AM DIESELS COUPLED TO 220 KIPS CARS

SPAN ft	BENDING ft-kips	END SHEAR kips	FLOOR BEAM REACTION kips
8	116.00	75.55	83.38
10	150.75	83.64	101.50
12	204.99	89.03	113.58
13	232.54	93.34	118.46
14	260.30	99.10	125.71
15	290.58	104.90	132.00
16	334.04	108.46	137.50
18	420.98	115.74	146.67
20	507.93	123.75	156.71
25	738.24	143.00	182.17
30	1,009.36	155.83	199.45
35	1,265.00	169.76	225.18
40	1,567.13	184.04	251.93
45	1,922.13	195.15	281.04
50	2,277.13	208.00	310.24
60	2,991.69	233.60	368.14
70	3,940.65	265.66	428.08
80	5,038.55	293.94	488.79
90	6,323.45	326.70	544.72
100	7,756.12	357.23	603.66
120	11,044.18	415.49	722.97
140	14,982.75	475.05	834.91
160	19,551.73	536.29	942.32
180	24,512.55	595.69	1,051.66
200	30,183.20	655.24	1,154.55
225	38,162.61	730.11	1,279.14
250	47,095.20	804.54	1,396.95
275	56,497.58	867.97	1,496.50
300	66,731.53	939.41	1,579.46
350	89,794.20	1,076.70	1,709.82
400	115,455.43	1,214.54	1,807.59

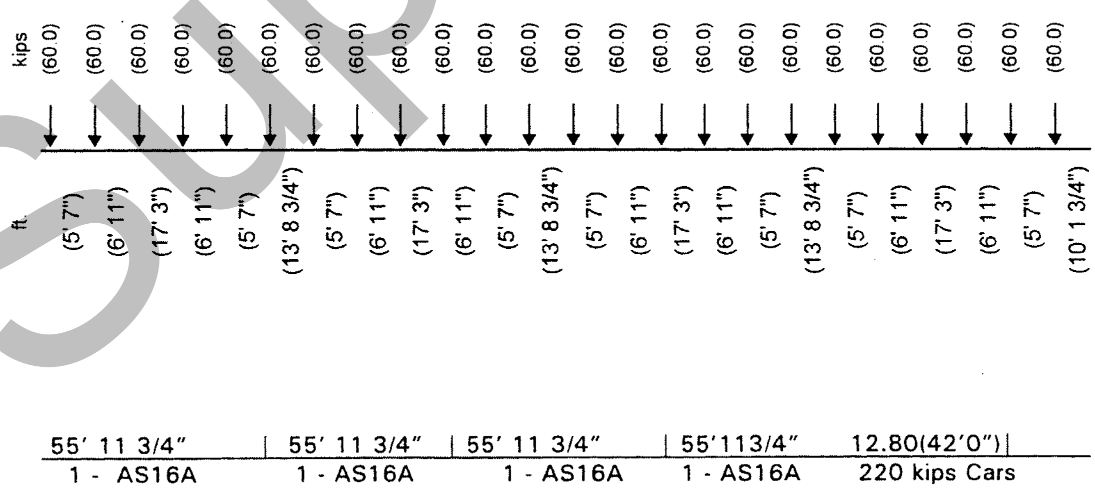


MOMENT AND SHEAR TABLE

LOAD 5

4—AS16A DIESELS COUPLED TO 220 KIPS CARS

SPAN	BENDING ft-kips	END SHEAR kips	FLOOR BEAM REACTION kips
8	120.00	78.15	86.25
10	155.95	86.52	105.00
12	212.06	92.10	117.50
13	240.56	96.55	122.31
14	269.28	102.51	126.43
15	300.60	107.68	132.00
16	345.56	112.20	137.50
18	435.50	119.73	151.14
20	525.45	125.76	165.03
25	750.36	143.00	190.02
30	1,009.36	158.17	209.05
35	1,287.80	177.01	236.40
40	1,650.80	191.13	269.34
45	2,012.80	205.08	299.41
50	2,375.30	220.57	331.43
60	3,135.70	247.83	393.71
70	4,137.00	279.81	457.44
80	5,386.80	313.31	523.92
90	6,736.80	348.22	583.44
100	8,285.65	379.04	647.92
120	11,811.45	440.45	776.41
140	16,010.40	506.32	890.05
160	20,956.80	571.42	1,000.12
180	26,254.80	633.66	1,109.53
200	32,395.80	699.85	1,211.89
225	40,895.24	776.36	1,335.15
250	50,459.45	853.53	1,450.15
275	60,249.39	923.22	1,549.22
300	71,051.85	996.13	1,631.79
350	94,882.88	1,140.10	1,761.53
400	121,189.25	1,281.81	1,858.84

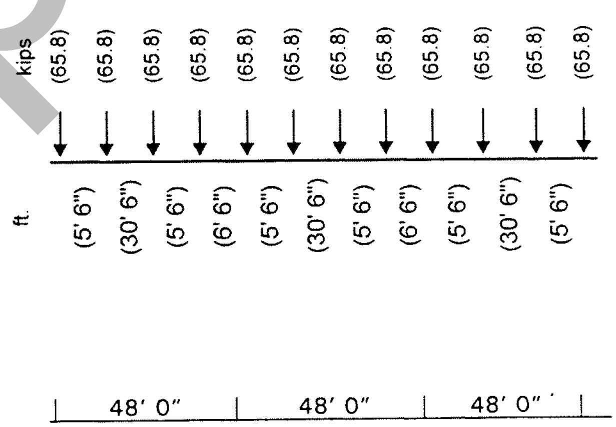


MOMENT AND SHEAR TABLE

LOAD 6

263 KIP CAR MIN. COUPLED LENGTH 48'-0"

SPAN ft.	BENDING ft-kips	END SHEAR kips	FLOOR BEAM REACTION kips
8	131.50	86.30	98.63
10	172.80	95.34	118.35
12	234.41	101.36	131.51
13	265.69	108.74	141.62
14	297.20	115.06	150.29
15	345.55	120.54	157.80
16	394.84	125.34	164.37
18	493.43	135.15	175.33
20	592.02	147.94	184.10
25	882.53	170.95	199.83
30	1,206.65	186.29	210.40
35	1,512.25	197.25	217.91
40	1,841.00	205.47	230.12
45	2,169.75	211.86	249.85
50	2,498.50	219.61	276.15
60	3,156.00	244.92	341.99
70	3,813.50	279.91	405.77
80	4,602.50	319.67	453.67
90	5,621.62	334.59	495.68
100	6,903.75	356.37	549.67
120	10,257.00	415.87	673.65
140	14,202.00	469.17	768.34
160	18,147.00	521.69	884.34
180	22,305.69	580.06	990.63
200	27,483.50	630.71	1,098.02
225	35,307.75	702.79	1,237.85
250	43,526.50	767.83	1,372.33
275	51,926.06	839.21	1,510.10
300	61,755.68	904.83	1,646.38
350	84,554.49	1,042.14	1,920.65
400	109,802.49	1,179.31	2,194.73



SECTION 43

HIGHWAY SIGNS, LUMINAIRES AND TRAFFIC SIGNAL STRUCTURAL SUPPORTS

1.43.1 DESIGN

a. Suppliers of highway signs, luminaires and traffic signal supports should be aware that AASHTO has published the 2001 Edition of the Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. These Specifications are currently under review before their adoption by the Department. However, suppliers should obtain the new edition and initiate their own study so that they can begin to plan for any changes to their processes.

b. The existing current NJDOT Standard Designs for Highway Signs, Luminaires and Traffic Signal Structural Supports have been completed in accordance with the 1994 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. The following stipulations to the usage of the AASHTO Specifications have been made:

   Article 1.2.5 - Application of wind load

   1.) V = Wind speed 80 miles per hour (50 yr. mean recurrence interval).

   2.) A design wind velocity greater than 80 miles per hour may be applicable in areas where extreme exposure conditions exist.

c. Additional criteria for design are as follows:

   1). Luminaire Dead Load: Approximately 80 lbs. each.

   2). Maximum projected area: 3.75 square feet per luminaire.

   3). The wind drag coefficient (C_d), to be utilized on the luminaires and davits, shall be 1.0.

   4). The wind drag coefficient (C_d) to be utilized on the tower shaft shall be 1.2.

   5). Gust factor: 1.3

   6). Maximum horizontal deflection at the top of the assembled standard with fixtures attached due to a 40 miles per hour wind (V) shall not exceed 1.25% of the total shaft height.

d. Fatigue

1.) The current AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals should be referred to for consideration of the fatigue life of support structures.

2.) For aluminum support structures, the guidance in the AASHTO Guide Specifications for Aluminum Highway Bridges should also be followed.

As stated therein, for aluminum structures, fatigue designs should be based on the infinite fatigue life of the 500 million cycle failure stress.

3.) For steel structures, the guidance provided in Section 32 of this Manual for the fatigue life should be followed.

4.) Section 32 of this Manual defines application of fatigue loads for steel support structures. As stated therein natural wind, truck induced and galloping induced gust factors shall be considered for such designs. Also, fatigue limit details and stress range categories should be followed in such designs.

1.43.2 SUPPORT STRUCTURE STANDARDS

a. Steel towers for lighting support structures shall be of the pole type. Material shall be high-strength, low alloy ASTM A588/A588M unpainted, or ASTM A595, Grade C, unpainted.

b. Details of the lighting support structure standards are provided in the NJDOT Electrical Standard Details. Specifications for their installation are provided in Division 700 of the NJDOT Standard Specifications.

c. Section 703 of the NJDOT Standard Specifications should be referred to for requirements regarding proper bolt assembly installation procedures.

d. Payment for the above is scheduled under the item TOWER LIGHTING STANDARD ASSEMBLIES, TYPE ________ under the electrical items of work in the contract.

1.43.3 FOUNDATION

a. The design and plan preparation for the footings of lighting support structures shall be the responsibility of the Designer.

b. The following information for lighting support structures, on an individual contract basis at the time of work request, will be furnished by the Department's Traffic Signal and Safety Engineering Unit.

1). Interchange layout showing location of towers by station and offset.

2). Height of towers and number of luminaires.

3). Design criteria for support structures which will be included in the electrical provisions of the Special Provisions.

4). If other than 3 inches above existing (or finished) ground line, elevations of the top of concrete pedestals.

c. The design of the footings shall be in accordance with applicable AASHTO LRFD Specification requirements and Section 3 of this Manual.

d. The Structural Design Engineer shall refer to previous construction contracts to review previous borings which may be useful in determining preliminary footing design. Boring log identification numbers for previous construction contracts shall be shown on the contract plans.

e. The proposed subsurface exploration (see Section 36) at each tower lighting location shall be submitted to the Geotechnical Engineering Unit for approval. One deep boring and one or more shallow borings may be required by the Geotechnical Engineer. Continuous sampling, to a reasonable depth, may be necessary and if so will be ordered by the Geotechnical Engineer.

Boring requests shall be directed to the Geotechnical Engineering Unit as soon as possible.

f. The foundations of tower lighting support structures that are located on undisturbed soils shall be designed for an allowable soil pressure that is estimated for a differential settlement that shall not exceed ½ inch.

Careful consideration shall be given to ground water conditions when estimating allowable pressure and settlement of the soil.

Rotation and displacement of a foundation must be restricted to alleviate the possibility of failure of the structure or its having an unsightly visual appearance. Pile foundations shall be used when soil conditions do not readily and reliably indicate the use of spread footings.

The foundation design criteria for tower lighting located on embankment fill shall be established with respect to soil bearing capacity and settlement. Consideration must be given to the stability of the embankment with respect to any possible vertical and/or horizontal movements.

The most important factor to be considered in the foundation design of a lighting support structure is the overturning factor. This will require an adequate provision for passive resistance and upward pull on spread footing and pile foundation design, respectively.

g. Adverse foundation conditions, property lines, subsurface utilities, temporary sheeting, traffic maintenance, and other special conditions which may require individual footing designs shall be investigated by the Structural Design Engineer at each support structure location.

1.43.4 GENERAL

a. Notes on the plans or guidance in the Special Provisions shall require that the contractor submit detail plans and calculations for the support structure shaft, luminaires, and anchor bolt assembly. The Design Unit shall review these drawings to determine that design loads and forces are in accordance with the design assumptions of the footings shown on contract plans.

b. Refer to Section 17 of the NJDOT Procedures Manual for Contract Plan requirements.

SECTION 44

ALTERNATIVE DESIGN CRITERIA
NON-NHS HIGHWAYS

1.44.1 ALTERNATIVE DESIGN CRITERIA

1. At the option of the owner, non-State-owned, non-NHS highway bridge structures may be designed to the current edition of the AASHTO Standard Specifications for Highway Bridges, with current Interims.

   a. For such bridge structures that have a projected ADTT up to 500, Subsection 3.7.4 of the above referenced AASHTO Standard Specifications, is modified to establish that the class of loading that shall be used is the HS20 loading class increased by 10%. Accordingly, the class of loading shall be designated as HS20 + 10%.

      For such bridge structures that have a projected ADTT greater than 500, the HS20 loading class shall be increased by 25%. Accordingly, the designated class of loading shall be HS20 + 25%.

      Refer to Guide Plates 3.16-1 and 3.16-2 for representation of the above vehicle configurations.

   b. Such bridge structures that are located on roadways that are classified as Major Collector Rural or lower shall utilize a bridge railing that meets the criteria of the above referenced AASHTO Standard Specifications for Highway Bridges.

   c. Such bridge structures that are located on roadways that are classified as Rural Arterial and Urban Arterial shall utilize a bridge railing system and connection to the deck slab that have been shown, through crash testing, to meet the Test Level designations described in Section 23 of this Manual.

2. Bridge geometry shall conform to the guidance of the current AASHTO Policy on Geometric Design of Highways and Streets.

3. Construction criteria shall follow the current NJDOT Standard Specifications for Road and Bridge Construction and necessary Special Provision requirements.

4. At the option of the owner, for structures that are designed to the AASHTO LRFD Bridge Design Specifications, the Operational Importance strength limit classification, as defined in Subsection 1.3.5 – Operational Importance, may be reduced from 1.00, which is required for State owned bridge structures that are located on NON-NHS highways, to 0.95.

1.44.2 DECK SLAB THICKNESS AND REINFORCEMENT STEEL TABLES FOR ALTERNATIVE DESIGN CRITERIA

1. The following tables for one course construction meet the HS20 + 10% and HS20 + 25% alternative live load criteria with projected ADTT to 500 and greater than 500, respectively.

2. These tables, based on 2½″ top cover, 1″ bottom cover, and rebars perpendicular to traffic with f_c = 1,400 psi and f_s = 24,000 psi, has been prepared in order to establish uniformity in design and details. However, the designer shall develop the design of the slab for each bridge and the calculations shall be included in the design folder.

ONE COURSE CONSTRUCTION FOR DESIGN LIVE LOADING HS20 + 10%		
EFFECTIVE SLAB SPAN (S)	SLAB THICKNESS	REINFORCEMENT STEEL (TOP & BOTTOM)
4′ to 5′-3″	8½″	# 16 @ 8″
5′-3″ to 6′-0″	8½″	# 16 @ 7″
6′-0″ to 6′-8″	8½″	# 19 @ 9″
6′-8″ to 7′-6″	8½″	# 19 @ 7″
7′-6″ to 7′-10″	8½″	# 19 @ 6″
7′-10″ to 8′-6″	8¾″	# 19 @ 6″
8′-6″ to 8′-10″	9″	# 19 @ 6″
8′-10″ to 9′-4″	9″	# 19 @ 6″
9′-4″ to 9′-10″	9¼″	# 19 @ 6″
9′-10″ to 10′-3″	9½″	# 19 @ 6″
10′-3″ to 10′-9″	9¾″	# 19 @ 6″
10′-9″ to 11′-3″	10″	# 19 @ 6″

ONE-COURSE CONSTRUCTION FOR DESIGN LIVE LOADING HS20 +25%		
EFFECTIVE SLAB SPAN (S)	SLAB THICKNESS (Actual)	REINFORCEMENT STEEL (TOP & BOTTOM)
4′-0″ to 4′-6″	8½″	#16 @ 8″
Over 4′-6″ to 5′-3″	8½″	#16 @ 7″
Over 5′-3″ to 5′-10″	8½″	#19 @ 9″
Over 5′-10″ to 6′-6″	8½″	#19 @ 7″
Over 6′-6″ to 6′-10″	8½″	#19 @ 6″
Over 6′-10″ to 7′-3″	8¾″	#19 @ 6″
Over 7′-3″ to 7′-9″	9″	#19 @ 6″
Over 7′-9″ to 8′-2″	9″	#19 @ 6″
Over 8′-2″ to 8′-8″	9¼″	#19 @ 6″
Over 8′-8″ to 9′-0″	9½″	#19 @ 6″
Over 9′-0″ to 9′-6″	9¾″	#19 @ 6″
Over 9′-6″ to 10′-0″	10″	#19 @ 6″
Over 10′-0″ to 10′-6″	10¼″	#19 @ 6″
Over 10′-6″ to 10′-10″	10½″	#19 @ 6″
Over 10′-10″ to 11′-0″	10½″	#19 @ 6″

SECTION 45

SEISMIC DESIGN AND RETROFIT

1.45.1 HISTORY OF SEISMIC ACTIVITY IN NEW JERSEY

In a Report published under the caption "Earthquake History of the United States" the United States has been divided into nine regions. New Jersey falls in the Eastern Region, an area that covers the Central Appalachian seismic region. Earthquakes of intensity equal to V or greater on the Modified Mercalli Intensity scale, that have occurred in New Jersey, are listed below.

Location	Date	Intensity MM Scale	Magnitude Richter Scale
Newark	September 1, 1895	VI	5.0
Asbury Park	June 1, 1927	VII	5.0
Trenton	January 24, 1933	V	4.0
Central NJ	August 22, 1922	V	4.0
Salem County	November 14, 1939	V	4.0
West-Central NJ	March 23, 1957	VI	5.0
NJ-PA border	December 27, 1961	V	4.0
Southern NJ	December 10, 1968	V	4.0

1.45.2 GENERAL

1. The Seismic design of new highway structures shall follow the requirements of Subsection 3.10 of the AASHTO LRFD Bridge Design Specifications.

2. The minimum seismic performance zone as indicated in Table 3.10.4-1 of the AASHTO Specifications shall be Zone 2 for the entire State of New Jersey. The guidance provided in Subsection 3.10.9.3 of the AASHTO LRFD Bridge Design Specifications should be referred to for clarification on the use of this designation.

3. As stated in Subsection 3.10.1 of the AASHTO LRFD Bridge Design Specifications, seismic provisions shall apply to bridge spans not greater than 500 feet and to superstructures of slab bridges, steel girders, concrete girders, box girders or truss bridges.

4. As stated in Section 3 of this Manual, all bridges in New Jersey shall initially be considered to be "Essential" for seismic design purposes. However, as stated therein, increasing this category is permitted.

5. Seismic ductility design at locations where plastic hinges will form shall be accounted for on all new structures.

6. As stated in Subsection 3.10.1 of the AASHTO LRFD Bridge Design Specifications, seismic effect considerations are not required for buried structures or culvert structures.

7. As an alternative to the use of the AASHTO LRFD Specifications, NCHRP Report 472, "Comprehensive Specification for the Seismic Design of Bridges" may be used. Designers may submit a request to the Manager, Bureau of Structural Engineering for the use of the NCHRP Report. A comparison of the effects on the design of a project between the two documents should be made to validate the request.

   In the use of the NCHRP Report 472 criteria, the Performance Level that should be followed is the Life Safety level of performance. If a Designer believes that a bridge structure warrants an Operational Performance Level, concurrence shall be obtained from the Manager, Structural Engineering.

1.45.3 ACCELERATION COEFFICIENTS

1. The acceleration coefficient for horizontal force effects, for use in the design and retrofit of bridge structures, shall be on a county to county basis as indicated below.

Acceleration Coefficient	County
A = 0.10	Atlantic, Cape May, Cumberland, Salem
A = 0.15	Burlington, Camden, Gloucester, Monmouth, Ocean
A = 0.18	Bergen, Essex, Hudson, Hunterdon, Mercer, Middlesex, Morris, Passaic, Somerset, Sussex, Union, Warren

2. If a bridge structure is located on the border between two counties with different acceleration coefficients, the larger value shall be used.

3. Vertical components of acceleration shall be neglected.

1.45.4 METHODS OF ANALYSIS

1. **Computation of Seismic Forces.** The magnitude of seismic forces will depend upon the following criteria:

   a. Dead weight of the structure
   b. Ground motion (acceleration coefficient)
   c. Type of soil
   d. Fundamental period of vibration
   e. Importance classification

2. **Single Span Bridges.** Due to the higher relative stiffness of abutments when compared to piers, with a single span, the ability to resist earthquakes is increased. Accordingly, for single span design, the following guidance may be followed:

   a. No formal analysis is required for seismic forces. The guidance provided in Subsection 4.7.4.2 of the AASHTO LRFD Bridge Design Specifications should be referred to.

   b. Subsection 4.7.4.4 of the AASHTO LRFD Bridge Design Specifications should be referred to for guidance on verifying provision of adequate bridge seat widths.

   c. With the exception of bridges with Integral abutments, abutments for a single span bridge do not need to be designed for seismic forces from the superstructure. For bridges with semi-integral abutments, only the required width of the bridge seat shall be checked.

   d. The abutments shall be designed for the effects of static earth pressure and the additional seismic induced earth pressure forces, using the Mononobe-Okabe method.

3. **The Mononobe-Okabe Method.** Refer to Section 11, Appendix A of the AASHTO LRFD Bridge Design Specification for a definition of this Method. This method is an extension of Coulomb's method for analyzing soil pressure on retaining walls. With the use of this method, the following shall apply:

   a. Backfill is assumed unsaturated so that liquefaction effects are negligible.
   b. The backfill is assumed cohesion-less.
   c. Seismically induced active and passive pressures will be considered.

4. **Single Span Bridges with Integral Abutments.** The Abutments shall be designed for seismic forces from the superstructure in addition to the static earth pressure and seismic induced forces using the Mononoke-Okabe method. Both active and passive pressures shall be considered. Also, refer to Subsection 1.15.2.K. of this Manual's Section 15 for additional guidance.

5. **Multi-Span Regular Bridges.** The Uniform load (Equivalent static load) method or the single mode spectral method is acceptable. The Uniform load method will require hand calculations, while the single mode spectral method will require the use of computer software.

6. **Uniform Load Method.** With this method, the loads are an approximation of the inertial effects resulting from the dynamic deflection of the structure. The guidance provided in Subsection 4.7.4.3 of the AASHTO LRFD Bridge Design Specifications should be referred to. For the designation of the elastic seismic response coefficient (C_{sm}) the guidance provided in Subsection 3.10.6 of the AASHTO LRFD Bridge Design Specifications should be referred to.

7. **Multi-Span Irregular Bridges.** For such bridges, a multi-mode spectral analysis method shall be used for the analysis of substructures for all bridges which are designated as Critical or Essential bridges.

8. **Load Combinations.** Extreme Event-I load combinations shall be applicable for a seismic analysis. The guidance provided in Section 3.4 of the AASHTO LRFD Bridge Design Specifications should be referred to.

   As stated in Subsection 3.10.8 of the AASHTO LRFD Bridge Design Specifications, Dead Load and Live Load forces will be combined with the forces from a single or multi-mode analysis as follows:

   a. 100% of longitudinal seismic forces + 30% of transverse seismic forces
   b. 100% of transverse seismic forces + 30% of longitudinal seismic forces

9. **Site Coefficients and Site Effects.** Due to large variations in the values of Site coefficients, Soil profiles will be based on soil composition at the site. A geotechnical investigation shall be performed to determine the soil conditions, whether cohesive or cohesion-less, the type of rock, sand, gravel, and stiff clay, soft clay or silt.

10. **Liquefaction.** The potential for soil liquefaction and liquefaction related ground instability shall be investigated at relevant locations along project alignments. Effects of settlement of footings, loss in bearing capacity and increased lateral earth pressures shall be considered in the design of abutments, walls and footings.

11. **Seismic Slope Instability and Landslide.** The potential for seismic induced slope movements and landslide along the proposed alignment shall be investigated. Mitigation measures shall be incorporated in the design of abutments, walls and footings.

12. **Response Modification Factors.** According to the provisions of Subsection 3.10.7 of the AASHTO LRFD Specifications, R-factors shall be used to reduce the moments and forces due to the ability of a member to develop a plastic

hinge. Moments and forces for member and connection designs shall be computed by dividing the forces and moments obtained from load combinations by the appropriate Response Modification Factors. The guidance provided in Subsection 3.10.7.1 and 3.10.9.3 of the AASHTO LRFD Bridge Design Specifications should be referred to.

13. **Resistance Factors.** The design of reinforced concrete sections of abutments and piers will be based on ϕ factors. The guidance provided in Subsection 5.5.4.1 of the AASHTO LRFD Bridge Design Specifications should be referred to.

14. **Abutment Analysis.** For all multi-span bridges, regular, irregular or with integral abutments, earthquake forces from the superstructure shall be considered. Abutments need to be analyzed for seismic forces from the superstructure, in addition to the static earth pressure and seismic induced forces using the Mononobe-Okabe method. Both active and passive pressures shall be considered.

15. In addition to the AASHTO LRFD Bridge Design Specifications, the FHWA Geotechnical Engineering Circular No. 3 titled, "Design Guidance: Geotechnical Earthquake Engineering for Highways" may be referred to for guidance on seismic design.

1.45.5 SEISMIC RETROFIT OF EXISTING HIGHWAY BRIDGES

1. The seismic retrofit design of existing highway structures shall follow the guidelines of the FHWA publication titled "Seismic Retrofitting Manual for Highway Bridges" currently numbered as, FHWA-RD-94-052, May, 1995

2. In accordance with the guidance of Article 1.5 of the above FHWA Retrofitting Manual, all bridge structures in New Jersey shall be assumed to have a Seismic Performance Category (SPC) of "Standard" for retrofitting designs.

   As stated in 1.45.2 Item 2 of this Manual, the minimum seismic performance zone for the State shall be Zone 2 which is based on an Acceleration Coefficient of $0.09 < A \leq 0.19$. This corresponds to a SPC of "B" under the Standard designation column in Table 1 of the Retrofitting Manual.

   In addition to investigating Expansion Joints, Bearings and Liquefaction (See Table 5, Subsection 3.4 of the FHWA Retrofitting Manual), pier columns should also be checked. Pier columns may be strengthened with the use of Carbon Fiber Reinforced Polymer (CFRP) material.

   If a Designer believes that the SPC for a bridge structure, that is to be retrofitted, should be taken as "Essential", correspondence to support this belief should be directed to the Manager, Structural Engineering for concurrence.

3. A Seismic Retrofit Report shall be prepared to provide a determination as to a bridge structure's eligibility for a seismic retrofit.

   a. A flow chart to provide guidance in determining if a bridge structure qualifies as a seismic retrofit candidate can be found in Subsection 1.45.8. The results of the analysis, performed in accordance with the flow chart, shall be provided in the Seismic Retrofit Report.

   b. In preparing the Seismic Retrofit Report, the following guidance shall be followed. Initially, seismic retrofitting of a bridge structure shall only be considered under the following conditions:

      - The planned work will involve widening of a deck by more than 30% of its deck area; or,
      - The planned work will involve an entire deck replacement; or,
      - The planned work will involve superstructure rehabilitation or replacement, major bearing seat area repairs, bearing repairs or bearing replacement.

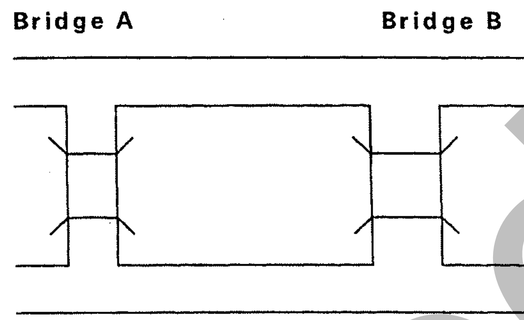
4. The Report should also include a study of a project to determine if retrofitting a bridge is a cost-effective measure. The following areas should be addressed:

   a. An investigation to determine the extent of retrofitting which may be required.

   b. Prior to making a detailed evaluation of the seismic capacity of the bridge structure, the relationship of the bridge structure to other bridge structures on the route system, that may also be damaged during an earthquake, shall be considered.

      1.) Consider two bridge structures that have similar functions, such as bridge structures A. and B. as detailed on the next page. It is possible, that retrofitting bridge structure A. would be more economical or that bridge structure A. is more seismically adequate.

      2.) Accordingly, even though bridge structure A. is not in the project scope and bridge structure B. is, it would be more rational to retrofit bridge structure A. than bridge structure B.



5. Several methods of seismic retrofit are outlined for bearings and expansion joints within the FHWA Retrofit Manual that is referenced above. Of these methods the following are recommended for consideration in order of preference. If applicable, a recommendation as to the proposed treatment of a bridge structure should be included in the Seismic Retrofit Report.

   a. Modify existing bearings to resist seismic loads or to prevent toppling of existing bearings by installing longitudinal displacement stoppers.

   b. Longitudinal joint restraints as outlined in Subsection 5.2.1 of the FHWA Retrofit Manual.

   c. Bearing replacement with those type bearings described in this Manual. If conventional steel and elastomeric bearings, are proposed to remain, typical modifications to these bearings to withstand zone 2 loadings would include the following:

      <u>Modifications to Steel Bearings</u>

      1. Increase size, number or embedment of anchor bolts.
      2. Increase the outer diameter of the pin head.
      3. Increase the width of the expansion rocker.
      4. Increase the top and bottom dimension of the pintle detail for increased movement.

      <u>Modifications to Elastomeric Bearings</u>

      1. Secure bearing against horizontal and vertical movement.
      2. Modify the plan area and/or thickness of the elastomeric bearing to reduce seismic forces to the substructure.

   The methods outlined above are recommended procedures and are not intended to restrict the ingenuity and creativity of the Design Engineer. Each bridge is different; therefore, retrofit procedures will be approved on a project to project basis by the Manager, Bureau of Structural Engineering.

6. If it is found through a seismic analysis that the substructure is in need of seismic retrofit, it will probably be economically advantageous to study bearing replacement as part of a retrofit.

7. In evaluating a bridge structure's history, a significant traffic count should warrant an increase to the Seismic Load Extreme Event load combination. As such, the 0.50 live load factor, listed as an Extreme Event II load combination, shall be combined with the Extreme Event I Earthquake load factor. A Designer should use his engineering judgment in assessing the traffic count in applying the increase.

1.45.6 BEARINGS

1. Refer to Subsection 1.24.19 of this Manual for guidance in providing bearing designs to meet seismic requirements.

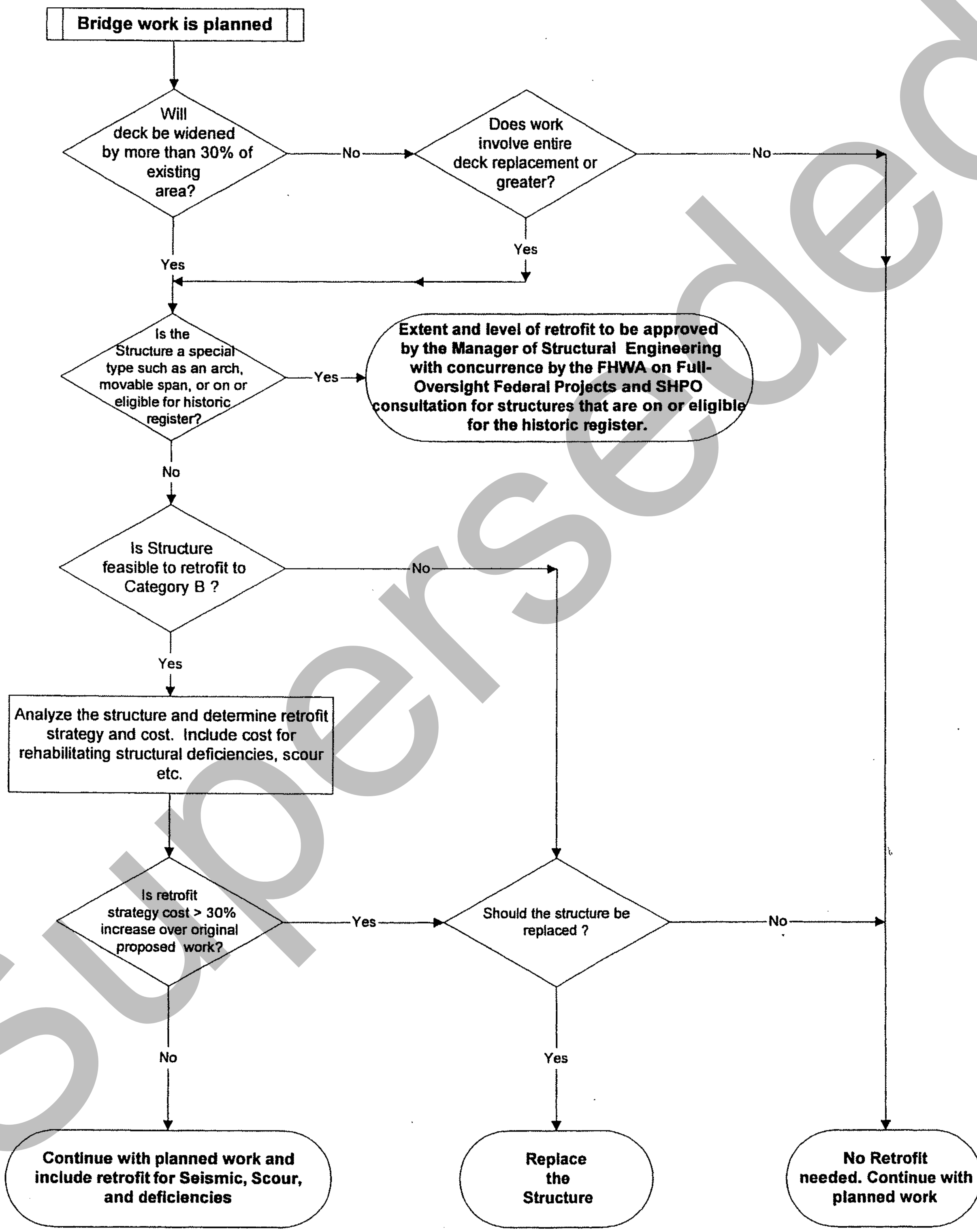
2. The AASHTO Guide Specifications for Seismic Isolation Design shall be used for designing isolation bearings when they have been deemed necessary for accommodating seismic loads. These bearings have special performance characteristics, which will alter the dynamic response of a bridge.

1.45.7 COMPUTER SOFTWARE

For Single and multi-mode analysis standard computer programs such as SEISAB and STAAD-PRO shall be used.

1.45.8 FLOW DIAGRAM FOR RETROFIT

Additional Analysis Required for Existing Bridges Found in Planned Projects



SECTION 46

SCOUR AT BRIDGES

1.46.1 GENERAL

1. In addition to the information presented within this Section, the specific guidance provided in Subsection 2.6 of the AASHTO LRFD Bridge Design Specifications should be referred to. As stated therein, the AASHTO Model Drainage Manual may be referred to for guidance and references on design procedures and references to hydrologic and hydraulic designs computer software.

   Additionally the following Hydraulic Engineering Circulars (HEC) reports provide guidance that should be used in performing a scour analysis:

   HEC 18 – Evaluating Scour at Bridges. Procedures for designing new, replacement and rehabilitation of bridges to resist scour are presented.

   HEC 20 – Stream Stability at Highway Structures. Guidance for identifying stream instability and for the selection and design of appropriate countermeasures to mitigate damage to bridges is presented.

   HEC 23 – Bridge Scour and Stream Instability Countermeasures. Bridge scour and stream instability countermeasures that have been implemented by various State Departments of Transportation are identified in this Report. Also, design guidelines for the countermeasures are provided.

2. Foundations of new bridges, bridges to be widened or bridges to be replaced, shall be designed to resist scour for a 100 year flood criteria, or a flood of a lesser interval, that may create the deepest scour at bridge foundations. A bridge may be in an inundated condition when the design flood for bridge scour occurs. This shall be referred to as the **"Design Flood for Bridge Scour"**.

   For existing bridges, the design flood criteria shall be the 100 year discharge, or a discharge of a lesser interval that is expected to produce the most severe adverse condition. However, the past history of floods at a particular location shall be evaluated to determine if a greater interval is justifiable to establish a flood discharge rate.

3. The foundation design shall be checked for a 500 year check flood, or if information for a 500 year flood is not available, 1.7 times the discharge rate of a 100 year flood. This shall be referred to as the **"Check Flood for Bridge Scour"**.

1.46.2 PRELIMINARY SCOUR ANALYSIS

1. Data Collection and Review Process. To perform a Scour analysis of an existing bridge location or for planning construction of a new bridge, data

collection should include the following:

a. Office Data Collection.

1.) Data on the waterway's history with respect to flooding and, if available, a Preliminary Scour Evaluation Report.

2.) Contract plans, As-built drawings, Aerial Surveys, Drainage area.

3.) Photographic documentation.

4.) FEMA Flood Insurance Studies from NJDEP.

5.) Bridge Evaluation Survey & Underwater Inspection Report, if any, from a local owner or the NJDOT.

6.) Foundation Reports and Boring logs.

7.) Existing Hydrologic and Hydraulic models, if available from NJDEP.

b. The NJDOT Structural Evaluation Unit should be contacted for obtaining information and documents on performance of scour analysis of existing bridge structures.

2. Identifying Scour Analysis Variables

Specific bridge scour variables or parameters shall be identified for a mathematical scour analysis. Such variables or parameters shall include the following:

a. Hydrologic & Hydraulics Analysis

1.) Hydrologic Analysis – Refer to Subsection 2.6.3 of the AASHTO LRFD Bridge Design Specifications for guidance. Determine the drainage area from USGS maps or other appropriate sources. List available flood records. Determine design flood discharge and discharges for other frequencies. Plot flood frequency and stage-discharge-frequency curves for the site.

2.) Hydraulic Analysis – Subsection 2.6.4 of the AASHTO LRFD Bridge Design Specifications and Chapter 10 of the AASHTO Model Drainage Manual provides guidance in the hydraulic design of a stream crossing. The AASHTO Model Drainage Manual defines technical aspects of hydraulic design and presents a design procedure that may be followed. The following guidance should also be used for a hydraulic analysis.

a.) In the event of recent floods or shifting of a stream, an old hydraulic study should not be considered reliable. A new study should be carried out. The HEC-RAS, "River Analysis System, Users Manual", 1995, published by the U.S. Army Corps of Engineers, or WSPRO software may be used. Existing studies performed by FEMA, the U.S. Army Corps of Engineers, U.S. Soil Conservation Service and NJDEP may also be assessed.

b.) The allowable velocity for a bridge location and the permissible backwater should be determined. This information may then be compared with computed velocities and backwater using HEC-RAS or WSPRO. The scour depth for a proposed bridge and, if economical, for an existing bridge should be estimated. Refer to item 3.) below for backwater criteria.

c.) When a dam exists upstream of a bridge, the design flood for the dam and its spillway shall be considered when performing the scour analysis.

d.) For criteria on bridge waterway sizing, refer to Subsection 2.6.4.3 of the AASHTO LRFD Bridge Design Specifications. Also, the NJDEP Technical Manual for Land Use Regulation Program Bureaus of Inland and Coastal Regulations, Stream Encroachment Permits should be referenced to verify permitted requirements.

3.) Backwater elevation criteria. The following criteria must be considered in the scour analysis.

a.) As per current NJDEP requirements, if projects are located in the Central Passaic Basin of the State, the permissible backwater rise and fill shall be, without exception, for both bridge replacement or new construction, zero.

b.) At other locations throughout the State, if an existing bridge structure, in a waterway, is to be replaced then the permitted water elevation rise shall be zero either upstream or downstream of the bridge structure.

Also, at other locations throughout the State, if new construction of a bridge structure is planned, then a 0.2 foot water elevation rise is permitted. For both new construction and bridge replacement scenarios, 20% net fill of the waterway location is permitted. For certain, as deemed necessary situations, an exception for additional fill may be granted.

b. Stream Stability

The NJDEP publication "Technical Manual for Land Use Regulation Program, Bureau of Inland and Coastal Regulations Stream Encroachment Permits", HEC 18 and HEC 20 Reports may be used to determine stream stability variables.

c. Geotechnical Considerations

The following data should be assessed in determining geotechnical impacts on the scour analysis:

1.) Review subsurface information that is provided in the Geotechnical Report.

2.) Evaluate historic scour related conditions and potential scour holes at the bridge site.

3.) Soil classification – Based on laboratory tests for grain size samples, classify the soil.

1.46.3 PERFORMING A SCOUR ANALYSIS

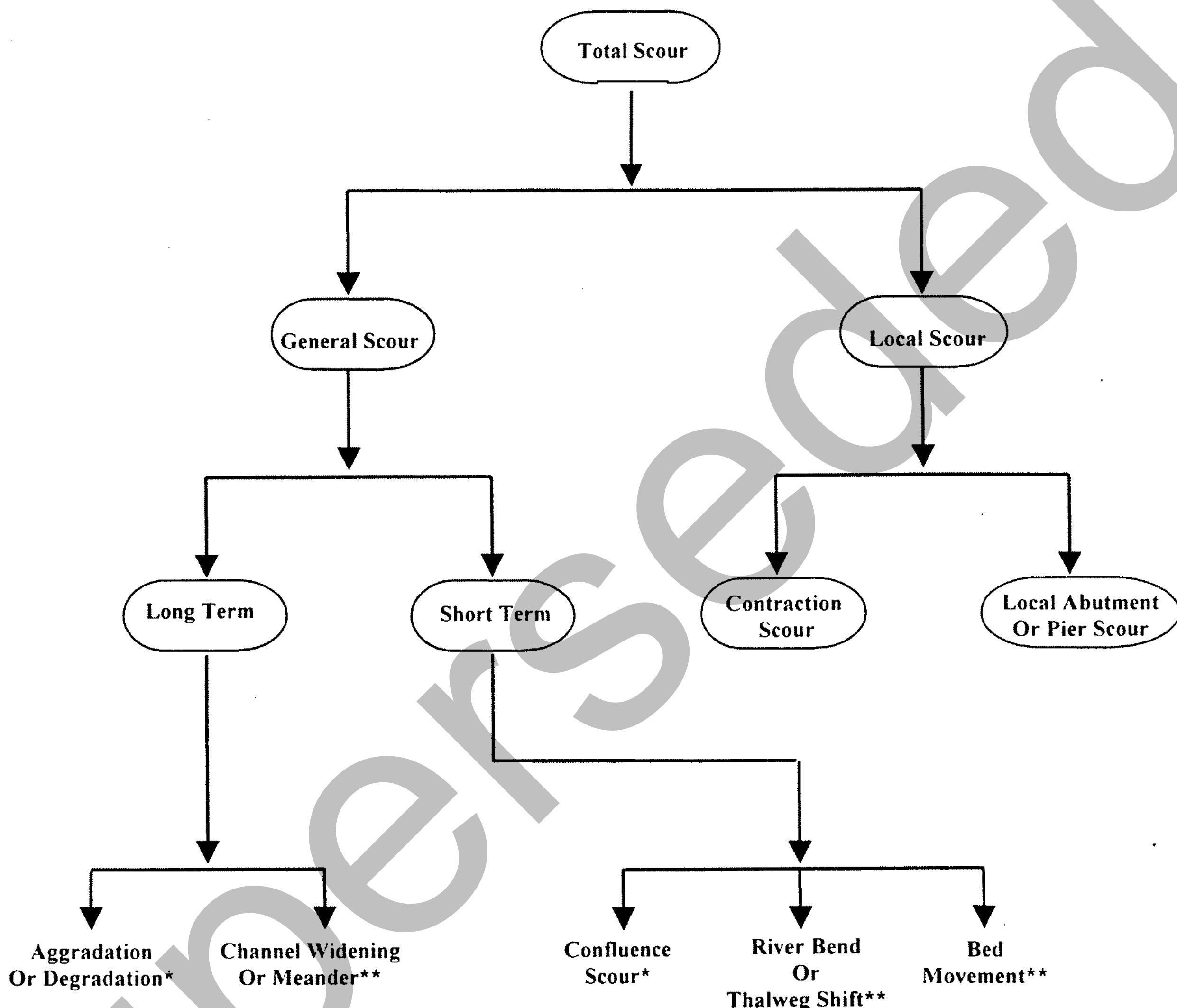
The following types of analyses should be conducted in the overall scour analysis of a bridge:

Level 1- Qualitative assessment of Stream stability, including lateral stability, vertical stability and determining the profiles and plan formations of streams and rivers. (Refer to HEC 20)

Level 2- More detailed quantitative analysis, including hydrologic, hydraulic and scour analysis to assess scour vulnerability. (Refer to HEC 18)

Level 3- Bridge scour design of stream instability countermeasures. (Refer to HEC 23)

The following flow diagram may be utilized to assess the impact of scour and scour components on a bridge structure site.



* Vertical Stability

** Lateral Stability

Notes:

1. Long term scour is based on the concept that long term streambed elevation changes can take place over the time scale of several years during the life of a bridge, due to aggradation or degradation. Also, natural or man-induced causes may affect the reach of a river in which the bridge is located.

2. Aggradation involves the deposition of material eroded from the channel or watershed upstream of the bridge.

3. Degradation involves the lowering or scouring of the longitudinal profile of a channel. The bends of meandering channels may move laterally in the vicinity of the bridge, causing the channel to widen and create lateral erosion and scour.

4. If bridge inspection records of cross sections of the stream at the bridge site are maintained over many years, long term scour can be calculated from streambed elevation changes. Projections of scour based on a long-term trend can be made.

5. Common Countermeasures used for aggradation are channel improvements by dredging or cleaning.

6. Countermeasures for degradation are channel lining with concrete pavement, increasing a bridge opening width or vegetation planting.

Upon determination of the effects of scour impact, a summary of scour depth may be prepared as presented in the following Table:

Scour Depth Summary at Abutment/Pier

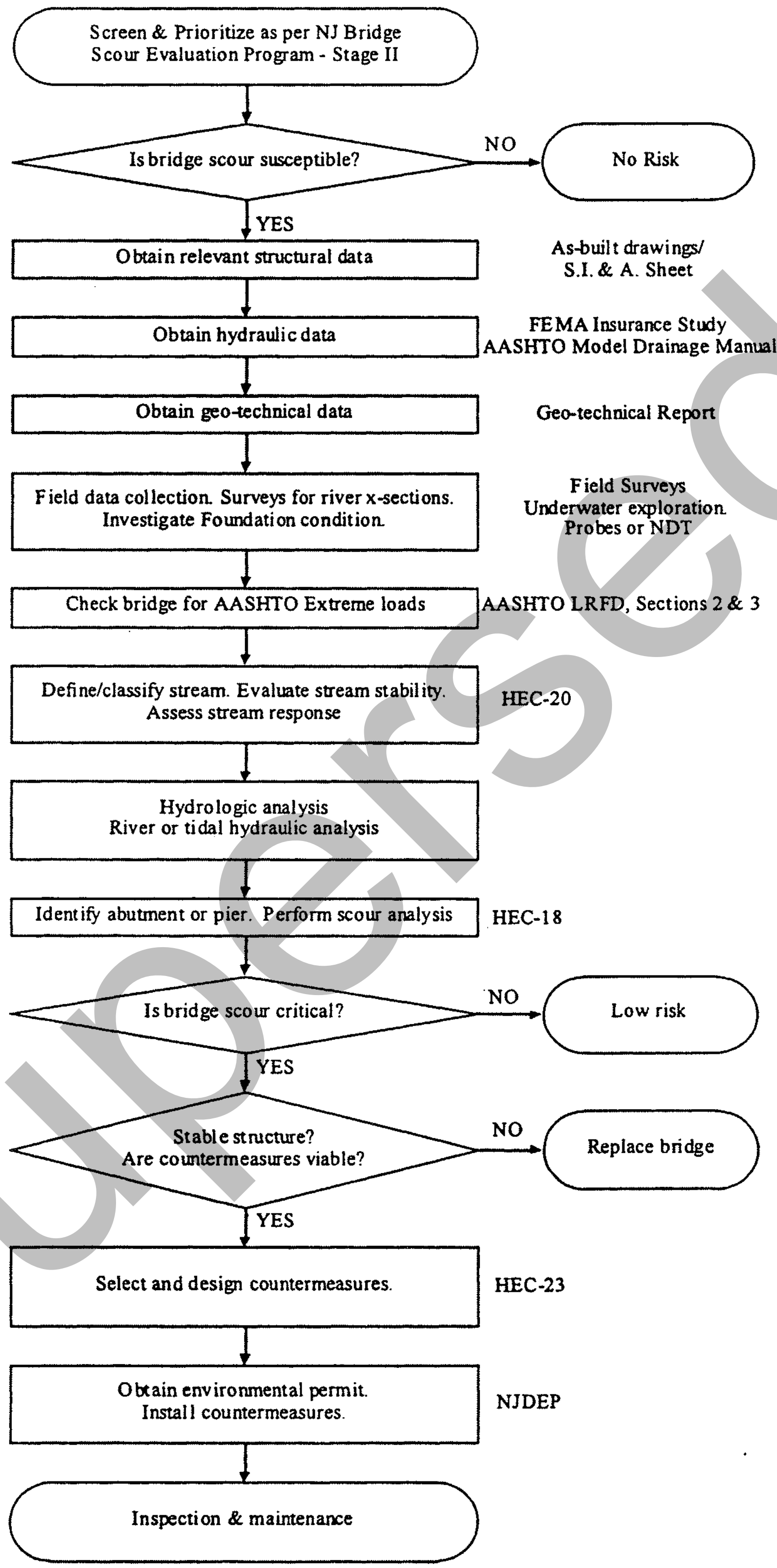
Discharge Frequency	Computed Scour Depths in Feet					Proposed Elevations	
	Long term Scour	Short term Scour	Contraction Scour	Local Scour	Total Scour	Top of Footing	Bottom of Footing
50 Year							
100 Year							
500 Year *							

* If 500 year Discharge is not available, use Q500 = 1.7 x Q100

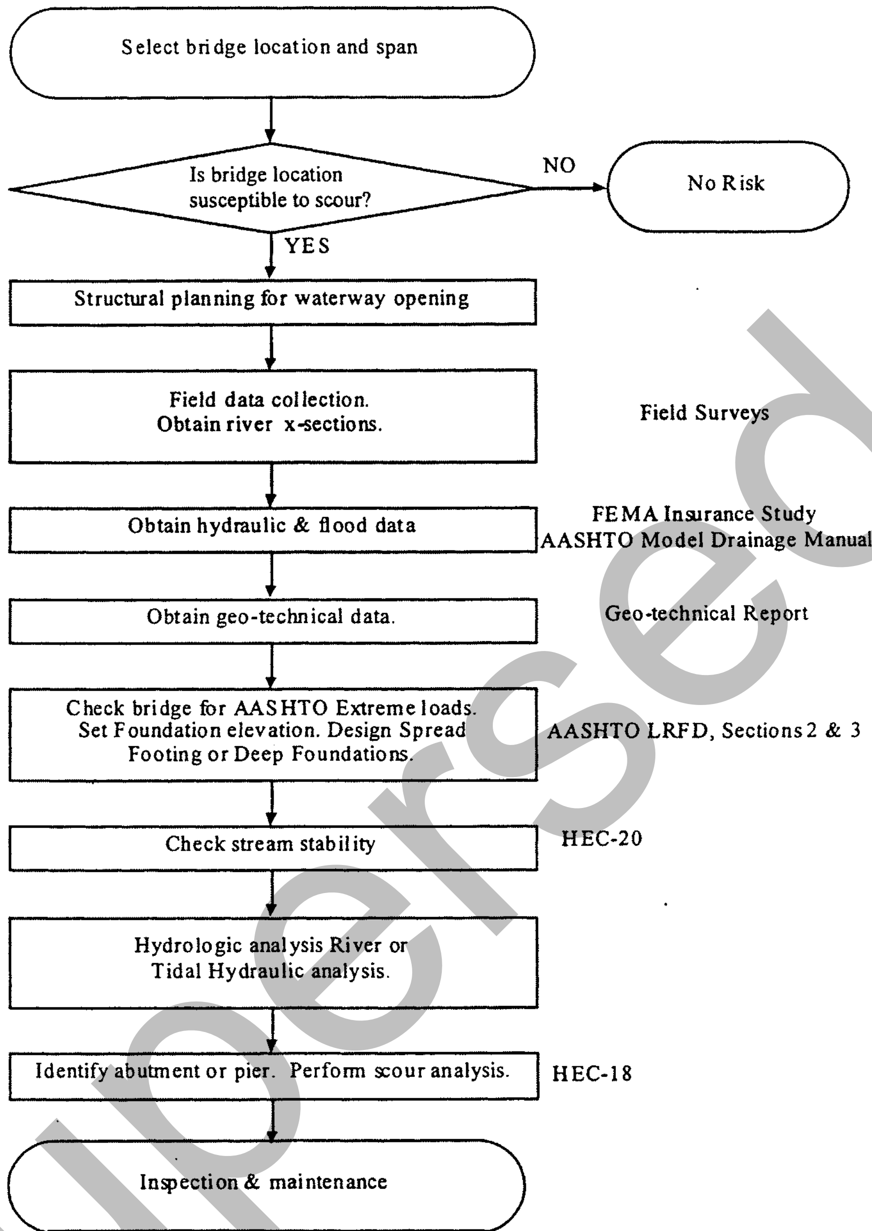
1.46.4 FLOW DIAGRAMS FOR DETAILED SCOUR EVALUATION

The following flow charts may be followed in developing a comprehensive scour analysis.

Existing Bridges and Bridges to be Widened



2. New Bridges and Bridges to be Replaced



1.46.5 SCOUR COUNTERMEASURE DEVELOPMENT PROCEDURES

1. Selection and Design of Scour Countermeasures

    a. Scour countermeasure methods shall provide vertical and lateral channel stability and minimize or eliminate aggradation, degradation, lateral erosion and local scour.

    b. Such methods to structural features may include:

        1.) use of deep foundations; such as, piles or drilled shafts
        2.) reduction of flood velocity by rounding the shape of a pier
        3.) driving sheet piling to protect existing footings or
        4.) driving sacrificial piles to deflect flow and induce deposition in a local scour hole at piers .

2. The following guidance may be followed in developing scour resistant bridge designs:

    a. If it is determined from established inspection procedures, that all streambed material in the computed scour prism has been removed and is not available for bearing or for lateral support, an existing bridge should be considered for replacement.

    b. When required, the preliminary submission shall include a Hydraulic and Scour Report which should establish a design procedure for scour resistance. Subsection 17.3 of the NJDOT Procedures Manual should be referred to for guidance on circulation and approval of the hydraulic and scour report's recommendations. The following structural elemental information should be addressed in this Report:

        1.) Superstructure

            a.) The bridge superstructure and the general elevation of approach roadways shall be above the maximum flood level of 100 years or other designated critical flood.

            b.) For streams that carry a large amount of debris, the elevation of the lower chord of the bridge shall be at least 2 feet above the freeboard for a 100 year flood.

        2.) Abutment and Wingwalls

            a.) The design of abutments and wingwalls shall be considerate of the potential that the channel may shift and that scour may occur during the life of the structure.

b.) Design loads shall be based on the AASHTO LRFD Bridge Design Specifications, Section 3, Extreme Events I (including water loads (WA) for scour depths based on mean discharges).

3.) Piers

a.) Location of piers in small streams should be avoided. Small streams are susceptible to flooding during localized rain storms. Erosion of a pier's foundation may occur.

b.) The number of piers in any stream channel shall be limited so that ice forces and potential for local and contraction scour are minimized.

c.) In order to reduce drift build up, piers shall be aligned with the flow direction.

d.) Design loads shall be based on the AASHTO LRFD Bridge Design Specifications, Section 3, Extreme Events I (including water loads (WA) for scour depths based on mean discharges).

e.) Piers subject to tidal conditions shall be protected on all sides by means identified in Section 19 of this Manual.

f.) If there is a hazard of ice and debris buildup, multiple pile bents shall be avoided.

g.) A solid wall or hammerhead pier is preferred to a column bent or pile bent pier. For scour estimation, evaluate a bent pier as a solid pier. Circular or elongated pier shapes shall be preferred to rectangular shapes.

4.) Foundation Planning Based on Scour Analysis

a.) Scour Depth Considerations

- Subsection 2.6.4.4 of the AASHTO LRFD Bridge Design Specifications may be referenced for guidance concerning bridge foundation design concepts.

- Foundations shall be designed for the condition that all stream bed material, in the 100 year scour prism above the total scour line, has eroded and is not available for bearing or lateral support.

- The top of footing shall be a minimum of 1 foot below the river bed and also below the total scour line and below the lateral migration levels.

b.) Spread Footings on Soil

- Use spread footings only where the stream bed is extremely stable.
- Place top of footing at the scour depth that is determined by the Check Flood for Scour.
- Calculated scour depth may be reduced by 50% if riprap scour protection and appropriate inspection frequency are provided.
- When non-erodible rock is present at a higher elevation than the calculated scour depth, place the bottom of footing at the rock elevation.

c.) Spread Footings on Erodible Rock

- Consult an Engineering geologist for rock erodibility.
- Estimate the potential scour depth and place the bottom of footing 6 inches below that depth.
- Place the final footing in contact with the sides of excavation and fill the excavation above the footing with riprap.
- Blasting shall not be permitted for rock excavation.

d.) Spread Footings on Non-erodible Rock. For highly resistant rock such as granite and non-erodible limestone, place the bottom of the footing on a clean rock surface 0.5 feet below the bedrock and consider doweling for increased lateral restraint.

e.) Deep Foundations.

- When a stream bed is not stable, piles should be considered.
- For driven piles or drilled shafts with footings or caps, place the top of the footing below the stream

bed at a depth that is equal to the estimated sum of long term degradation and contraction scour.

- Consideration should be given to using a lesser number of longer piles as compared to a greater number of shorter piles. This will develop higher bearing loads. This approach will provide a greater factor of safety against pile failure due to scour, at little or no increase in cost.

- If, due to an increase in unsupported pile length that is measured up to the total scour depth line, pile stability shall be checked for column action requirements. Additional lateral loads due to stream pressure, currents, debris and ice loads should be considered in the pile design.

- For stub abutments, piles shall be carried at least 3 feet below the thalweg elevation.

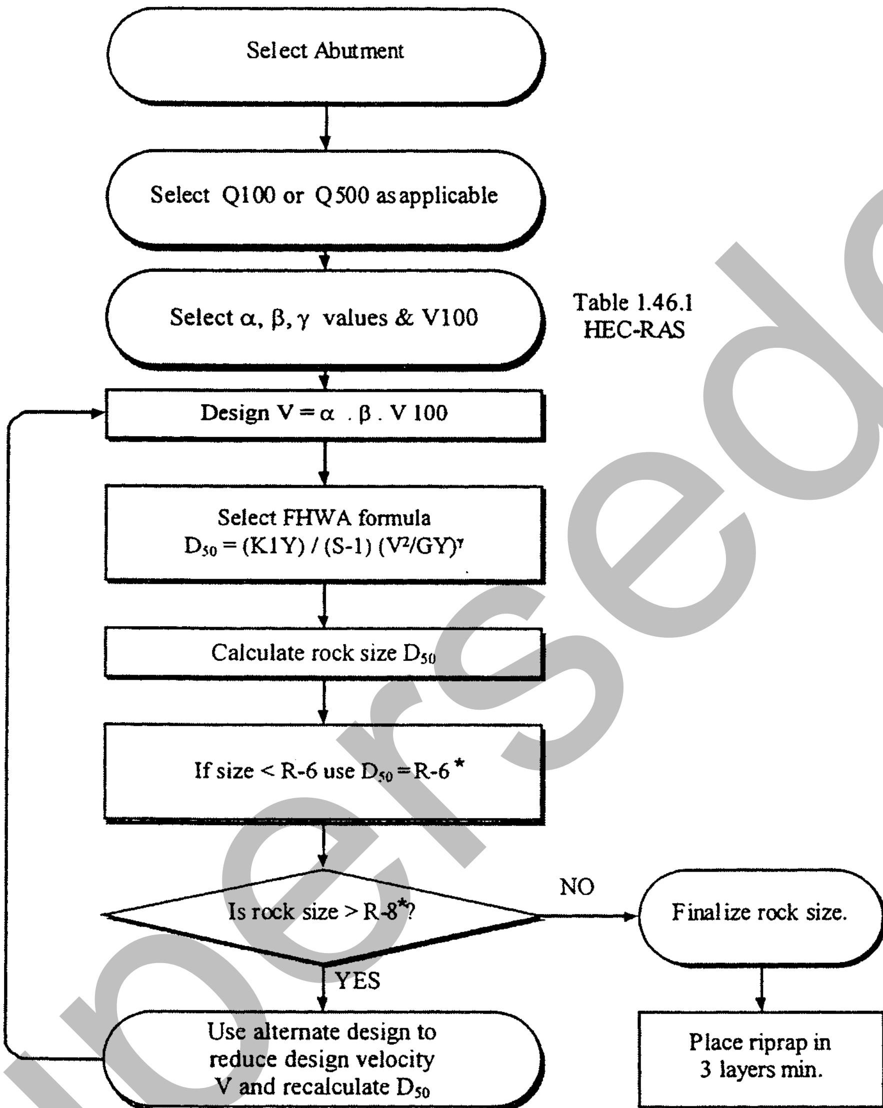
- When piles cannot be driven, drilled shafts or caissons shall be used.

3. Using Riprap as a Temporary Countermeasure

a. Limitations of riprap: Although natural riprap is the most commonly used armoring, it requires monitoring since it is not held in position similar to other types of armoring; such as, articulated concrete blocks, grout filled bags, gabion or reno mattress.

b. Riprap is not recommended for new piers and should be considered as a temporary measure for existing piers. Alternate countermeasures as described in HEC-23 and in this Section; such as, heavier armoring, river training measures, channel improvements, modifying the structural features including monitoring, shall be adopted.

c. The following flow diagram may be followed in designing a riprap system for abutment protection:

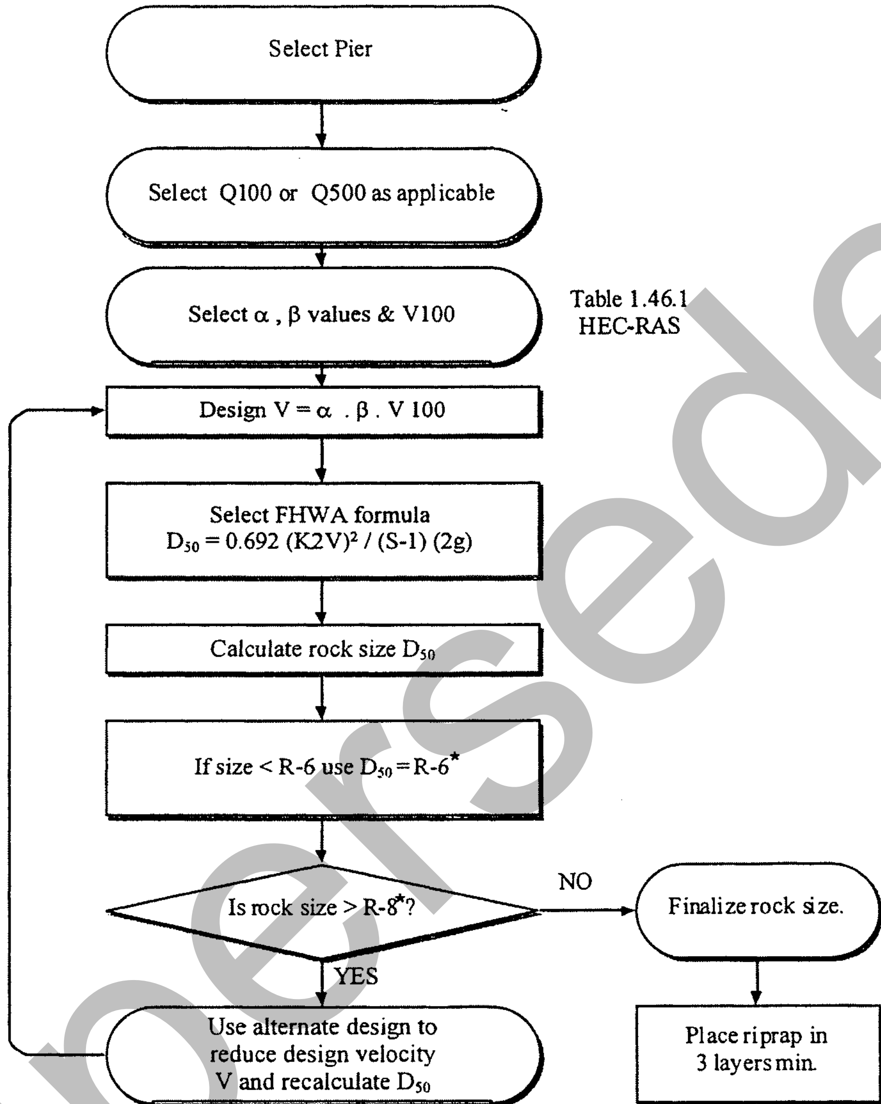


* NCSA Classification

Riprap at Abutment on Spread Footing (on soil).

NOTES:
1. If rock exists at a depth lower than the design depth, place bottom of footing at 6" below rock surface.
2. Set design depth = 1/2 scour depth if only riprap countermeasure is used.

d. The following flow diagram may be followed in designing a riprap system for pier protection:



* NCSA Classification

Riprap at Pier on Spread Footing (on soil).

e. Rip-Rap Layout Procedures

1.) Riprap grading – Designate 50 percent of stones in a layer to be equal or greater than the specified size (D_{50}). The specified size can be calculated by hydraulic considerations using FHWA formulae (see flow diagrams above). The remaining 50 percent of the stones can be of a smaller size than the (D_{50}) to fill the smaller voids between the stones.

2.) Maximum stone size in a layer < 1.5 D_{50}.

3.) Minimum thickness of each layer = 1 foot.

4.) Minimum number of layers = 3.

5.) Width of a riprap layer on a footing, at the river side of an abutment or around the pier shall be the maximum of the following :

2 x (width of abutment or pier at base) or

(1 foot + d cot θ), where d is the design scour depth at the abutment or the pier and θ is the angle of natural repose for the soil, as obtained from the Geotechnical Report.

6.) Place riprap around the footings with the slope starting at a distance of 1 foot from vertical face of the footing.

7.) Before placing riprap, check that the excavation line that is located adjacent to the abutment and around the pier meets OSHA safety requirement for the type of soil.

8.) The top of riprap shall be below the river bed to avoid encroachment of the river, or dislodging of the stones by floating debris, ice or currents.

9.) If a riprap design is based on a scour analysis, use a reduced design depth d = y/2, Where y = computed scour depth.

10.) If the design depth "d" is greater than the available depth between riverbed elevation and bottom of footing, and the rock is not available within depth "d", or if the computed D_{50} size > R-8, alternate countermeasures will be required.

1.46.6 SCOUR PROTECTION DETAILING

Figures 1.46.1 to 1.46.4 provide details for riprap placement at abutments and piers.

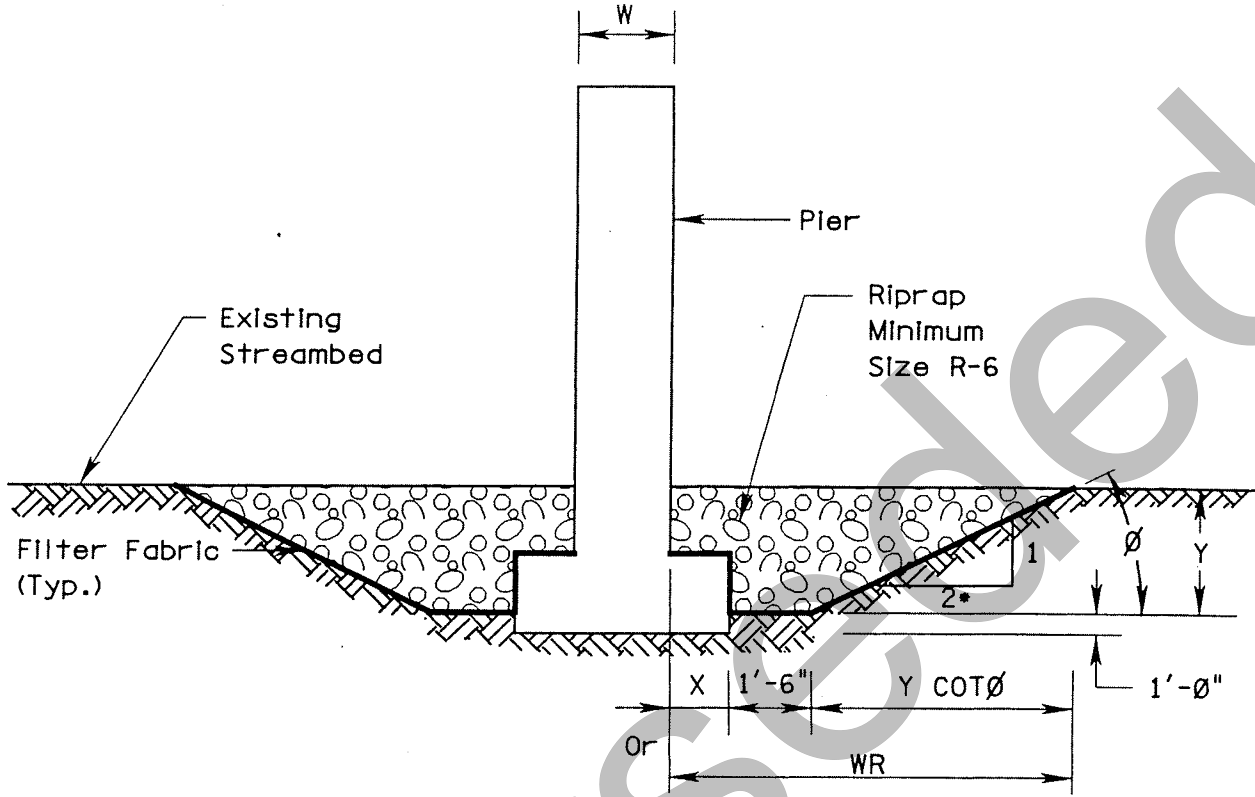
1.46.7 SCOUR PROTECTION AT CULVERTS

1. Hydraulic design: Chapter 9 of AASHTO Model Drainage Manual and HEC 23 provide design procedures for the hydraulic design of highway culverts. Included therein are design examples, tables and charts that provide a basis for determining the selection of a culvert opening.

2. Footings for any flared wingwalls, provided at the entry and the exit of culverts will be protected by riprap or alternate armoring countermeasures.

3. For high velocities exceeding 12 ft/sec, riprap at wingwalls will be replaced by a concrete apron, which is to extend between the opposite wingwalls and to the edge of the culvert.

4. Regular monitoring will be required if riprap has been installed at the entry and exit of culverts.



Y = DESIGN DEPTH OF RIPRAP
W = WIDTH OF PIER
WR = WIDTH OF RIPRAP
Ø = ANGLE OF REPOSE OF SOIL (OBTAIN FROM GEOTECHNICAL REPORT)

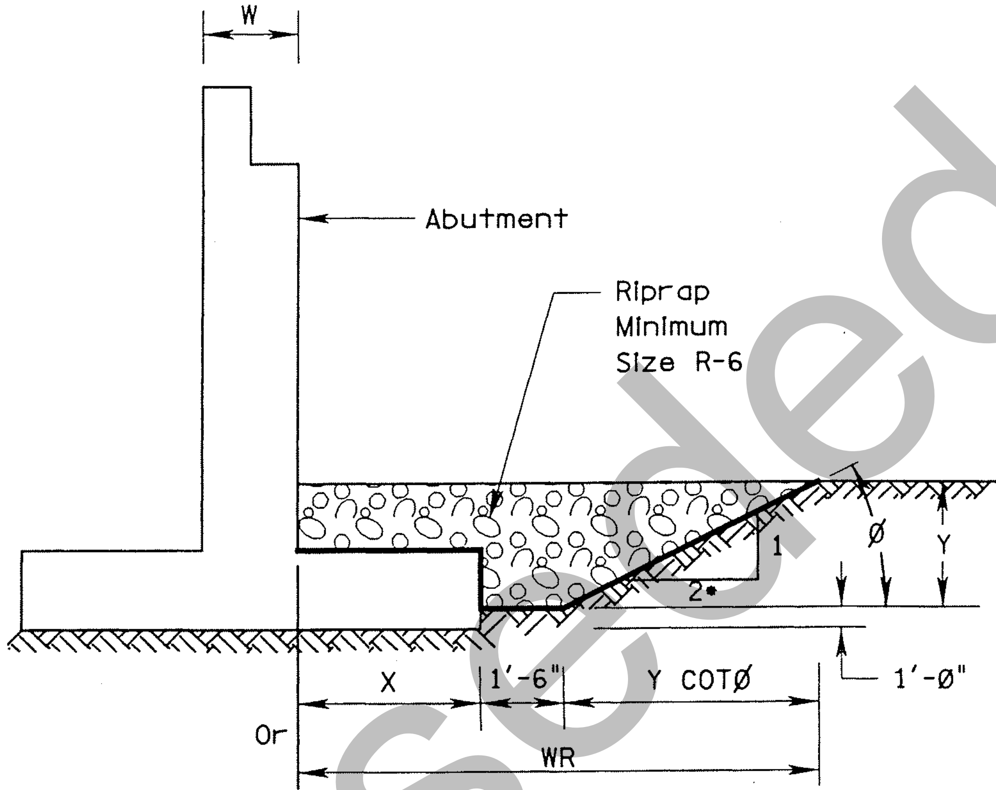
* USE 2 HORIZONTAL TO 1 VERTICAL SLOPE, IF Ø VALUE IS NOT KNOWN.

USE GREATER OF:
1. WR = X + 18" + Y COTØ
2. 2W
3. WIDTH OF SCOUR HOLE AT PIER

Figure 1.46-1: TYPICAL PIER SECTION

N.T.S.

SCOUR COUNTERMEASURES



* USE 2 HORIZONTAL TO 1 VERTICAL SLOPE, IF Ø VALUE IS NOT KNOWN.

Y = DESIGN DEPTH OF RIPRAP
W = WIDTH OF PIER
WR = WIDTH OF RIPRAP
Ø = ANGLE OF REPOSE OF SOIL (OBTAIN FROM GEOTECHNICAL REPORT)

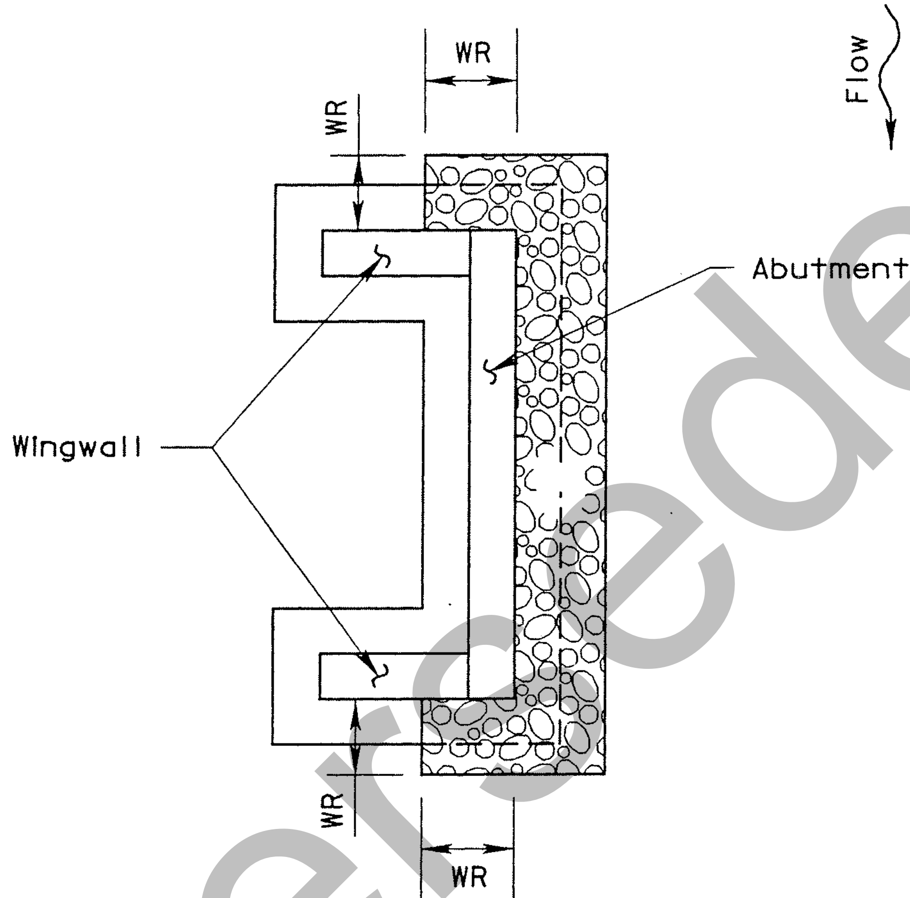
USE GREATER OF:

1. WR = X + 18" + Y COTØ
2. 2W
3. WIDTH OF SCOUR HOLE AT PIER

Figure 1.46-2: TYPICAL ABUTMENT SECTION

N.T.S.

SCOUR COUNTERMEASURES



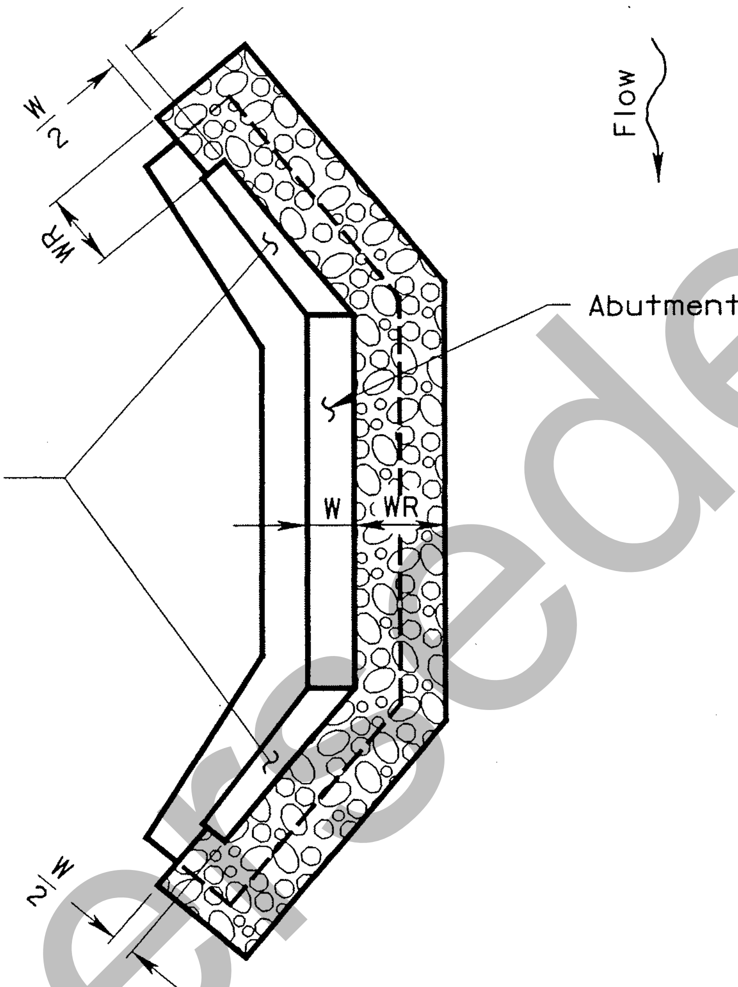
PLAN

(a) Wingwalls Normal to Abutment

Figure 1.46-3: REPAIR DETAILS AT ABUTMENT

N.T.S.

SCOUR COUNTERMEASURES



PLAN
(a) Wingwalls Flared

Figure 1.46-4: REPAIR DETAILS AT ABUTMENT
N.T.S.

SCOUR COUNTERMEASURES

SECTION 47

NOISE BARRIERS

1.47.1 GENERAL

a. The Designer shall obtain preliminary information necessary for the design of noise barriers from the Department. This information will include the following:

- Types of noise barriers to be used
- Required height, length and offset for noise abatement
- Architectural treatments.

Refer to Subsection 1.47.2 for more information concerning preferred types of barriers and architectural treatments.

In general, the Landscape Design Unit is responsible for determining the types of noise barriers and the architectural treatments of noise barriers. The Bureau of Environmental Services of the Division of Project Management is responsible for determining the required height, length and offset of noise barriers for noise abatement.

Due to deterioration of installed sound absorptive facing material on Noise Wall panels, the use of this material shall not be planned on Department Noise Barrier construction projects.

The Designer shall identify and verify all existing utility conduits in the vicinity of the proposed noise barrier wall alignment. If any existing utility interferes with the noise barrier, the Department shall be contacted for possible relocation of the existing utility conduits.

b. The AASHTO Guide Specifications for the Structural Design of Sound Barriers shall be followed as the Design Specifications for such designs.

Design criteria, not specifically herein addressed, shall conform to applicable Sections of the current AASHTO LRFD Bridge Design Specifications, and as modified by Section 3 of the Manual.

The following Tables (47-1 through 47-4), are obtained from the AASHTO Guide Specifications.

The following Tables, 47-1 through 47-4, shall be used for the design of Noise Barriers:

Table 47-1: Minimum Wind Pressure On Sound Barriers Located In Coastal Regions

Distance From Average Level Of Adjoining Ground Surface To Centroid Of Loaded Area In Each Height Zone, Feet	Cc	Minimum Pressure (P), psf For The Indicated Wind Velocity (V), mph			
		80	90	100	110
$0 < H \leq 14$	1.20	40	50	62	75
$14 < H \leq 29$	1.37	46	58	71	87
Greater Than 29	1.49	50	63	77	94

This Table is to be used for both ground mounted and structure mounted noise barriers in flat unobstructed areas exposed to wind flowing over large bodies of water and extending inland from the shoreline a distance of 0.5 miles.

Table 47-2: Minimum Wind Pressure On Sound Barriers Located On Bridge Structures, Retaining Walls, Or Traffic Barriers

Distance From Average Level Of Adjoining Ground Surface To Centroid Of Loaded Area In Each Height Zone, Feet	Cc	Minimum Pressure (P), psf For The Indicated Wind Velocity (V), mph			
		80	90	100	110
$0 < H \leq 14$	0.80	27	34	42	50
$4.3 < H \leq 29$	1.00	33	42	52	63
Greater Than 29	1.10	37	46	57	69

This Table is to be used in open terrain with scattered obstructions. This includes flat, open country and grasslands. This exposure shall be used for all sound barriers located on bridge structures, retaining walls or traffic barriers that are not covered by Table 47-1.

Table 47-3: Minimum Wind Pressures On Sound Barriers Not Located On Structure

Distance From Average Level Of Adjoining Ground Surface To Centroid Of Loaded Area In Each Height Zone, Feet	Cc	Minimum Pressure (P), psf For The Indicated Wind Velocity (V), mph			
		80	90	100	110
0 < H ≤ 14	0.59	20	25	31	37
14 < H ≤ 29	0.75	25	32	39	47
Greater Than 29	0.85	28	36	44	53

This Table is to used in urban and suburban areas with open terrain that does not meet the requirements of Table 47-4. Generally, this Table should be used for ground mounted noise barriers.

Table 47-4: Minimum Wind Pressure On Sound Barriers Not Located On Structures.

Distance From Average Level Of Adjoining Ground Surface To Centroid Of Loaded Area In Each Height Zone, Feet	Cc	Minimum Pressure (P), psf For The Indicated Wind Velocity (V), mph			
		80	90	100	110
0 < H ≤ 14	0.37	12	16	19	23
14 < H ≤ 29	0.50	17	21	26	31
Greater Than 29	0.59	20	25	31	37

This table is to be used in urban and suburban areas with numerous closely spaced obstructions having the size of single-family dwellings or larger that prevail in the upwind direction from the noise wall for a distance of at least 1500 feet. Wind loads shall be applied perpendicular to the wall surface.

Adjacent ground surface can be defined as the ground elevation (or water elevation) immediately adjacent to the structure. In situations where noise barriers are mounted on bridges and retaining walls, the height to be utilized in determining the design wind pressure, P, shall be taken from the lowest average ground or water elevation adjacent to the noise barrier, to the centroid of the loaded area.

c. The following are load groups to which the noise barriers may be subjected. Each part of the structure shall be proportioned for the load combinations. Foundations shall be proportioned according to Subsection 1.47.4.

Wind Loads
Earth Loads
Traffic Loads
Ice and Snow Loads
Bridge Loads

The AASHTO LRFD Bridge Design Specifications shall be used to determine these loading conditions. The following information for Seismic Loads as well as the AASHTO LRFD Bridge Design Specifications for Highway Bridges shall be referenced in considering the Seismic load combination.

Seismic Loads

The seismic dead load, EQD, in the following formula shall be computed as follows:

EQD = A x f x D

Where:

	EQD	=	Seismic dead load
	D	=	Dead load of noise barrier, excluding foundations
	A	=	Acceleration coefficient (as per Section 45 of this Manual)
	f	=	Dead load coefficient

f	
0.75	Dead load, except on bridges
2.50	Dead load, on bridges
8.0	Dead load for connections of walls, not cast in place, to bridges
5.0	Dead loads for connections of walls, not cast in place, to retaining walls

The dead load shall consist of the weight of all the component materials making up the noise barrier, excluding the foundation. The point of application of the Seismic Dead Load, EQD, of the individual components shall be at their respective centers of gravity.

When a noise barrier is supported by a bridge superstructure, the wind or seismic load to be transferred to the superstructure and substructure of the bridge shall be as specified in Subsection 1.47.1(c). Additional reinforcement may be required in traffic barriers and overhangs to resist the loads transferred by the noise barrier.

d. **Functional Requirements**

1). Guide rail or concrete barrier curb shall be used when the noise barrier is located within the clear zone (see Section 8 of the NJDOT Roadway Design Manual for more information).

2). Stopping sight distance criteria shall apply in determining the location of a noise barrier. Horizontal clearances which reduce the stopping sight distance shall be avoided. In those extreme cases where reduced stopping sight distances may be warranted, a design exception shall be provided to justify the need.

3). Minimum Height - Noise barriers should have a minimum height consistent with that of a right of way fence (measured from the top of the barrier to the ground). Height requirements will be determined by noise studies performed by the Bureau of Environmental Services. When the tops of noise walls have to be stepped, the maximum height of step should not exceed 2 feet.

When noise barriers higher than 15 feet are required by sound studies performed by the Bureau of Environmental Services, consideration of surrounding features should be evaluated such that an exceptionally high wall does not create an unsightly impact on the environmental aesthetic features of the territory. In such situations, noise barriers in combination with earth mounds should be considered.

4). Barriers can obstruct light as well as noise. Special consideration shall be given to possible roadway icing and other induced environmental conditions caused by the placement of the wall.

5). It is important to have drainage facilities along noise barriers to assure soil stability. Soil with phi (∅) of 25 degrees or less may develop flowing characteristics when saturated. Surface runoffs should be directed away from the noise barrier.

6). Provisions may be necessary to allow fire fighters and chemical spill cleanup crews access to fire hydrants on the opposite side of the noise barrier. The designer should consult with local fire and emergency officials regarding their specific needs.

7.) For noise barriers that must bridge over conduits, provisions should be made to accommodate differential settlement in the noise walls substructures.

8). The Preliminary Submission for Noise Barriers shall include a Report to address the possibility of icing, the storage of snow, utilities impact, drainage, mounting on culverts and the issues discussed in items 4, 5, 6 and 7 above.

e. **Maintenance Considerations**

1). Noise barriers placed within the area between the shoulder and right of way line may complicate the ongoing maintenance and landscaping operations, especially if landscaping is placed on both sides of the noise barrier. Special considerations should be given to maintaining the adjoining land behind the noise barrier and adjacent to the right of way line. A minimum 4 to 6 feet wide shrub planting area between the proposed guide rail and the noise barrier might be considered.

2). In some urban areas, noise barriers may be subjected to graffiti being placed on their surfaces. In these locations, the surface texture selected should be such that it is difficult to place the graffiti or such that the graffiti is easily removed. Noise barriers with rough textures and dark colors tend to discourage graffiti.

3). Access to the back side of the noise barrier should be provided for inspection, litter control, soil erosion monitoring, grass mowing and maintenance. In subdivision areas, access may be via local streets, when available. If access is not available via local streets, access gates or openings are essential at intervals along the noise barrier. Offset barriers concealing the access opening must be overlapped a minimum of 4 times the offset distance in order to maintain the integrity of the noise attenuation of the main barrier. Location of the access openings should be coordinated with the appropriate agency or land owner. Gates in the noise barriers along federal aid routes require justification and FHWA approval.

f. **Noise Barriers on Bridges**

1). Provisions for expansion shall be placed in the noise barrier at locations of bridge deck expansion joints and at parapet deflection joints.

2). For noise barrier retrofit onto existing bridges, the Designer must verify that the dead and live load from the wall do not overstress any component of the bridge including the existing parapets, slab overhang, girders and superstructure members.

The dead load of noise barriers can affect the overload capacity and deflection of some bridges. Check the change in load capacity of the bridge and verify whether the change is acceptable.

3). When Noise Barriers are to be installed on a bridge structure, the Designer shall closely examine all proposed connections. Connections of aluminum panels to the bridge structure and those of the noise barrier panels shall be reviewed to assure that disassemblies will not occur. Traffic induced vibration should be considered as part of the examination.

1.47.2 TYPES OF BARRIERS

a. Timber or precast prestressed reinforced concrete post and panel systems are preferred; however, if unusual site conditions prohibit the use of a post and panel system, another noise barrier type may be considered (such as aluminum for bridges). Determination of the type of barrier and architectural treatments to be used at a site prior to the design of the barrier will be made by the Department. The Designer shall obtain the necessary information regarding barrier type and architectural treatments from the Department and shall refine and incorporate this information into the design.

Refer to Standard Drawings 2.8-1 through 2.8-4 "Noise Wall Barrier Standard Drawings" for information concerning standardization of Noise Barrier criteria.

Example considerations of noise barrier architectural treatments:

1.) Flush posts and panels on the traffic face of the barrier to provide a smooth appearance to motorists.

2.) Coloring of the surfaces by tinting, staining or other methods.

3.) End treatments

4.) Sloping transitions (rather than stepped transitions)

5.) Planting pockets

6.) Meandering barriers (posts and panels not arranged in a straight line, parallel to the centerline of the roadway).

7.) Caps on top of the barriers to provide horizontal continuity.

b. In most cases, foundations for noise barriers shall be drilled shafts; however, in cases where shallow rock formations exist, spread footings will be unavoidable. Noise barriers on bridges shall be mounted on the parapets or attached directly behind the parapet.

In a retrofit or rehabilitation situation, where it is determined that the existing or rehabilitated structure cannot accommodate the noise barrier loading, a separate supporting structure for the noise barrier may be considered. Sound leakage between the parapet and noise barrier shall be prevented by the use of flashing or other mechanical means.

c. A number of proprietary sound barrier systems are available. The materials, load carrying mechanisms and capabilities vary with each system; however, these systems shall conform to the criteria outlined in Subsection 1.47.1 of this Manual as well as current NJDOT Standard Specifications for Road and Bridge Construction and applicable project Special Provisions. Proprietary wall systems shall be approved prior to the design of the barrier.

On Federal-Aid projects, alternate systems must be specified in the Contract documents

1.47.3 MATERIALS

a. Concrete for cast in place foundations and precast/prestressed posts and panels shall conform to Section 914 of the NJDOT Standard Specifications. Class B concrete shall be used for foundations and Class P concrete shall be used for precast elements.

b. Reinforcing steel shall conform to Subsection 915.01 of the NJDOT Standard Specifications, Grade 60, fs = 24,000 psi.

Welded wire fabric fabricated from deformed wire may be substituted for reinforcing bars. Refer to Subsection 522.05 of the NJDOT Standard Specifications for additional criteria concerning the use of welded wire fabric reinforcement.

The provision of corrosion protected reinforcement shall be as determined on a project to project basis. The location of the noise barrier panels, in relationship to the offset distance from the roadway, shall be evaluated to determine if provision of corrosion protected reinforcement is warranted.

If the location of the noise barrier panels may subject the panels to splashing from the roadway surface, provision of corrosion protected reinforcement, should be recommended. In such cases, the bottom one third height of the panels should be scheduled for placement of corrosion protected reinforcement.

c. Glued laminated timber material is preferred for construction of timber noise barriers.

Glued laminated timber material shall meet the requirements of Subsection 918.05 of the NJDOT Specifications for Road and Bridge Construction.

Design guidance can be obtained from Subsection 8.4.1.2 of the AASHTO LRFD Bridge Design Specifications.

Solid sawn lumber elements and workmanship shall conform to the provisions of Section 504 of the NJDOT Standard Specifications for Road and Bridge Construction.

d. Allowable stresses for aluminum shall conform to the current edition of the Aluminum Association Specifications for Aluminum Structures. The allowable stresses pertaining to bridge structures shall be utilized.

1.47.4 FOUNDATION DESIGN

a. The method of design for drilled shaft foundations shall be approved, or as directed, by the NJDOT Geotechnical Engineering Unit. The lateral load determined by the controlling Group Load Case, Subsection 1.47.1 c. shall be applied to the noise barrier and shall be multiplied by a factor of 2 to obtain F, the applied lateral load. The intent of this procedure is to maintain a factor of safety of 2 against overturning. The allowable overstress of Subsection 1.47.1 b. should not be applied to the allowable soil strength.

b. Special Requirements for Sloped Soil Conditions

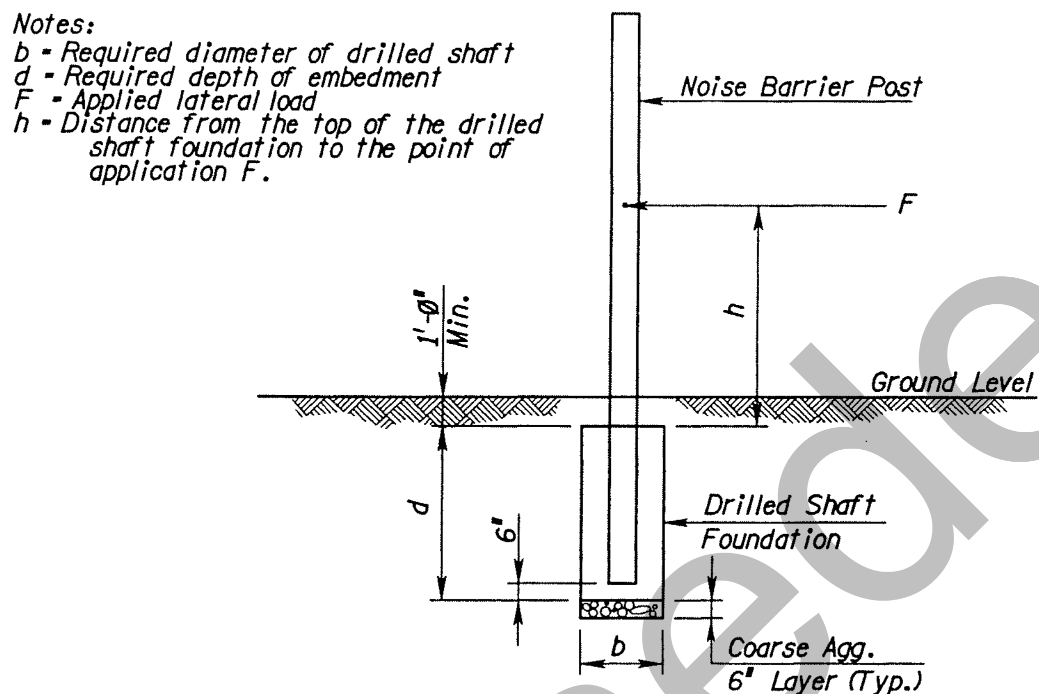
As stated in Appendix C, Part B of the AASHTO, Guide Specifications for the Structural Design of Sound Barriers, a level ground condition is defined as one in which the ground surface is approximately level or, when sloping down and away from the drilled shaft foundation, is not steeper than 1:10 (V:H) for phi (ϕ) = 35 degrees or 1:14 (V:H) for phi (ϕ) = 25 degrees. When these conditions prevail within a distance of two times the drilled shaft foundation embedment, the ground may be considered level, regardless of steeper slopes outside these limits.

Drilled shafts located in slopes shall be protected by a berm. The berm shall be level and provide a minimum cover of 1 foot over the drilled shaft. It shall extend a minimum of 1 foot beyond the face of the drilled shaft.

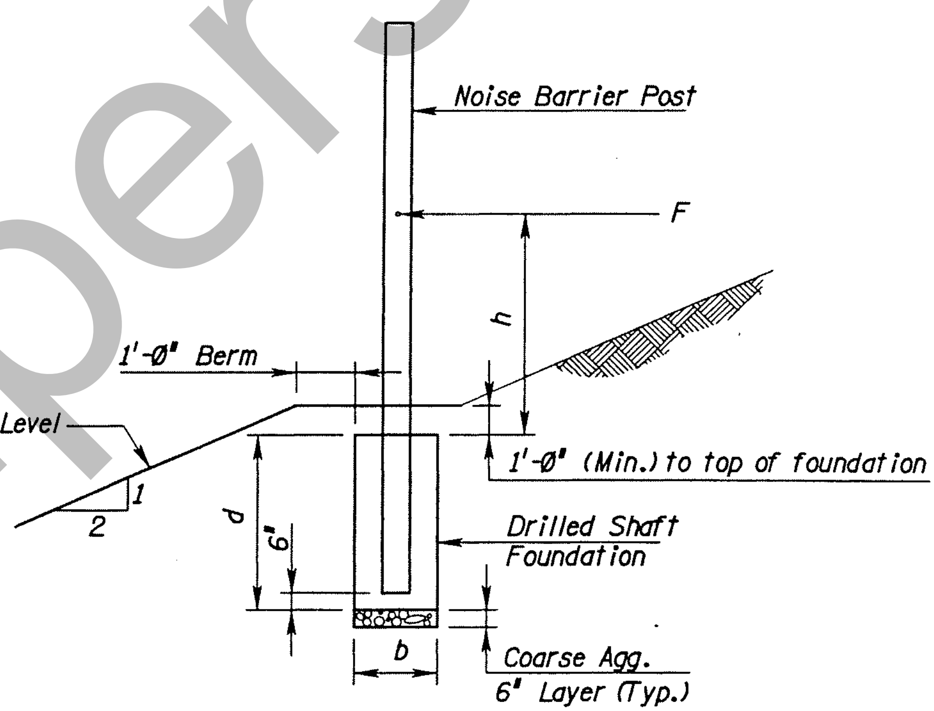
Sloped soil conditions shall be taken into account when computing the required embedment length for drilled shaft foundations. The method of design shall be approved, or as directed, by the NJDOT Geotechnical Engineering Unit.

c. A foundation report shall be submitted for noise barriers in accordance with Subsections 1.11.1 and 1.36.1 of this Manual.

Figure 47.1: Diagram for Drilled Shaft Foundation Design



Foundations Located On Level Ground



Foundations Located On Slopes

SECTION 48

BRIDGE SECURITY

The terrorist events of September 11, 2001 have led to an acute awareness that the nation's infrastructure is very much vulnerable to aggression. Among the elements that are vulnerable to attack are bridge structures and tunnels. In New Jersey, it is required that Designers of bridge structures and tunnels be cognizant of methods that provide security to these elements of our infrastructure. The methods shall then be a prime consideration in the design of new bridge structures and in the rehabilitation of existing bridge structures.

1.48.1 VULNERABILITY ASSESSMENT

Designers must evaluate certain aspects of a bridge structure to determine whether the bridge structure could be a potential target for terrorists. Among these aspects are the following:

1. The location of the bridge structure or tunnel. Would the loss of the bridge create loss of access to major cities, recreation facilities or lead to major replacement cost? Would the loss create a long detour route? Would the loss cause severe economic impact to the Community, State or Region?

2. Traffic usage of the bridge structure or tunnel. If the bridge were attacked, would there be a major loss of life? Is there a significant traffic count that, if attacked during peak rush hours, a large number of deaths and injuries would result?

3. Prominence or historical significance. Is the bridge structure or tunnel of historical significance to the State or local community?

4. Environmental impact. Are there targets that are adjacent to or near the bridge or tunnel that could cause severe environmental threats if attacked?

5. Public Services. Would the loss of a bridge structure or tunnel result in the disruption of service by emergency vehicles (ambulances, fire equipment), the disruption of services by State or Federal agencies and by military personnel?

The above aspects may include others. Designers must use judgment and advice of NJDOT staff and others' knowledge of the project and region to assess the vulnerability of bridge structures or tunnels. This assessment should be documented and included in the project's Design Appraisal Statement. The assessment should be a part of rehabilitation, reconstruction, as well as replacement or new bridge projects.

1.48.2 VULNERABILITY COUNTERMEASURES

After assessing the vulnerability of a bridge structure or tunnel, certain countermeasures should be established within the project documents to provide for their security. Recommendations for use of countermeasures should be based on a prudent assessment of the specific vulnerability assessment of the bridge and with concurrence of the Manager, Bureau of Structural Engineering.

Following are suggested methods that can be called for in the Plans or Special Provisions:

1. Restrict parking under a bridge structure. This can be done by the use of concrete barriers. Barriers should be placed to also restrict parking adjacent to a bridge structure.

2. Detail the installation of surveillance cameras that can be tied to NJDOT Headquarters or Operations control.

3. Restrict the placement of vegetation that would obstruct surveillance measures.

4. Restrict access to ventilation machinery in tunnels. Detail installation of emergency shut-off mechanisms.

5. Restrict access to key details that, if damaged, would result in the loss of the structure.

6. Detail the restriction of access to movable bridge machinery and operator's housing.

7. Detail the installation of lighting throughout a bridge structure to ensure surveillance. This should include lighting under a bridge that is located over a waterway.

8. Detail, in general, all bridge components so that no component is concealed from view.

9. Prohibit the use of non-redundant members.

10. Protect all main load carrying members from direct impact from automobile, marine or rail traffic.

11. Locate utilities in such a way as to minimize their potential use against the structure. Appropriate shut offs shall be provided adjacent to the structure.

It is realized that the above countermeasures may not be all inclusive. Designers are encouraged to recommend other methods. The security of a bridge structure or tunnel is a paramount concern to the Department. Security measures will protect New Jersey's motorists and provide the security that must be part of being a citizen of the United States.

DIVISION 2

STANDARD DRAWINGS

NEW JERSEY DEPARTMENT OF TRANSPORTATION

AASHTO LRFD NJDOT DESIGN MANUAL for BRIDGES AND STRUCTURES

DIVISION 2 - STANDARD DRAWINGS

CONTENTS

STRUCTURAL COMPONENT DETAILING

UTILITY INSTALLATIONS

NOISE WALL BARRIERS

INTEGRAL ABUTMENTS

PROPRIETARY RETAINING WALLS

PRECAST R.C. BOX CULVERT

The Standard Drawings have been reduced in this Manual for convenience. Full size reproductions for use with Contract Plans are available.

NOTES

(1) Also see Subsection 1.25.1 of this Manual.

(2) These are utility company standard drawings and are intended to be used only as guide sheets in the preparation of Contract Plans.

(3) Also see Division 1 Section 47 of this Manual.

(4) Also see Division 1 Section 15 of this Manual.

(5) Also see Subsection 1.24.19 of this Manual.

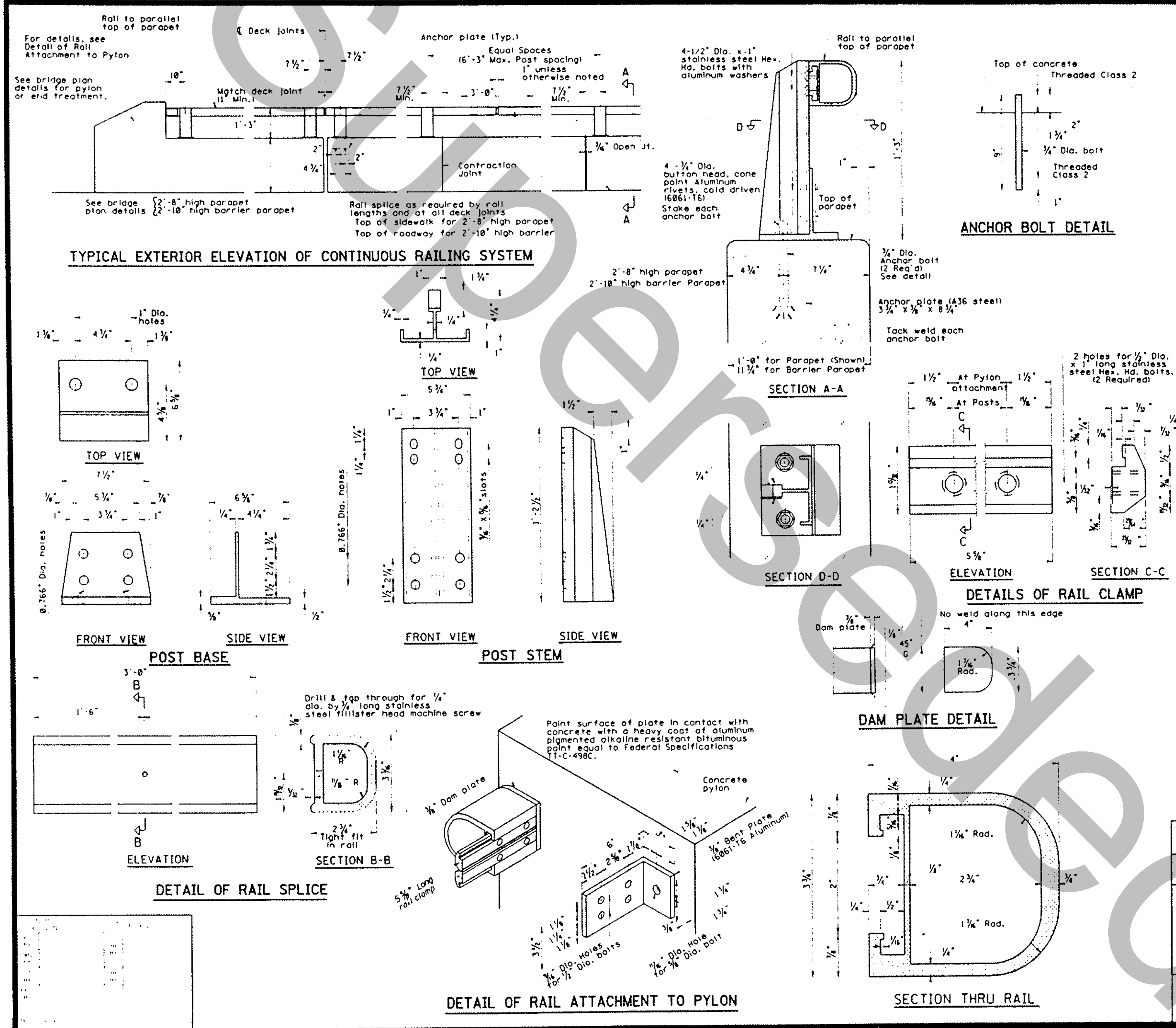
(6) Refer to Subsections 1.7.2 and 1.8.3 of this Manual.

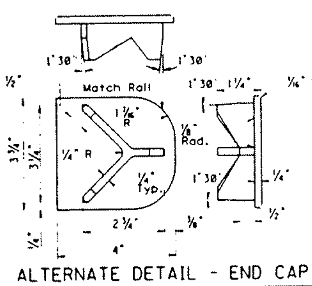
(7) Also refer to Subsection 1.30.4 of this Manual.

STATE	FEDERAL PROJECT NO.	SHEET	TOTAL SHEETS
N. J.			

STRUCTURE NO.

STRUCTURE NAME





GENERAL NOTES

1. Material for posts, bases, rails, and rail clamps shall be ASTM B221, Aluminum Alloy 6061-T6.
2. Washers shall be ASTM B209 Alclad 2024-T3 and nuts shall be ASTM B211, Aluminum Alloy 6061-T6.
3. Anchor bolts shall be ASTM A276 stainless steel, Type 302, Type 304 or Type 430. Top nuts shall be Aluminum thick nuts ASTM B211 or B316 Alloy 6061-T6 Class 2 thread. Bottom nuts shall be ASTM A325.
4. Dam Plates shall be used to close all open railing ends. Material shall be ASTM B209 Aluminum Alloy 6061-T6. As an alternate, drive-in end caps may be used. Caps shall be alluminum alloy sand mold astings complying with ASTM B26, Alloy SG 356.6-T6.
5. End caps shall be welded to the rails.
6. Where necessary for post alignment, Aluminum Alloy shim material shall be used where required by the Engineer. Shim material shall be ASTM B209, Alloy 1100-0.
7. Paint underside of base with a heavy coat of Aluminum pigmented bituminous paint complying with ASTM D2824, Type I.
8. All anchor bolt holes and spaces between base plates and concrete shall be thoroughly caulked with a caulking compound conforming to Federal Specifications A-A-272A, Type III or Type IV.

STANDARD DRAWING PLATE 2.1-1

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

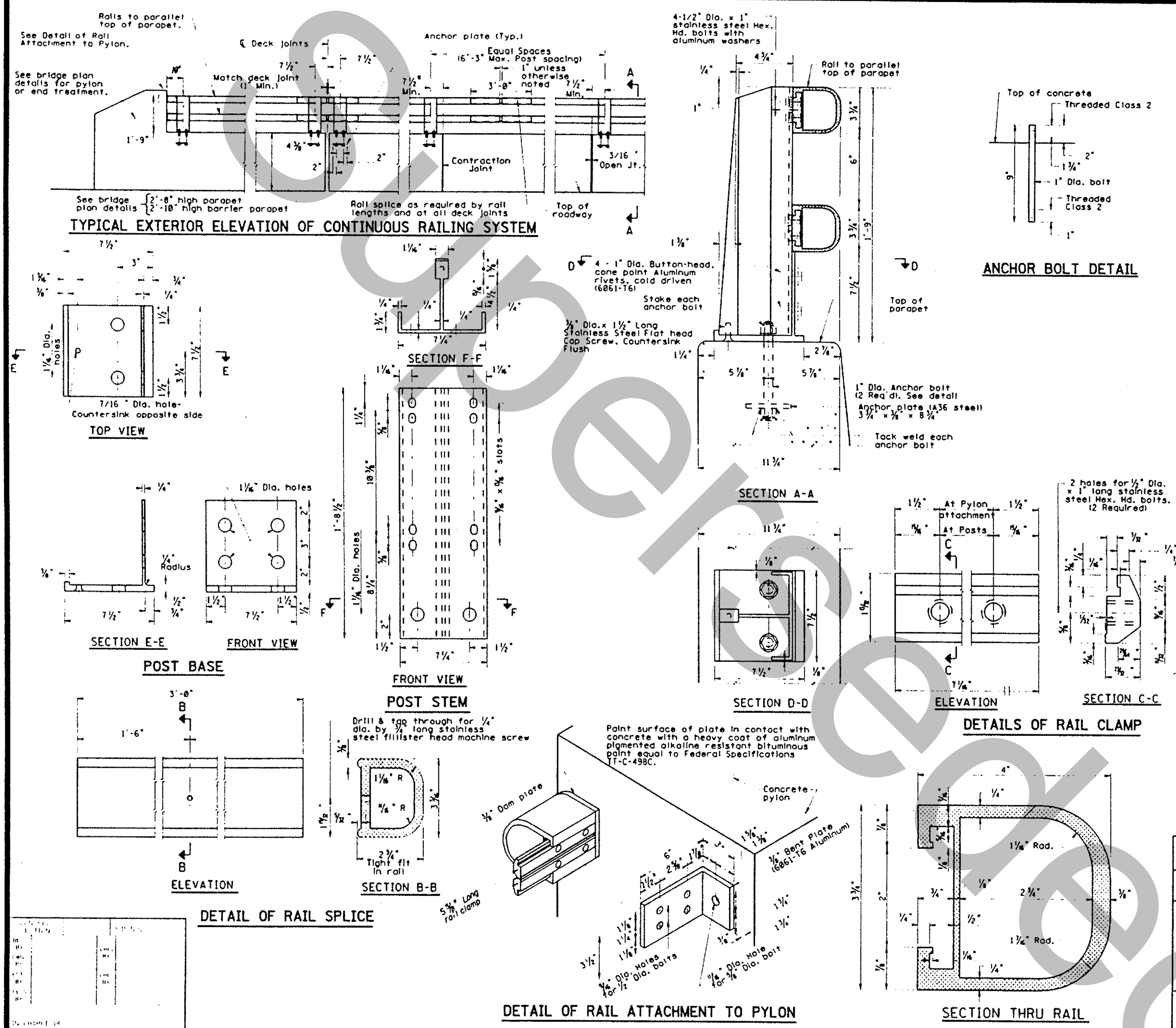
1-RAIL RAILING

ROUTE: SECTION:

STATE	FEDERAL PROJECT NO.	SHEET	TOTAL SHEETS
N. J.			

STRUCTURE NO.

STRUCTURE NAME



GENERAL NOTES

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2. Washers shall be ASTM B209 Alclad 2024-T3 and nuts shall be ASTM B211, Aluminum Alloy 6061-T6.
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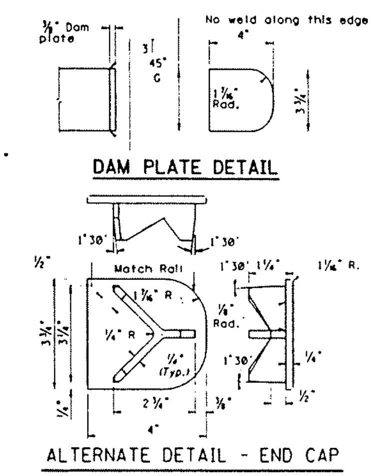


STANDARD DRAWING PLATE 2.1-2

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

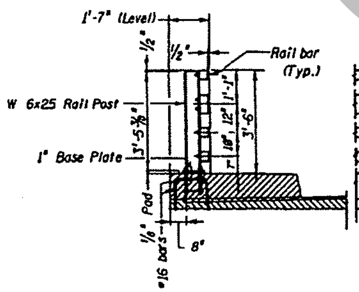
2-RAIL RAILING

ROUTE: SECTION:

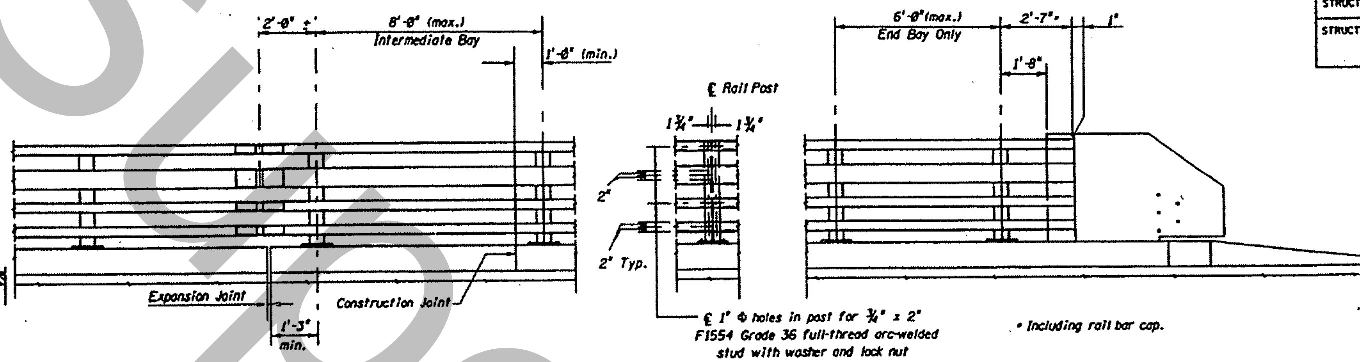
N. J.			

STRUCTURE NO.

STRUCTURE NAME



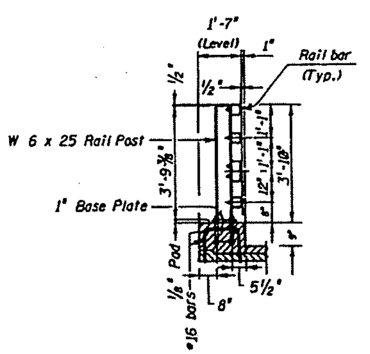
TYPICAL SECTION



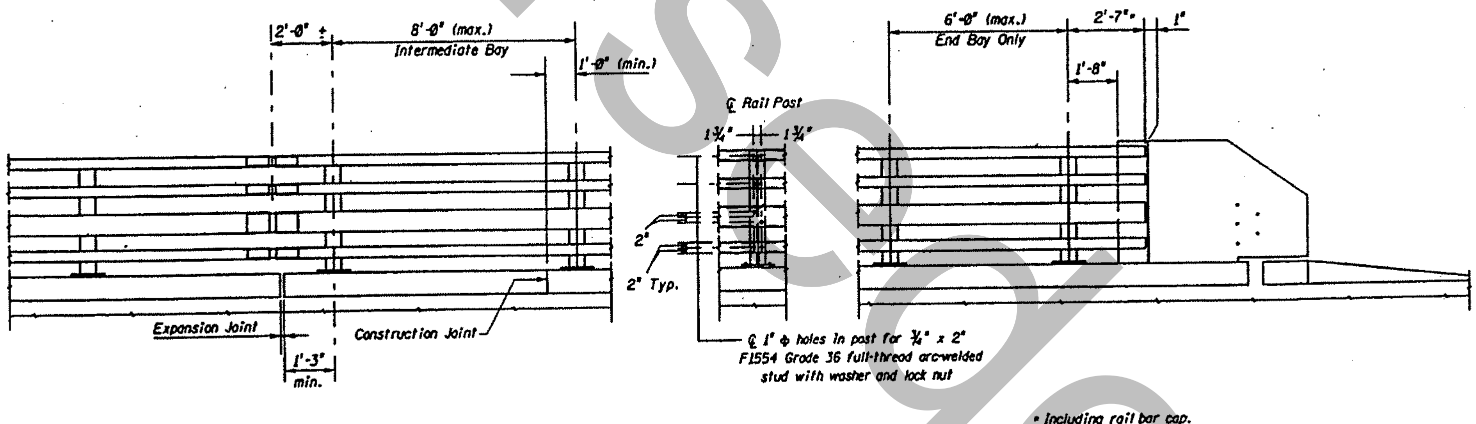
ELEVATION

Rail Bars
TS 8 x 4 x 5/16 "(1)
TS 4 x 4 x 1/4" (3)

4 - Bar Traffic/ Pedestrian Railing
STEEL BRIDGE RAILING



TYPICAL SECTION



ELEVATION

4 - Bar Traffic/ Bicycle Railing
STEEL BRIDGE RAILING

CONTROL SECTION	JOB NO.
	CHK. BY
	CHK. BY

BDC04MB-01

STANDARD DRAWING PLATE 2.2-1

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

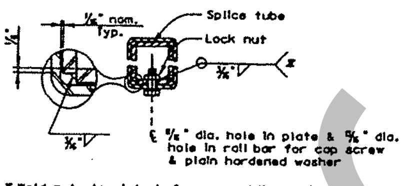
4 - BAR OPEN STEEL BRIDGE RAILING
TYPICAL SECTION AND ELEVATION

ROUTE: SECTION:

MUNICIPALITY COUNTY

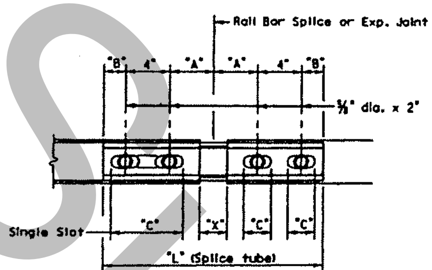
SCALE: NONE

BRIDGE SHEET NO. OF



* Weld nuts to plate before assembling splice tube

RAIL BAR SPLICE SECTION



RAIL BAR SPLICE & EXPANSION JOINT DETAIL

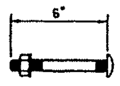
(Bottom View)

SPLICE TUBE DIMENSIONS		
	TS 8" X 4"	TS 4" X 4"
Top & Bot. Plates	2½" X 3/8" "L"	2 3/8" X 3/8" "L"
Side Plates	6¼" X 3/8" "L"	2¼" X 3/8" "L"

SPLICE & EXPANSION JOINT TABLE					
"T"	"A"	"B"	"C"	"L"	"X"
Splice	4"	2"	--	1'-8"	¾"
≤ 4"	4"	2"	2½"	1'-8"	2½"
> 4" ≤ 6½"	5½"	2½"	3½"	2'-0"	3¾"
> 6½" ≤ 9"	6½"	3½"	9" *	2'-4"	5"
> 9" ≤ 13"	8½"	4½"	11" *	2'-10"	7"

T = Total Movement

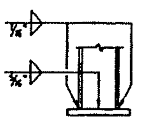
* = Single Slot



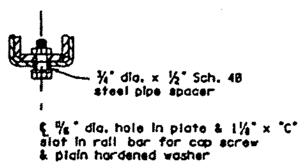
RIBBED NECK BOLT

(with washer & lock nut)

(See Note No. 9)

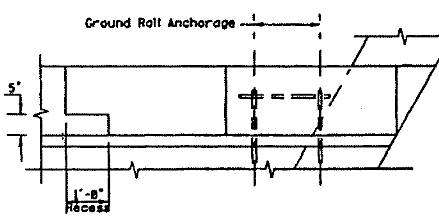


BASE WELD DETAIL



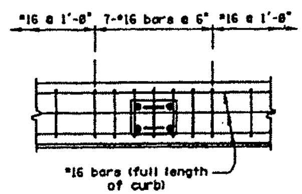
EXPANSION JOINT SECTION

For details not shown, see "Rail Bar Splice Section"

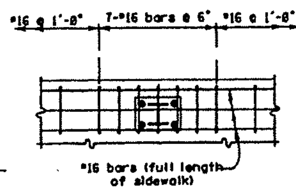


TRANSITION BARRIER PLAN

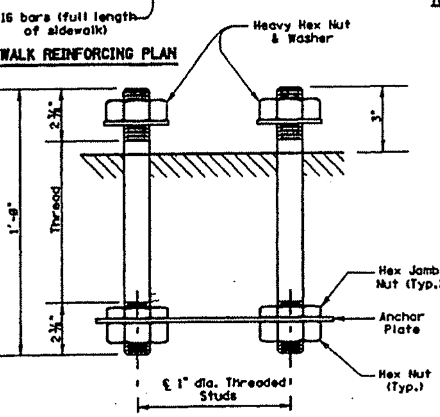
(Typical all transition barrier types)



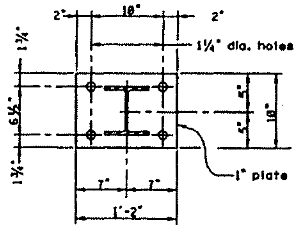
CURB REINFORCING PLAN



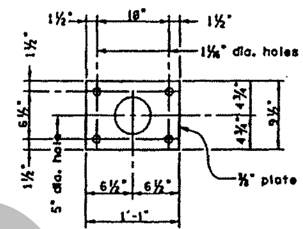
SIDEWALK REINFORCING PLAN



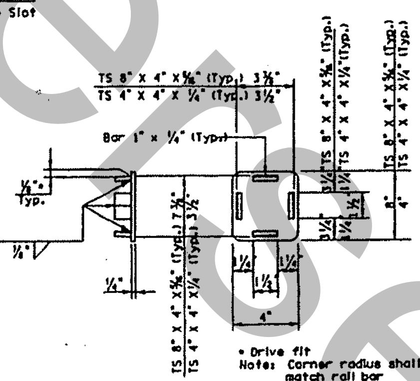
RAIL POST ANCHORAGE



POST & BASE PLATE PLAN



ANCHOR PLATE PLAN



RAIL BAR CAP

NOTES:

1. All work and materials shall conform to the provisions of Section 508 - Metal Bridge Railing and Fence of the Standard Specifications for Road and Bridge Construction.

2. Twenty five percent of the post-to-base welds in a production lot shall be tested by the Magnetic Particle Method. If rejectable discontinuities are found, another twenty five percent of that production lot shall be tested. If rejectable discontinuities are found in the second twenty five percent, all post-to-base welds in that lot shall be tested. Acceptance criteria shall be in accordance with the latest edition of the AWS D1.5, Bridge Welding Code.

3. All exposed cut or sheared edges shall be rounded and free of burrs. The inside weld flash of tubing shall be removed at splices and expansion joints.

4. Rail posts shall be set normal to grade unless otherwise shown.

5. Lengths of rail bar shall be attached to a minimum of two rail posts and to at least four posts whenever possible.

6. Rail bar expansion joints shall be provided in any rail bay spanning a superstructure expansion joint. Expansion joint width shall be "X" at 45° F and will be adjusted in the field by the Engineer. Refer to detail and table for dimension "X".

7. All parts shall be galvanized after fabrication in accordance with AASHTO M111, except that hardware shall meet the requirements of either ASTM A153 or ASTM B695, Class 50, Type I. Parts except hardware shall be blast- cleaned prior to galvanizing in accordance with SSPC - SP6.

8. Anchor bolts or anchor bolt sleeves shall be set with a template and shall be securely placed in their final position prior to the placement of the embedding concrete. Post anchor assemblies shall be installed to within 1/16 inch of theoretical horizontal and vertical location. Post bearing areas shall be dressed smooth and true to grade. Prior to post erection, each rail post location shall be finished to the theoretical elevation determined from profile grade, cross slope and curb height and will not be acceptable until it is within 1/16 inch of theoretical elevation, as measured at the top of concrete. Preformed pads shall be used to adjust the rail posts for height and alignment. The number of preformed pads supplied shall be 10 % in excess of the theoretical minimum number required. Nuts securing the post base plate shall be tightened to a snug fit and given an additional ½ turn. After erection of the railing, the contractor shall clean the whole assembly, to present a neat and uniform appearance.

9. Rail bars shall alternatively be attached to posts using ⅝" dia. - ASTM F1554, Grade 36 bolts (5/8" dia. - ASTM A325 bolts may be substituted) inserted through the face of the rail bar. Bolts shall be round or dome head and may be rib neck, slotted, wrench head or tension control (TC or twist-off). Holes in posts shall be 1/16" larger than the diameter of the bolt. Holes in rail bars shall be drilled to size as follows:

   Slotted, wrench head or TC bolts --------1/16" larger than bolt diameter
   Rib neck bolts ----- size appropriate to accommodate an interference fit

   All bolts for fastening the rail bars to the posts shall be 6" in length and shall include a flat washer under the nut.

10. Holes in rail bars shall be field - drilled and shall be coated with an approved zinc-rich paint prior to erection.

11. Bolts in expansion joints shall be tightened only to a point that will allow rail movement.

12. If there is a conflict between these Standard Details and the Shop Drawings, the contractor shall notify the Engineer immediately.

13. ⅛" pads under post base plate shall be fabric pads conforming to Subsection 919.02.0 of the Standard Specifications.

MATERIALS:

Rail bars -- ASTM A500, Grade B
Rail posts --------------------------------------- AASHTO M223 (ASTM A572), Grade 50
All other shapes & plates ----------------------- AASHTO M270 (ASTM A709), Grade 36
Anchor studs, washers & exposed nuts ---- ASTM F1554, Grade 55
All other bolts & nuts (unless noted) ------ ASTM F1554, Grade 36

STATE	FEDERAL PROJECT NO.	SHEET	TOTAL SHEETS
N. J.			

STRUCTURE NO.

STRUCTURE NAME

BDC04B-01

STANDARD DRAWING PLATE 2.2-2

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

4 - BAR OPEN STEEL BRIDGE RAILING DETAILS

ROUTE : SECTION :

MUNICIPALITY COUNTY

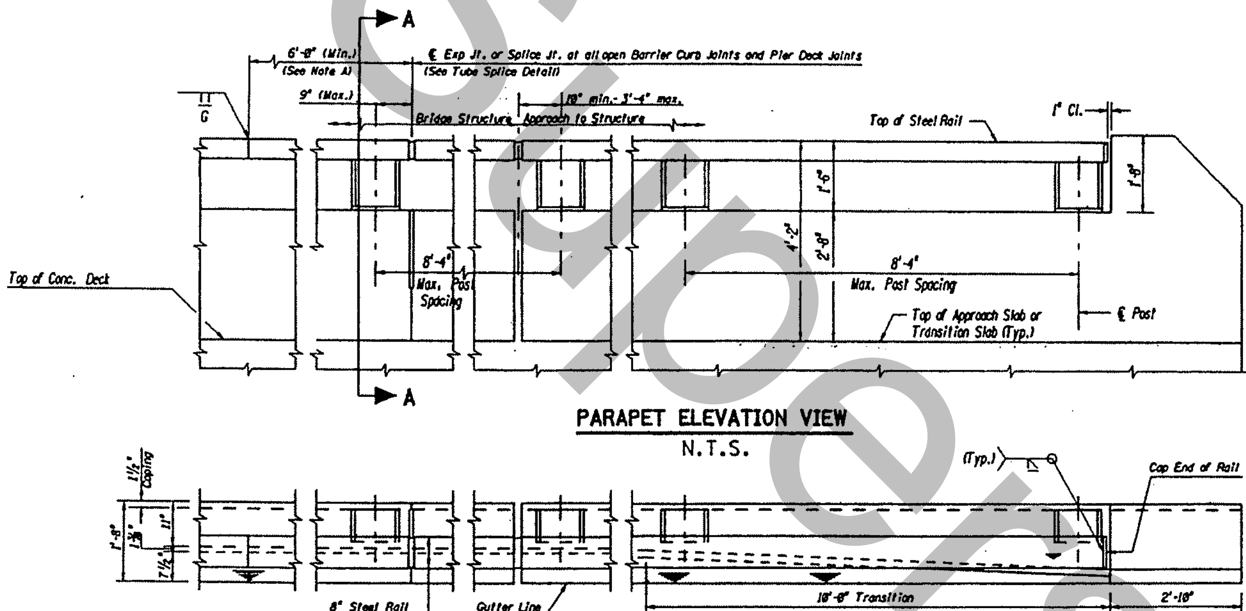
SCALE : NONE

BRIDGE SHEET NO. ___ OF ___

CONTROL SECTION		JOB NO.	
DES. BY		CHK. BY	
DWN. BY			
EST. BY		CHK. BY	
SPECS. BY			

IN CHARGE OF

STATE / FEDERAL PROJECT NO. / SHEET / TOTAL SHEETS	N. J.
STRUCTURE NO.	
STRUCTURE NAME	



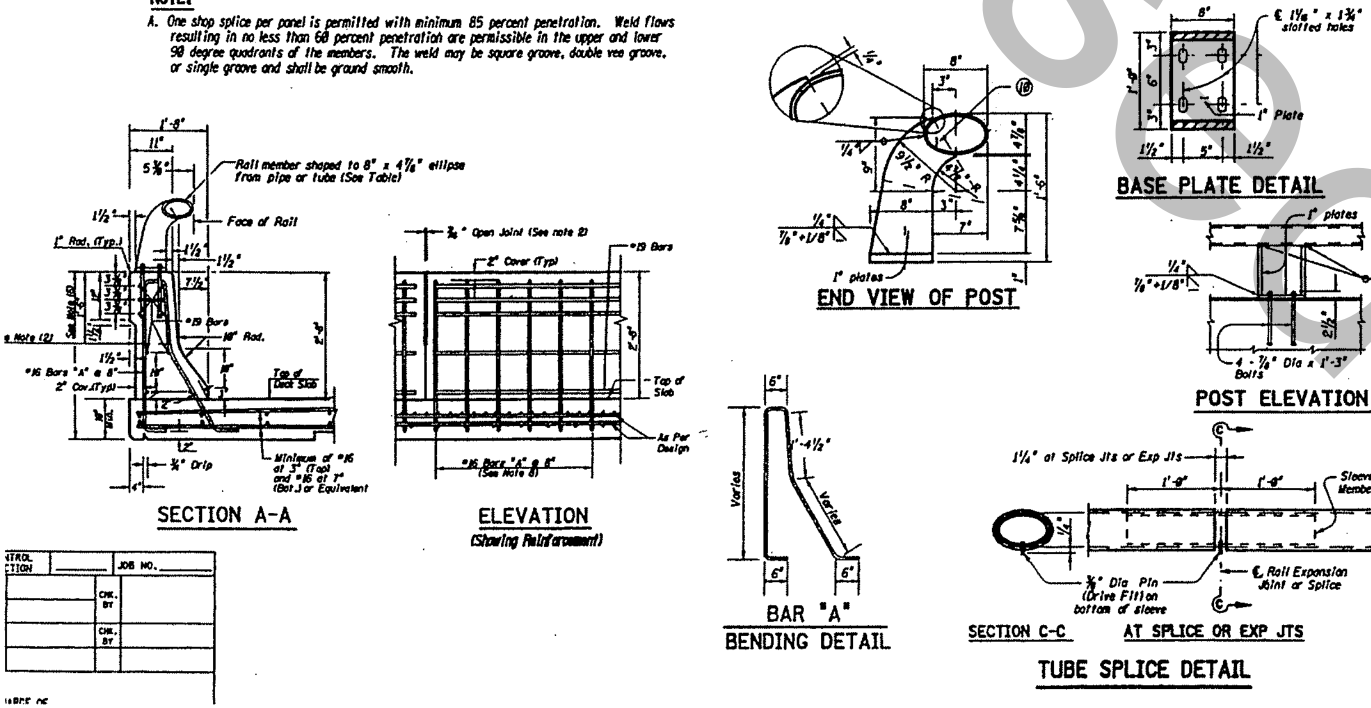
PARAPET ELEVATION VIEW

N.T.S.

PARAPET PLAN VIEW

NOTE:

A. One shop splice per panel is permitted with minimum 85 percent penetration. Weld flaws resulting in no less than 60 percent penetration are permissible in the upper and lower 90 degree quadrants of the members. The weld may be square groove, double vee groove, or single groove and shall be ground smooth.



SECTION A-A

ELEVATION (Showing Reinforcement)

END VIEW OF POST

BASE PLATE DETAIL

POST ELEVATION

BAR "A" BENDING DETAIL

SECTION C-C

AT SPLICE OR EXP JTS

TUBE SPLICE DETAIL

GENERAL NOTES:

1. 3/8" open deflection joint shall be provided in parapets at intervals not exceeding 20'-0" and contraction joints shall be provided at the midpoint between the open joints.
2. The 3/8" open joint shall stop at the line indicated and a contraction joint shall be provided below that line.
3. Full depth joints shall be provided at location of transverse deck joints. The full depth joint opening width shall equal the transverse deck joint opening width.
4. All reinforcement bars in parapet shall be corrosion protected. (Refer to section 26 of this manual for types of corrosion protected reinforcement steel that can be used)
5. Permanent metal stay-in-place forms not permitted in the deck overhang area.
6. Fascia rustication and/or configuration as per specifications.
7. For additional reinforcement that is required to prevent concrete cracking in the overhang portions of the deck slab see Detail I in Standard Drawing 2.2-4.
8. All steel components including bolts, nuts, and washers shall be galvanized unless otherwise shown on the plans.
9. Anchor bolts shall be 7/8" dia. ASTM F1554 bolts with one hex nut and one 2 1/4" O.D. washer (3/16" min. thickness) plus one 1 3/4" O.D. hardened steel washer (1/8" Min. thickness) at each bolt. Nuts shall conform to A563 requirements.
10. The pipe may be slotted to fit plates in lieu of cutting plates to fit pipe, except plates adjacent to tube splice.
11. The plates shall be AASHTO M 270, Grade 36.
12. The payment for the railing shall be made under the pay item "HEAVY TRUCK PARAPET STEEL RAILING".

TUBE & SLEEVE MEMBERS

8" x 4 7/8" Ellipse	Splice Member	
Material	Material	Thickness
6" Dia Std Pipe ASTM-A53 E or S Gr B)	ASTM-A53-B	0.353"
	A36 or A500 Gr B	0.339"
	API-5LX52	0.224"
6 5/8" O.D. x 0.188" Tube API-5LX52	ASTM-A53-B	0.339"
	A36 or A500 Gr B	0.325"
	API-5LX52	0.216"

NOTES:

1. Other sections of equal or greater strength are acceptable for sleeves.
2. The major and minor diameters of the rail member may vary +/-0.1875 inches from plan dimension. However, the difference between the outside diameters of the sleeve and the inside diameters of the rail shall not exceed 0.125 inches along the major or minor axis. Gaps exceeding this amount up to 0.25 inches are permissible along the 45° axes of the sleeves.

BDC04MB-01

STANDARD DRAWING PLATE 2.2-3

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

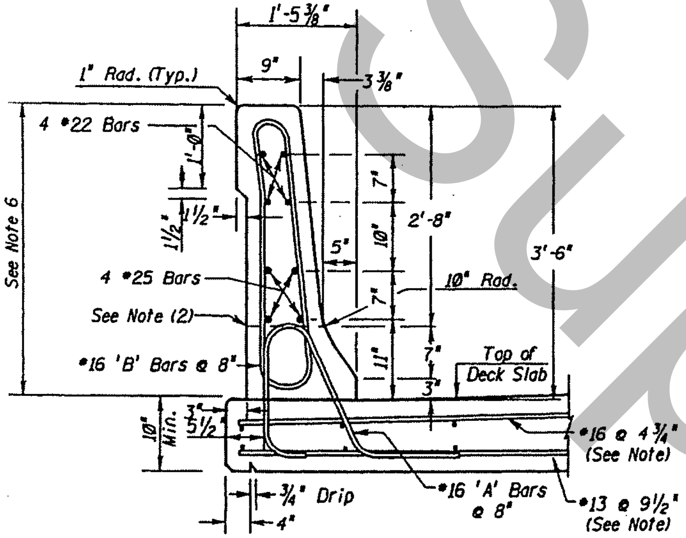
4'-2" HIGH
HEAVY TRUCK PARAPET

ROUTE: SECTION:

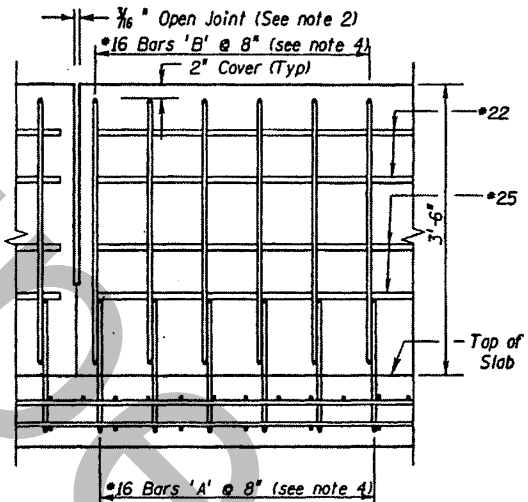
SCALE: NONE

BRIDGE SHEET NO. B OF B

STATE FEDERAL PROJECT NO. SHEET | TOTAL SHEETS
N. J.
STRUCTURE NO.
STRUCTURE NAME



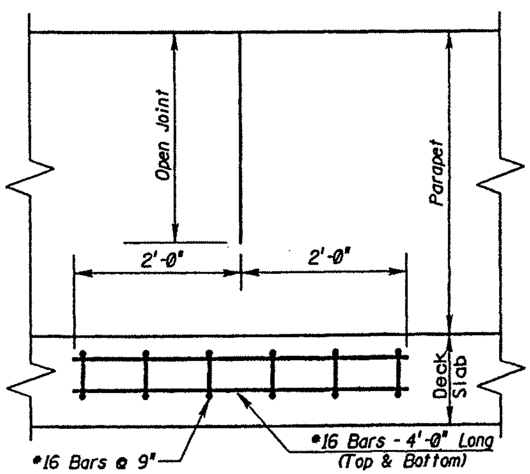
3'-6" HIGH F-SHAPE PARAPET



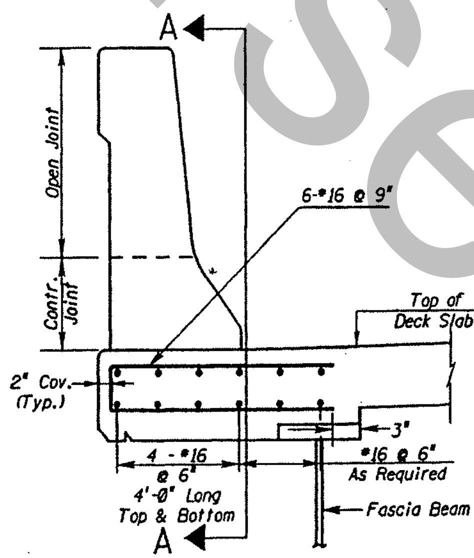
ELEVATION
(Showing Reinforcement)

GENERAL NOTES:

1. 3/16" open deflection joint shall be provided in parapets at intervals not exceeding 20'-0" and contraction joints shall be provided at the midpoint between the open joints.
2. The 3/16" open joint shall stop at the line indicated and a contraction joint shall be provided below that line.
3. Full depth joints shall be provided at location of transverse deck joints. The full depth joint opening width shall equal the transverse deck joint opening width.
4. All reinforcement bars in parapet shall be corrosion protected. (Refer to section 26 of this manual for types of corrosion protected reinforcement steel that can be used)
5. Permanent metal stay-in-place forms not permitted in the deck overhang area.
6. Fascia rustication and configuration as per Specifications.
7. For additional reinforcement that is required in the vicinity of parapet joints to prevent concrete cracking in the overhang portions of the deck slab see Detail 1.

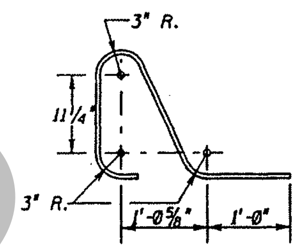


SECTION A-A

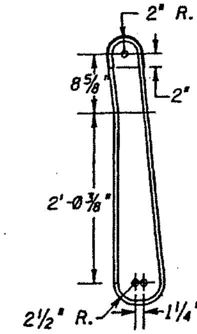


DETAIL 1

DECK REINFORCEMENT AT PARAPET JOINTS



BAR A (#16)



BAR B (#16)

BAR BENDING DETAILS

CONTROL SECTION	JOB NO.
	CHK. BY
	CHK. BY
CHARGE OF	

BDC04MB-01

STANDARD DRAWING PLATE 2.2-4

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

3'-6" HIGH F-SHAPE PARAPET DETAILS

ROUTE: SECTION:

SCALE : NONE
BRIDGE SHEET NO. B OF B

NOTES TO DESIGNER:

1. THE DESIGNER SHALL COMPLETE ALL TITLE BLOCK INFORMATION AND ITEMS DESIGNATED WITH (D) PRIOR TO INCLUDING ANY OF PLATES 2.4-1 THROUGH 2.4-5 INTO THE CONTRACT PLANS.

2. END DIAPHRAGMS SHALL BE PLACED PARALLEL TO THE SKEW ANGLE.

3. FOR INTERMEDIATE DIAPHRAGM spacings and details see Standard Drawing Plate 2.4-5.

4. A. END DIAPHRAGM WIDTH SHALL BE 9" AND 8" RESPECTIVELY FOR THE 45" AND 54" PRESTRESSED CONCRETE I BEAMS.

   B. END DIAPHRAGM WIDTH SHALL BE 12" AND 10" RESPECTIVELY FOR THE 63" AND 72" PRESTRESSED CONCRETE I BEAMS.

5. MILD STEEL REINFORCEMENT DESIGNATED AS BAR NUMBERS R4 AND R6 AT THE ENDS OF THE BEAM SHALL BE PER DESIGN REQUIREMENTS AND SHALL BE A MINIMUM OF #16 BARS. MILD STEEL REINFORCEMENT LOCATIONS AND SPACINGS SHALL BE VERIFIED FOR EACH BEAM TO INSURE REQUIRED CONCRETE CLEAR COVER AND TO AVOID CONFLICTS WITH PRESTRESSING STEEL.

6. STANDARD PLATES 2.4-1 THROUGH 2.4-5 APPLY TO SIMPLY SUPPORTED NON-CONTINUOUS BEAMS. ADDITIONAL REINFORCEMENT, INCLUDING SHEAR REINFORCEMENT, MAY BE REQUIRED FOR CONTINUOUS AND FOR LIVE LOAD CONTINUOUS APPLICATIONS AND SHALL BE DESIGNED ACCORDINGLY.

7. A CAMBER DIAGRAM, FIG. 1, AND AN ESTIMATED CAMBER TABLE FIG. 2, SHALL BE SHOWN ON THE FRAMING PLAN OR THE BEAM DETAILS SHEET. ALL CAMBERS SHOWN SHALL BE IN INCHES. THE FOLLOWING CAMBER VALUES SHALL BE PROVIDED AT QUARTER POINTS ALONG THE BEAM SPAN LENGTH:

   A_{REL} = ESTIMATED PRESTRESS CAMBER AT RELEASE LESS DEFLECTION DUE TO DEAD LOAD OF BEAM TIMES CREEP FACTOR.

   A_{EREC} = ESTIMATED PRESTRESS CAMBER AT RELEASE LESS DEFLECTION DUE TO DEAD LOAD OF BEAM.

   B = DEFLECTION DUE TO DEAD LOAD OF SLAB, PERMANENT STEEL BRIDGE DECK FORMS, PARAPETS, SIDEWALKS, MEDIANS, RAILING, UTILITIES AND FUTURE PAVING.

   C = NET FINAL CAMBER (A_{EREC}-B)

   CAMBER IN PRESTRESS BEAMS ARE TIME DEPENDENT AND THEREFORE ARE APPROXIMATE. A, B, AND C ARE THEORETICAL VALUES AND MAY VARY WITH ACTUAL CONCRETE STRENGTH, VARIOUS PRESTRESSING CONDITIONS, CREEP FACTOR AND PRESTRESS LOSSES.

   THE FOLLOWING STATEMENTS SHALL BE INCLUDED ALONG WITH THE CAMBER DIAGRAM AND THE ESTIMATED CAMBER TABLE:

   "THE ERECTION CAMBER SHALL BE CHECKED BY THE CONTRACTOR IN THE FIELD TO ESTABLISH PROPER CONCRETE HAUNCH AND DECK ELEVATIONS."

   "SHOP DRAWINGS SHALL INCLUDE CALCULATIONS OF PRESTRESS LOSSES FOR THE ENGINEER'S REVIEW AND APPROVAL."

8. PRESTRESSED CONCRETE I - BEAMS SHALL BE TREATED WITH AN EPOXY WATER-PROOFING SEAL COAT, FIG. 3, CONFORMING TO SUBSECTION 912.12 OF THE NJDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, WITH CURRENT SUPPLEMENTAL SPECIFICATIONS, AS MODIFIED BY THE SPECIAL PROVISIONS. THE LIMITS FOR SEALER APPLICATION SHALL BE SHOWN ON THE CONSTRUCTION PLANS FOR BEAMS SUBJECTED TO DECK JOINT LEAKAGE AND SHALL CONFORM TO THE FOLLOWING:

AREAS TO BE TREATED	APPLICATION LIMITS*
ENDS, SIDES, AND BOTTOMS	4'-8" AND 8" LENGTH MEASURED FROM THE BEAM ENDS FOR EXTERIOR FACES OF FASCIAS AND INTERIOR FACES RESPECTIVELY.

   DIAPHRAGM CONNECTION AREA NEED NOT BE EPOXY WATERPROOFING SEAL COATED. EPOXY WATERPROOFING SEAL COAT SHALL BE OMITTED FROM THE BEARING CONTACT AREAS FOR VARIOUS TYPES OF BEARINGS, CHECK BEARING MANUFACTURER'S RECOMMENDATIONS.

   * IF THE STRUCTURE IS LOCATED IN A SEVERE SALT INTRUSION ZONE OR A SALT SPLASH ZONE (ZONE 3A OR 3B, SEE CHART TITLED "ZONAL AREAS OF NEW JERSEY AFFECTED BY SALINITY" IN SUBSECTION 1.24.10 OF THE DESIGN MANUAL FOR BRIDGES AND STRUCTURES) AND IS LOCATED LESS THAN 15 FEET ABOVE THE MEAN HIGH SALT WATER MARK, THE ENTIRE BEAM, INCLUDING BOTH SIDES, BOTTOM AND ENDS SHALL BE TREATED WITH AN EPOXY WATERPROOFING SEAL COAT.

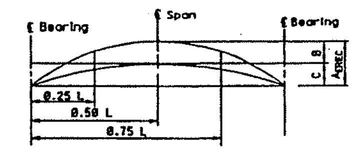
9. ALL MILD STEEL REINFORCEMENT USED FOR SHEAR CONNECTORS AND CAST-IN-PLACE DIAPHRAGMS SHALL BE CORROSION PROTECTED. (REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED)

10. HEIGHT OF SHEAR CONNECTOR STIRRUPS ABOVE THE TOP OF THE BEAMS SHOULD BE VERIFIED FOR ADEQUACY FOR EACH BRIDGE BASED UPON HAUNCH REQUIREMENTS.

11. SPACINGS OF SOLE PLATE STRAPS FOR BEARING ATTACHMENT SHOULD BE VERIFIED FOR ADEQUACY FOR EACH BRIDGE BASED UPON THE STRAND ARRANGEMENT.

12. DRAPED, STRAIGHT AND STRAIGHT/UNBONDED STRAND PATTERNS OF PRESTRESSING STEEL ARE PERMITTED. ALTERNATIVE PATTERNS MAY BE PROPOSED DURING FABRICATION.

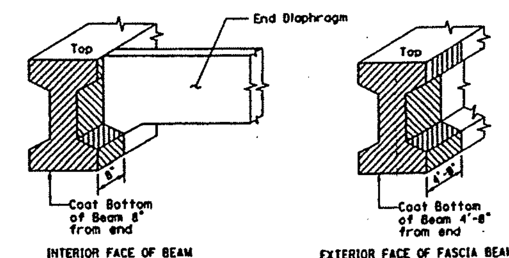
STANDARD DRAWING PLATE No.	INDEX DESCRIPTION
2.3-1	NOTES TO DESIGNER
2.4-1	45" PRETENSIONED PRESTRESSED CONCRETE BEAMS
2.4-2	54" PRETENSIONED PRESTRESSED CONCRETE BEAMS
2.4-3	63" PRETENSIONED PRESTRESSED CONCRETE BEAMS
2.4-4	72" PRETENSIONED PRESTRESSED CONCRETE BEAMS
2.4-5	DETAILS OF INTERMEDIATE STEEL DIAPHRAMS FOR PRESTRESSED CONCRETE BEAMS



CAMBER DIAGRAM
FIG. 1

ESTIMATED BEAM CAMBER (INCHES)					
BEAM No.	LOCATION	A_{REL}	A_{EREC}	B	C
	0.25 L				
	0.50 L				
	0.75 L				

CAMBER TABLE
FIG. 2



EPOXY WATERPROOFING LIMITS
FIG. 3

BDC04MB-01

THIS SHEET IS FOR DESIGN INFORMATION ONLY. DO NOT INCLUDE IN CONTRACT PLANS.

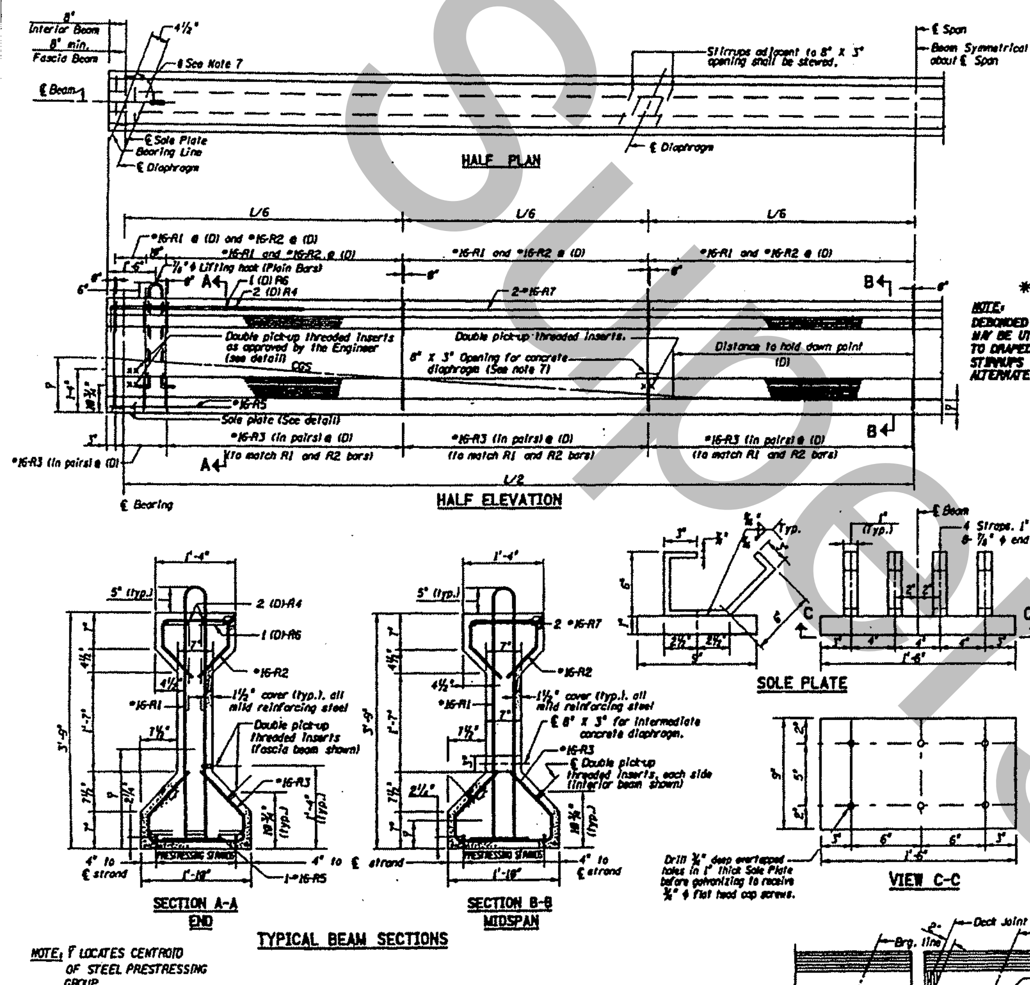
STANDARD DRAWING PLATE 2.3-1

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

PRETENSIONED PRESTRESSED CONCRETE BEAMS

NOTES TO DESIGNER

REVISION	BY	CKD	DATE



NOTE: $\bar{Y}$ LOCATES CENTROID OF STEEL PRESTRESSING GROUP.

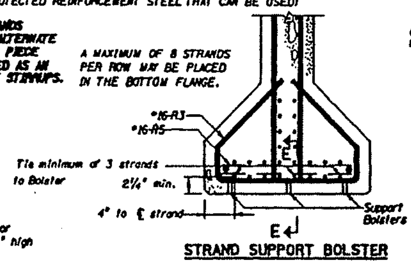
NOTE: OMIT THREADED INSERTS ON OUTSIDE FACE OF FASCIA BEAM

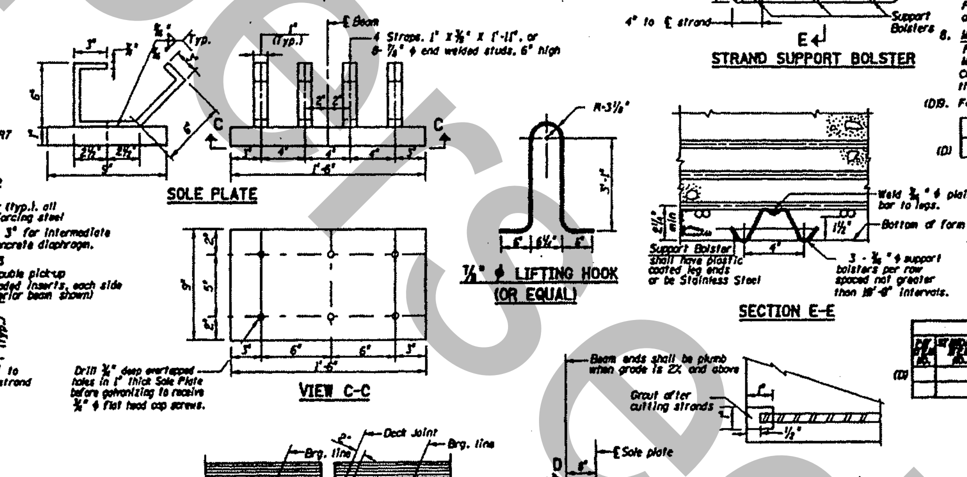
SCHEDULE OF MILD STEEL REINFORCEMENT								
NO.	MARK	SIZE	LENGTH	TYPE	A	B	C	D
(D)	*R1	#16	8'-5"	1	4'-½"	4"	—	—
(D)	R2	#16	3'-5"	3	6"	6"	5"	1'-1"
(D)	R3	#16	2'-6"	4	8"	8"	5"	1'-4"
(D)	*R4	(D)	6'-8"	2	6'-6"	1'-6"	—	—
(D)	*R5	#16	11'-8"	2	4'-9"	1'-6"	4'-9"	—
(D)	*R6	(D)	14'-8"	2	6'-6"	1'-8"	6'-6"	—
(D)	R7	#16	(D)	STR	—	—	—	—

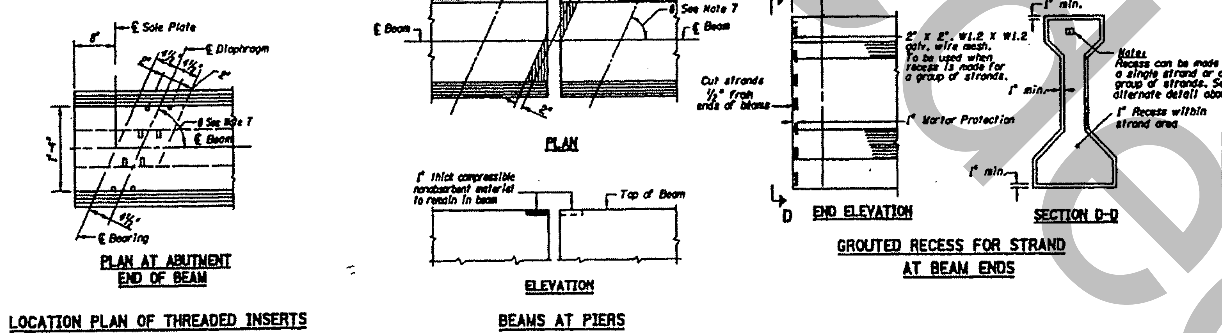
* CORROSION PROTECTED BARS (REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED)

NOTE:
DEBONDED STRAIGHT STRANDS MAY BE UTILIZED AS AN ALTERNATE TO DRAPED STRANDS. ONE PIECE STIRRUPS MAY BE UTILIZED AS AN ALTERNATE TO TWO PIECE STIRRUPS.

A MAXIMUM OF 8 STRANDS PER ROW MAY BE PLACED IN THE BOTTOM FLANGE.







(D) STRUCTURE NO.

STRUCTURE NAME

GENERAL NOTES

1. DESIGN SPECIFICATIONS
(D) The AASHTO LRFD Bridge Design Specifications, with current Interims, as modified by Section 3 of the NJDOT Design Manual for Bridges and Structures
2. LIVE LOAD
HL-93 or NJDOT Permit Vehicle, whichever governs.
3. PRESTRESSING STEEL
The pretensioning strands shall be ½" dia. or 0.6" dia., 7-wire uncoated steel strands conforming to current AASHTO M203 Grade 270 and shall be low relaxation strands. Each strand shall be given an initial tension of 0.75 f's x As as specified in applicable sections of the PCI Design Handbook - Precast and Prestressed Concrete. Any change in the system of prestressing must be accompanied by complete calculations for approval by the Engineer.
4. CONCRETE DESIGN STRESSES
(D) Design compressive strength (f'c) = ______ psi. class ______ concrete.
(D) Compressive strength at prestress (f'ci) = ______ psi.
5. CONCRETE
All exposed corners shall be chamfered ¾" or rounded to ¾" radius. Angles of intersection between webs and flanges shall be rounded to not less than ¾" radius. Top surface of beams shall be roughened to the satisfaction of the Engineer. At approximate time of initial set all laitance shall be removed with a stiff wire brush.
6. SOLE PLATES
Cost of Sole Plates shall be included in price bid for Prestressed Concrete Beams. Sole Plates shall be galvanized as per Specifications.
7. DIAPHRAGMS
For the angle θ between the center line of beam and center line of diaphragms or bearings reference the Framing Plan.
8. MILD STEEL REINFORCEMENT
Reinforcement bars shall conform to ASTM A615, Grade 60.
Minimum clear cover shall be 1½" unless otherwise noted.
Cost of furnishing and placing reinforcement steel shall be included in the price bid for Prestressed Concrete Beams.

(D) 9. For camber diagram see sheet No. B ______

BEAM NO.	$\bar{Y}$ MIDSPAN	$\bar{Y}$ ENDS	NO. OF STRANDS
(D)			

QUANTITIES				
PAY ITEM NO.	STANDARD ITEM NO.	DESCRIPTION	UNIT	CONTRACT QUANTITY
(D)		PRETENSIONED PRESTRESSED CONCRETE BEAMS, 45"	L.F.	

CONTROL SECTION		JOB NO.	
DES. BY		CHK. BY	
DRN. BY			
EST. BY		CHK. BY	
RECS. BY			

(D)

BDC04MB-01

STANDARD DRAWING PLATE 2.4-1

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

45" PRETENSIONED PRESTRESSED CONCRETE BEAMS

ROUTE (D) SECTION

SCALE: NONE

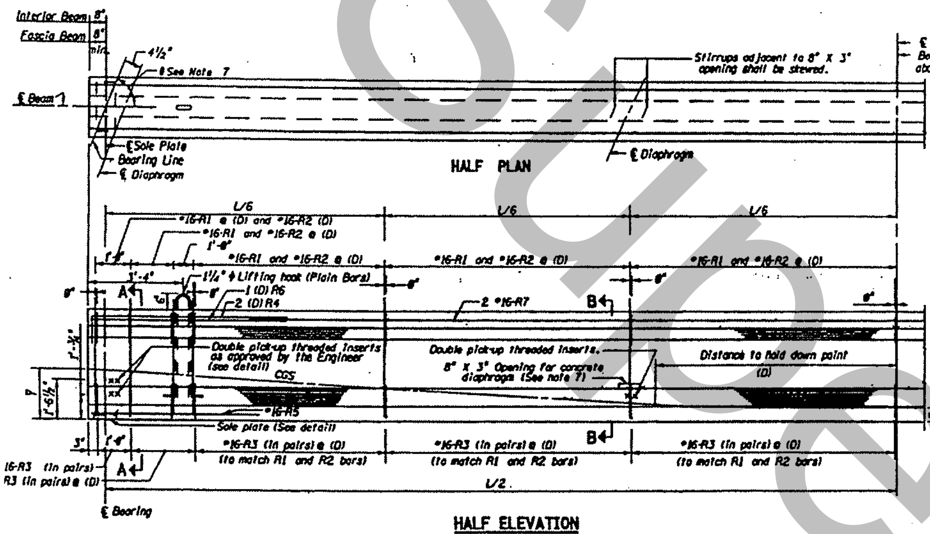
BRIDGE SHEET NO. B of B

REVISION	BY	CKD	DATE

STATE	FEDERAL PROJECT NO.	SHEET NO.	TOTAL SHEETS
N. J.			

(D) STRUCTURE NO.

STRUCTURE NAME



HALF PLAN

HALF ELEVATION

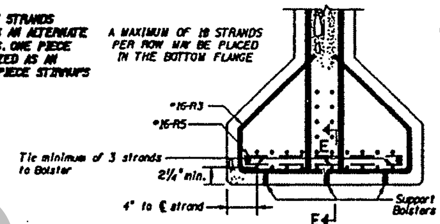
No.	MARK	SIZE	LENGTH	TYPE	A	B	C	D
(D)	* R1	#16	9'-10"	1	4'-9½"	5"	—	—
(D)	R2	#16	4'-1"	3	7⅞"	7⅞"	6"	1'-5"
(D)	R3	#16	3'-4"	4	9¾"	9¾"	5½"	1'-5"
(D)	* R4	(D)	9'-4"	2	7'-6"	1'-6"	—	—
(D)	* R5	#16	13'-10"	2	6'-4"	1'-10"	6'-4"	—
(D)	* A6	(D)	16'-4"	2	7'-6"	1'-4"	7'-6"	—
(D)	R7	#16	(D)	STR	—	—	—	—

SCHEDULE OF MILD STEEL REINFORCEMENT

* CORROSION PROTECTED BARS (REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED)

NOTE:
DEBONDED STRAIGHT STRANDS MAY BE UTILIZED AS AN ALTERNATE TO DRAPED STRANDS. ONE PIECE STIRRUPS MAY UTILIZED AS AN ALTERNATE TO TWO PIECE STIRRUPS

A MAXIMUM OF 18 STRANDS PER ROW MAY BE PLACED IN THE BOTTOM FLANGE



STRAND SUPPORT BOLSTER

GENERAL NOTES

1. DESIGN SPECIFICATIONS

(D) The AASHTO LRFD Bridge Design Specifications, with current Interims, as modified by Section 3 of the NJDOT Design Manual for Bridges and Structures.

2. LIVE LOAD

HL-93 or NJDOT Permit Vehicle, whichever governs.

3. PRESTRESSING STEEL

The pretensioning strands shall be ½" dia. or 0.6" dia., 7-wire uncoated steel strands conforming to current AASHTO M203 Grade 270 and shall be low relaxation strands. Each strand shall be given an initial tension of 0.75 f's x As as specified in applicable sections of the PCI Design Handbook - Precast and Prestressed Concrete. Any change in the system of prestressing must be accompanied by complete calculations for approval by the Engineer.

4. CONCRETE DESIGN STRESSES

(D) Design compressive strength (f'c) = ______ psi, class ______ concrete.

(D) Compressive strength at prestress (f'ci) = ______ psi.

5. CONCRETE

All exposed corners shall be chamfered ¾" or rounded to ¾" radius. Angles of intersection between webs and flanges shall be rounded, to not less than ¾" radius. Top surface of beams shall be roughened to the satisfaction of the Engineer. At approximate time of initial set all laitance shall be removed with a stiff wire brush.

6. SOLE PLATES

Cost of Sole Plates shall be included in price bid for Prestressed Concrete Beams. Sole Plates shall be galvanized as per Specifications.

7. DIAPHRAGMS

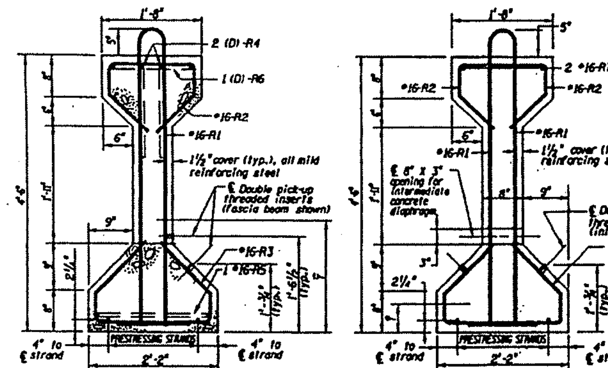
For the angle θ between the center line of beam and center line of diaphragms or bearings reference the Framing Plan.

8. MILD STEEL REINFORCEMENT

Reinforcement bars shall conform to ASTM A615, Grade 60. Minimum clear cover shall be 1½" unless otherwise noted. Cost of furnishing and placing reinforcement steel shall be included in the price bid for Prestressed Concrete Beams.

(D)9. For camber diagram see sheet No. B ______

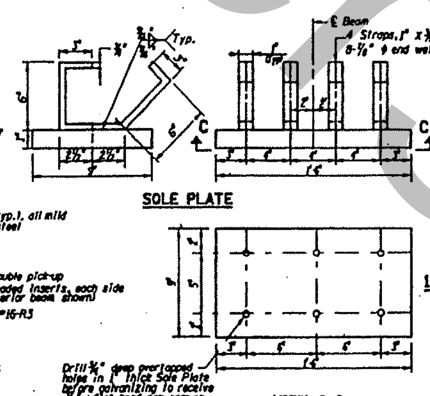
	BEAM NO.	$\bar{Y}$ MIDSPAN	$\bar{Y}$ ENDS	NO. OF STRANDS
(D)				



SECTION A-A END

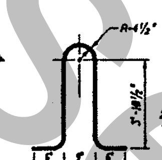
SECTION B-B MIDSPAN

TYPICAL BEAM SECTIONS

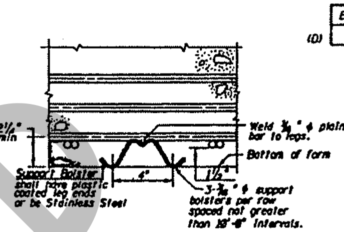


SOLE PLATE

VIEW C-C



1¼" ϕ LIFTING HOOK (OR EQUAL)

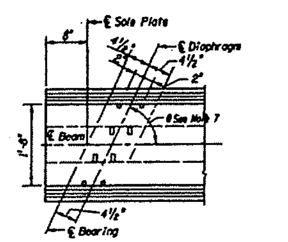


SECTION E-E

F.A. ITEM NO.	STANDARD ITEM NO.	DESCRIPTION	UNIT	CONTRACT QUANTITY
		QUANTITIES		
(D)		PRETENSIONED PRESTRESSED CONCRETE BEAMS, 54"	L.F.	

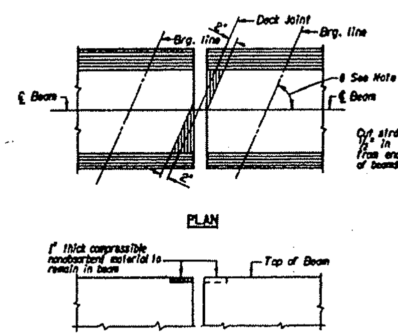
NOTE: $\bar{Y}$ LOCATES CENTROID OF STEEL PRESTRESSING GROUP.

E: OMIT THREADED INSERTS ON OUTSIDE FACE OF FASCIA BEAM



PLAN AT ABUTMENT END OF BEAM

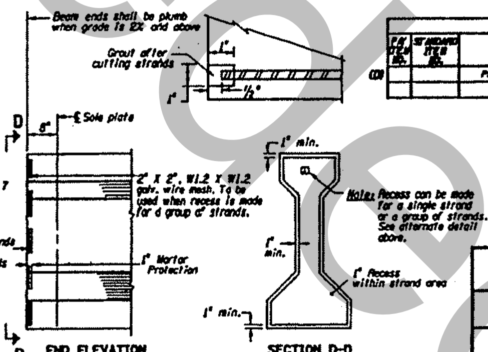
LOCATION PLAN OF THREADED INSERTS



PLAN

ELEVATION

BEAMS AT PIERS



END ELEVATION

SECTION D-D

GROUTED RECESS FOR STRAND AT BEAM ENDS

BDC84MB-01

STANDARD DRAWING PLATE 2.4-2

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

54" PRETENSIONED PRESTRESSED CONCRETE BEAMS

ROUTE (D) SECTION

SCALE: NONE

BRIDGE SHEET NO. B of B

REVISION	BY	CKD	DATE

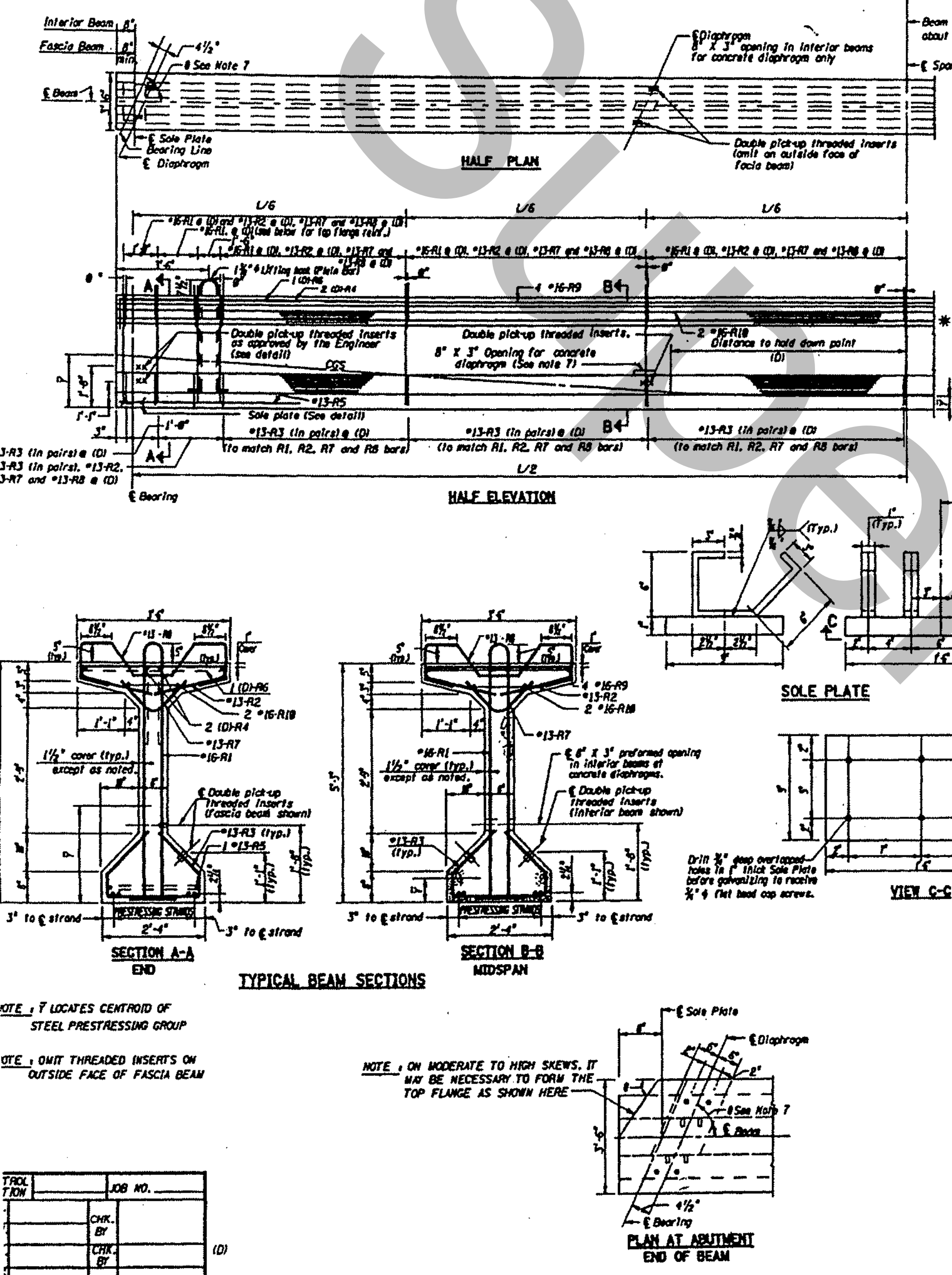
CONTROL SECTION	JOB NO.	
	CHK. BY	
	CHK. BY	

(D)

STATE	FEDERAL PROJECT NO.	SHEET NO.	TOTAL SHEETS
N. J.			

(D) STRUCTURE NO.

STRUCTURE NAME



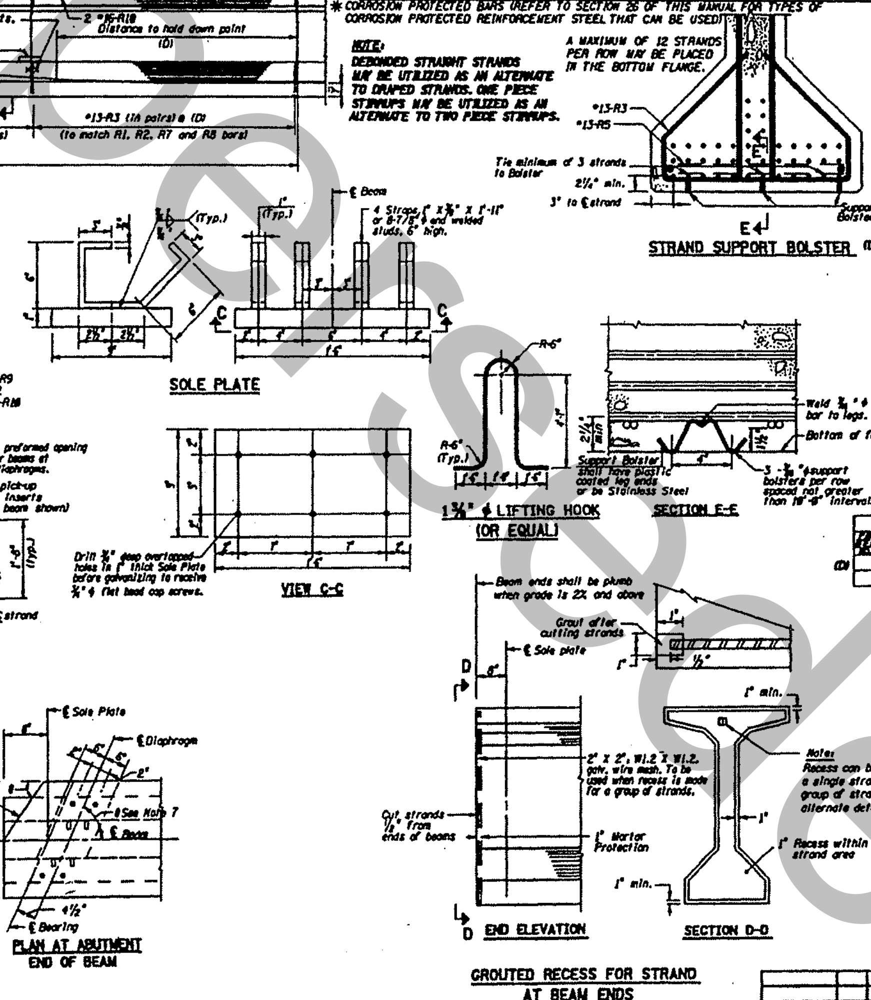
SCHEDULE OF MILD STEEL REINFORCEMENT

NO.	MARK	SIZE	LENGTH	TYPE	A	B	C	D
(D)	✱ R1	#16	11'-6¾	1	5'-6"	5¾"	–	–
(D)	✱ R2	#13	5'-7¾"	5	1'-7"	4"	2½"	3'-3"
(D)	R3	#13	3'-5¾"	3	10¾"	10¾"	6"	1'-8"
(D)	✱ R4	(D)	10'-6"	2	9'-0"	1'-6"	–	–
(D)	✱ R5	#13	17'-0"	2	7'-6"	2'-0"	7'-6"	–
(D)	✱ R6	(D)	20'-11"	2	9'-0"	3'-0"	9'-0"	–
(D)	R7	#13	2'-1"	4	5"	6½"	6½"	–
(D)	✱ R8	#13	6'-1"	6	–	–	–	–
(D)	✱ R9	#16	(D)	STR.				
(D)	R10	#16	(D)	STR.				

✱ CORROSION PROTECTED BARS (REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED)

NOTE:
DEBONDED STRAIGHT STRANDS MAY BE UTILIZED AS AN ALTERNATE TO DRAPED STRANDS. ONE PIECE STIRRUPS MAY BE UTILIZED AS AN ALTERNATE TO TWO PIECE STIRRUPS.

A MAXIMUM OF 12 STRANDS PER ROW MAY BE PLACED IN THE BOTTOM FLANGE.



GENERAL NOTES

1. DESIGN SPECIFICATIONS
(D) The AASHTO LRFD Bridge Design Specifications, with current interims, as modified by Section 3 of the NJDOT Design Manual for Bridges and Structures.
2. LIVE LOAD
HL-93 or NJDOT Permit Vehicle, whichever governs.
3. PRESTRESSING STEEL
The pretensioning strands shall be ½" dia. or 0.6" dia., 7-wire uncoated steel strands conforming to current AASHTO M203 Grade 270 and shall be low relaxation strands. Each strand shall be given an initial tension of 0.75 f's x As as specified in applicable sections of the PCI Design Handbook - Precast and Prestressed Concrete. Any change in the system of prestressing must be accompanied by complete calculations for approval by the Engineer.
4. CONCRETE DESIGN STRESSES
(D) Design compressive strength (f'c) = ______ psi, class ______ concrete.
(D) Compressive strength at prestress (f'ci) = ______ psi.
5. CONCRETE
All exposed corners shall be chamfered ¾" or rounded to ¾" radius. Angles of intersection between webs and flanges shall be rounded to not less than ¾" radius. Top surface of beams shall be roughened to the satisfaction of the Engineer. At approximate time of initial set all laitance shall be removed with a stiff wire brush.
6. SOLE PLATES
Cost of Sole Plates shall be included in price bid for Prestressed Concrete Beams. Sole Plates shall be galvanized as per Specifications.
7. DIAPHRAGMS
For the angle θ between the center line of beam and center line of diaphragms or bearings reference the Framing Plan.
8. MILD STEEL REINFORCEMENT
Reinforcement bars shall conform to ASTM A615, Grade 60. Minimum clear cover shall be 1½" unless otherwise noted. Cost of furnishing and placing reinforcement steel shall be included in the price bid for Prestressed Concrete Beams.
(D) 9. For camber diagram see sheet No. B ______

	BEAM NO.	Ȳ MIDSPAN	Ȳ ENDS	NO. OF STRANDS
(D)				

	QUANTITIES			
		DESCRIPTION	UNIT	CONTRACT QUANTITY
(D)		PRETENSIONED PRESTRESSED CONCRETE BEAMS, 63"	L.F.	

BDC04MB-01

STANDARD DRAWING PLATE 2.4-3

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

63" PRETENSIONED PRESTRESSED CONCRETE BEAMS

ROUTE (D) SECTION

SCALE : NONE

BRIDGE SHEET NO. B ___ OF B ___

REVISION	BY	CKD	DATE

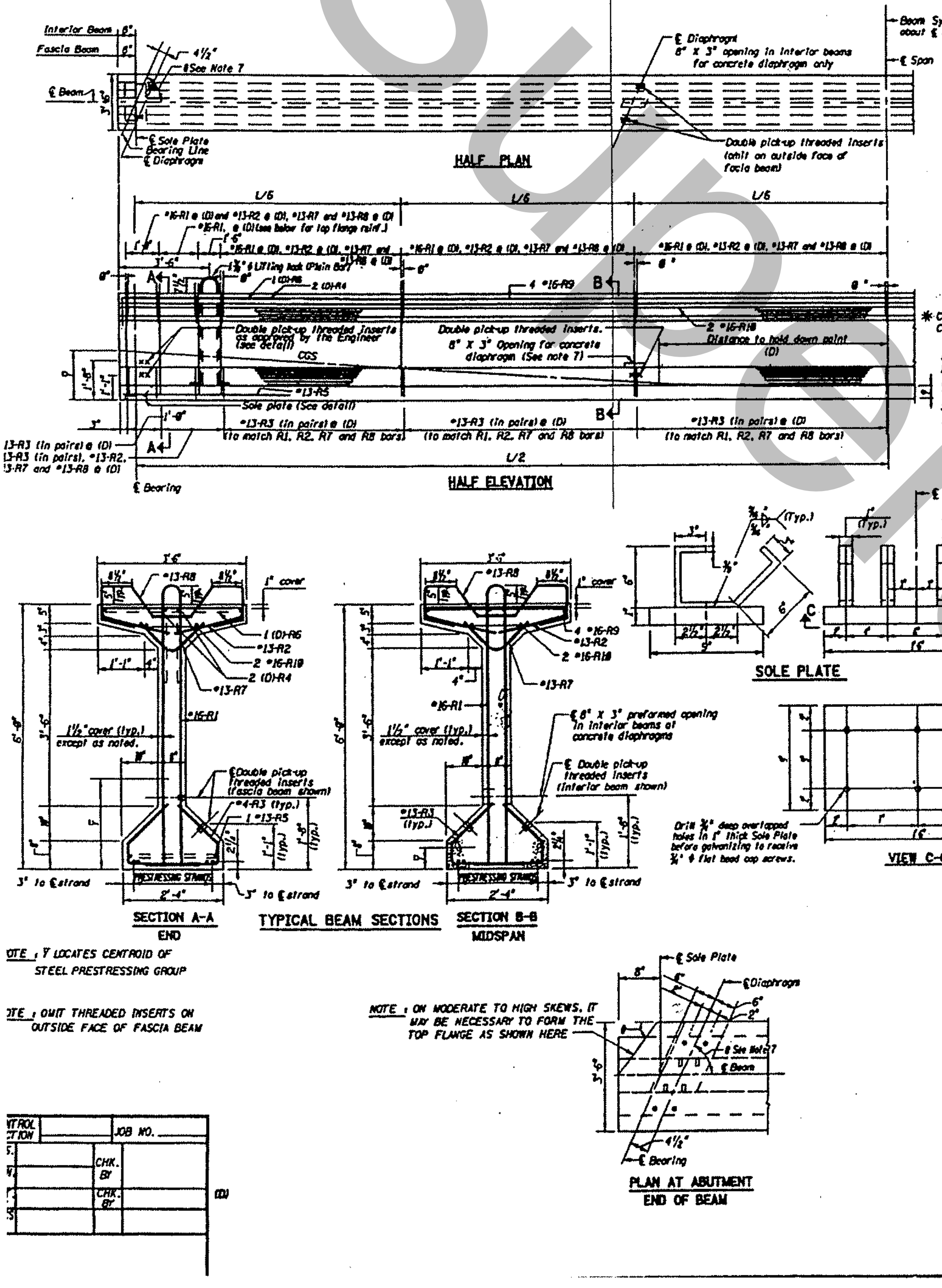
CONTROL SECTION	JOB NO.
	CHK. BY
	CHK. BY

(D)

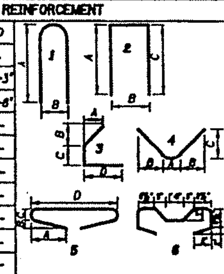
N. J.

(D) STRUCTURE NO.

STRUCTURE NAME



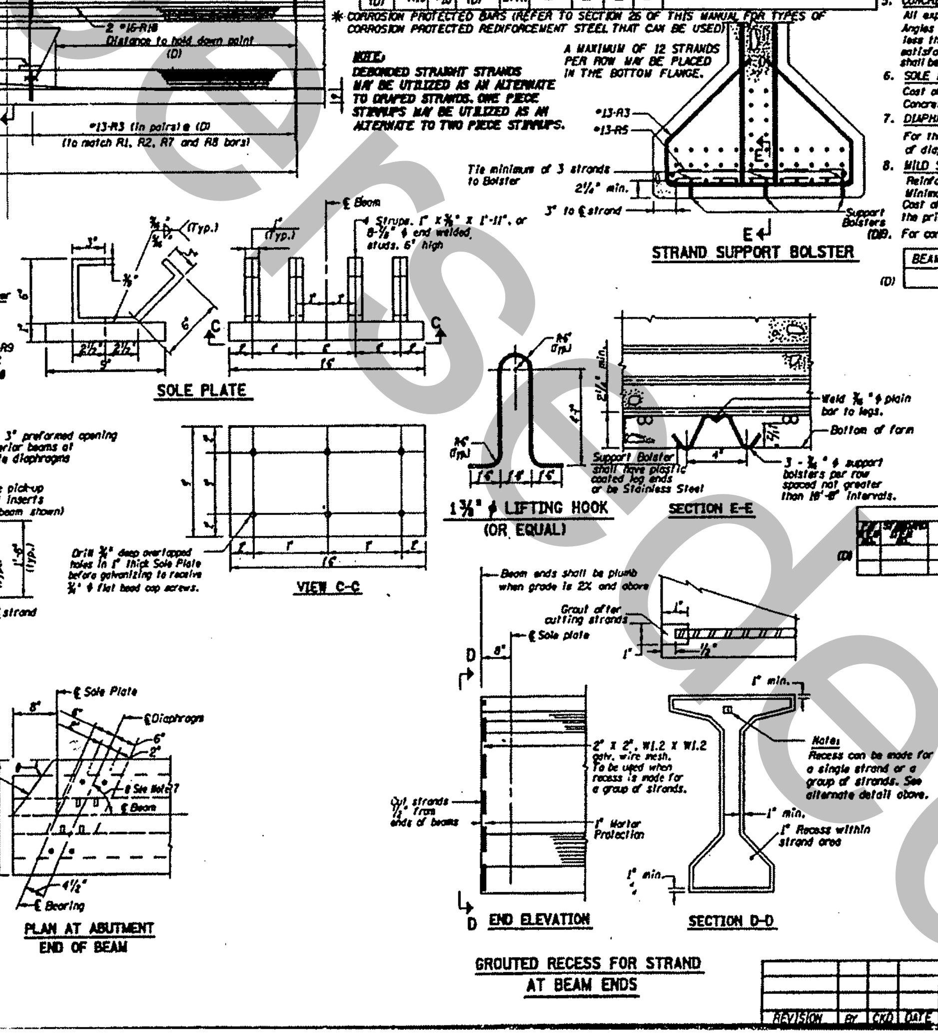
SCHEDULE OF MILD STEEL REINFORCEMENT								
No.	MARK	SIZE	LENGTH	TYPE	A	B	C	D
(D)	✱R1	#16	13'-1½"	1	6'-3¾"	5⅝"	–	–
(D)	✱R2	#13	6'-7¾"	5	1'-7"	4"	2½"	3'-3"
(D)	R3	#13	5'-5¾"	3	10¾"	10¾"	6"	1'-6"
(D)	✱R4	(D)	18'-6"	2	9'-0"	1'-6"	–	–
(D)	✱R5	#13	17'-0"	2	7'-6"	2'-0"	7'-6"	–
(D)	✱R6	(D)	28'-11"	2	9'-0"	3'-0"	9'-0"	–
(D)	R7	#13	2'-1"	4	5"	6½"	6½"	–
(D)	✱R8	#13	6"-7"	6	–	–	–	–
(D)	✱R9	#16	(D)	STR.	–	–	–	–
(D)	R10	#16	(D)	STR.	–	–	–	–



✱ CORROSION PROTECTED BARS (REFER TO SECTION 25 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED)

NOTE:
DEBONDED STRAIGHT STRANDS MAY BE UTILIZED AS AN ALTERNATE TO DRAPED STRANDS. ONE PIECE STIRRUPS MAY BE UTILIZED AS AN ALTERNATE TO TWO PIECE STIRRUPS.

A MAXIMUM OF 12 STRANDS PER ROW MAY BE PLACED IN THE BOTTOM FLANGE.



GENERAL NOTES

1. DESIGN SPECIFICATIONS

(D) The AASHTO LRFD Bridge Design Specifications, with current Interims, as modified by Section 3 of the NJDOT Design Manual for Bridges and Structures.

2. LIVE LOAD

HL-93 or NJDOT Permit Vehicle, whichever governs.

3. PRESTRESSING STEEL

The pretensioning strands shall be ½" ф or 0.6" ф, 7 wire uncoated steel strands conforming to current AASHTO M203, Grade 270 and shall be low relaxation strands. Each strand shall be given an initial tension of 0.75 f's As as specified in applicable sections of the PCI Design Handbook - Precast and Prestressed Concrete. Any change in the system of prestressing must be accompanied by complete calculations for approval by the Engineer.

4. CONCRETE DESIGN STRESSES

(D) Design compressive strength (f'c) = _____ psi, class _____ concrete.

(D) Compressive strength at prestress (f'ci) _____ psi.

5. CONCRETE

All exposed corners shall be chamfered ¾" or rounded to ¾" radius. Angles of intersection between webs and flanges shall be rounded to not less than ¾" radius. Top surface of beams shall be roughened to the satisfaction of the Engineer. At approximate time of initial set all laitance shall be removed with a stiff wire brush.

6. SOLE PLATES

Cost of Sole Plates shall be included in price bid for Prestressed Concrete Beams. Sole Plates shall be galvanized as per Specifications.

7. DIAPHRAGMS

For the angle θ between the center line of beam and center line of diaphragms or bearings reference the Framing Plan.

8. MILD STEEL REINFORCEMENT

Reinforcement bars shall conform to ASTM A615, Grade 60. Minimum clear cover shall be 1½" unless otherwise noted. Cost of furnishing and placing reinforcement steel shall be included in the price bid for Prestressed Concrete Beams.

(D) 9. For camber diagram see sheet No. B_____

BEAM NO.	Ȳ MIDSPAN	Ȳ ENDS	NO. OF STRANDS
(D)			

QUANTITIES		
DESCRIPTION	UNIT	CONTRACT QUANTITY
(D) PRETENSIONED PRESTRESSED CONCRETE BEAMS, 72"	L.F.	

BDC04MB-01

STANDARD DRAWING PLATE 2.4-4

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

72" PRETENSIONED PRESTRESSED CONCRETE BEAMS

ROUTE (D) SECTION

SCALE : NONE

BRIDGE SHEET NO. B of B

REVISION	BY	CKD	DATE

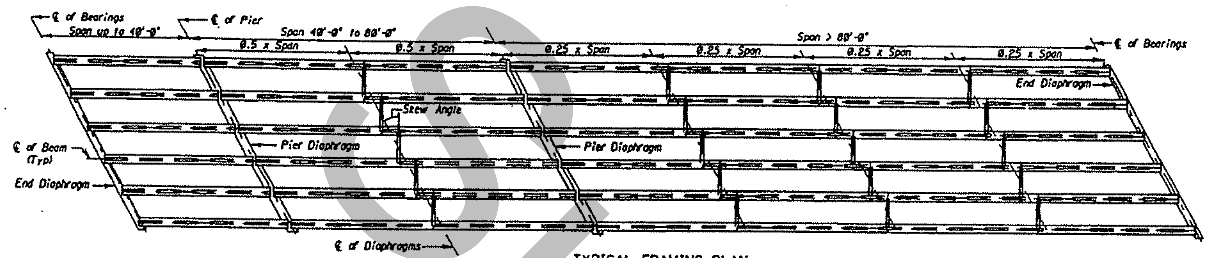
CONTROL SECTION	JOB NO.
	CHK. BY
	CHK. BY

(D)

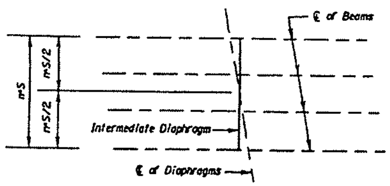
STATE	FEDERAL PROJECT NO.	SHEET	TOTAL SHEETS
N. J.			

STRUCTURE NO.

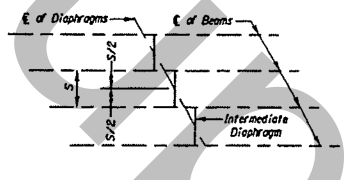
STRUCTURE NAME



TYPICAL FRAMING PLAN



PLAN FOR SKEW ANGLES ≤ 10°



PLAN FOR SKEW ANGLES > 10°

DIAPHRAGM SUPPORT DIMENSIONS

BEAM HEIGHT	A	B	C	D
45"	1'-2½"	1'-1"	1'-5"	10"
54"	1'-5"	1'-5"	1'-9"	1'-2"
63"	1'-½"	11"	3'-2"	-
72"	1'-½"	1'-1"	3'-8"	-

GENERAL NOTES

1. This standard drawing provides steel diaphragm details for prestressed concrete I-Beam bridges. The details in this standard are applicable to structures with beam spacings less than 14'-0" and skews less than 45°.

✗ 2. End and pier diaphragms shall be cast-in-place, the design plans shall show the centerline location of each intermediate diaphragm. All intermediate diaphragm details and associated prestressed beam details shall be included on the fabricator's shop drawings. Only one type of intermediate diaphragm may be used per structure.

✗ 3. The sizes of steel diaphragm and accessories provided are for information purpose only. Actual sizes shall be based on design requirements in accordance with the AASHTO LRFD Bridge Design Specifications, with current interims, as modified by Section 3 of the NJDOT Design Manual for Bridges and Structures.

4. All structural steel, including bolts, nuts and washers shall be in accordance with the NJDOT Standard Specifications for Road and Bridge Construction with current Supplemental Specifications, as modified by the Special Provisions.

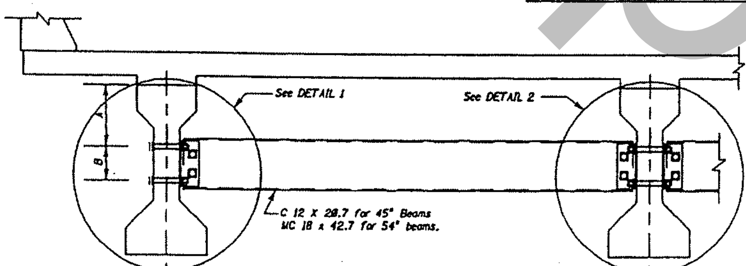
5. All structural steel shall be ASTM A36, galvanized as per ASTM A153, Class C.

6. All bolts are ⅞" dia. ASTM A325, Type 1. All bolts, nuts and washers shall be galvanized as per ASTM A153, Class C.

7. Bolt holes in the I-beam webs shall be located to avoid prestressing strands.

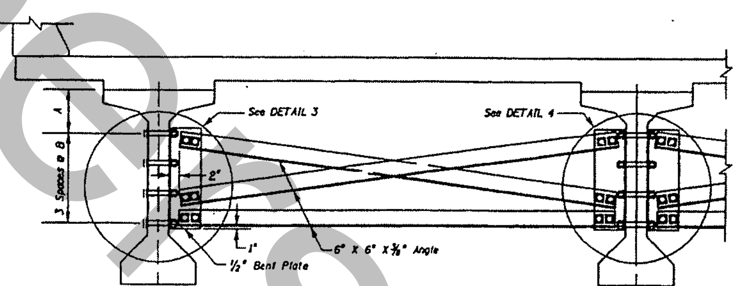
8. The placement of deck concrete shall not proceed until all intermediate diaphragms have been properly installed.

✗ The note should be modified to reflect applicable year and updated Specifications



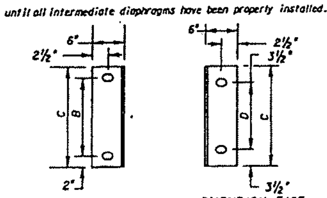
INTERMEDIATE DIAPHRAGM

(FOR 45" AND 54" PRETENSIONED BEAMS)



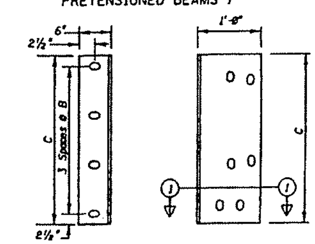
INTERMEDIATE DIAPHRAGM

(FOR 63" AND 72" PRETENSIONED BEAMS)



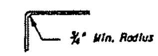
DIAPHRAGM SUPPORT

(FOR 45" AND 54" PRETENSIONED BEAMS)

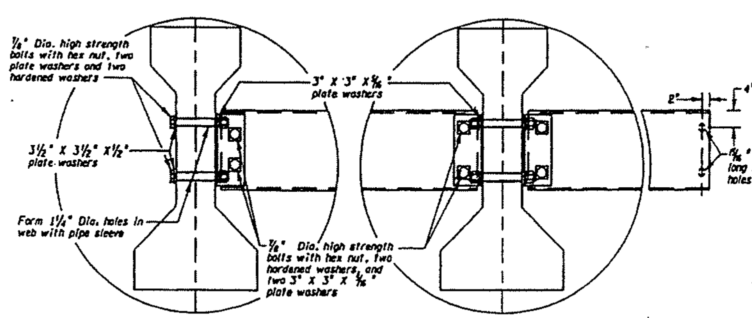


DIAPHRAGM SUPPORT

(FOR 63" AND 72" PRETENSIONED BEAMS)



SECTION 1-1

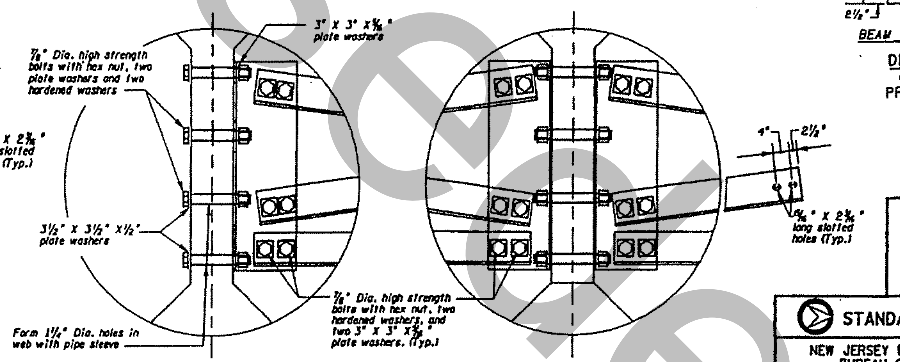


DETAIL 1

Detail 1 shall be used at the fascia beam and all interior beams when the skew angle exceeds 10°

DETAIL 2

Detail 2 shall be used at interior beams when the skew angle is less than 10°



DETAIL 3

Detail 3 shall be used at the fascia beam and all interior beams when the skew angle exceeds 10°

DETAIL 4

Detail 4 shall be used at interior beams when the skew angle is less than 10°

THIS SHEET IS FOR DESIGN INFORMATION ONLY. DO NOT INCLUDE IN CONTRACT PLANS.

STANDARD DRAWING PLATE 2.4-5

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

DETAILS OF
INTERMEDIATE STEEL DIAPHRAGMS
FOR PRESTRESSED CONCRETE BEAMS

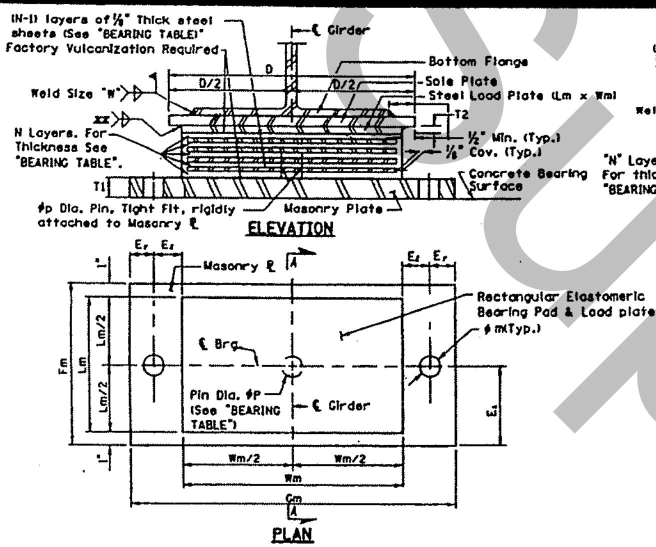
ROUTE SECTION

SCALE NONE

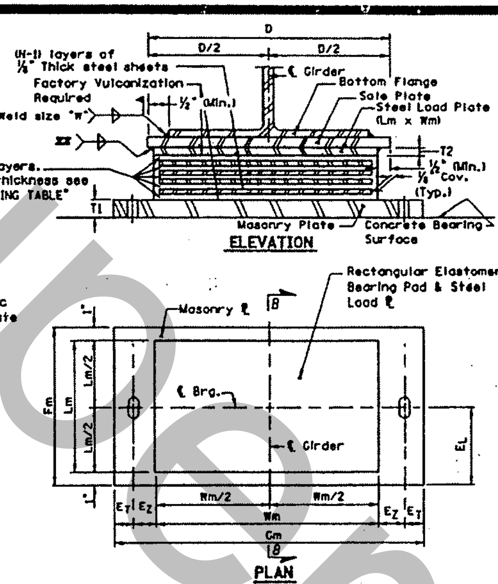
BRIDGE SHEET NO. B of B

REVISION	BY	CKD	DATE

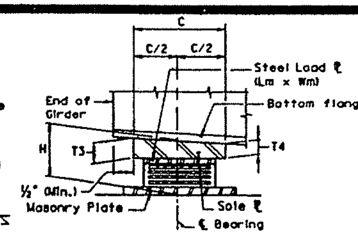
CONTROL SECTION		JOB NO.	
DES. BY			
DWN. BY		CHK. BY	
EST. BY		CHK. BY	
SPECS BY			



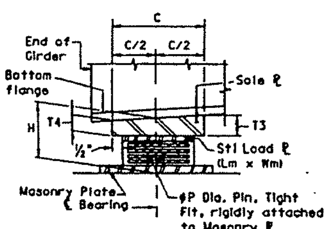
FIXED BEARINGS



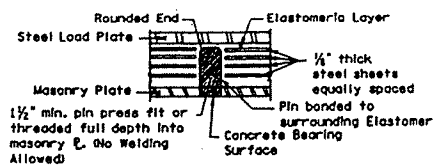
EXPANSION BEARINGS



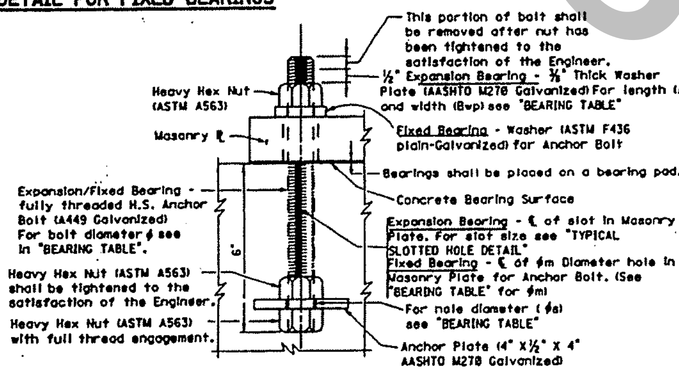
SECTION B-B



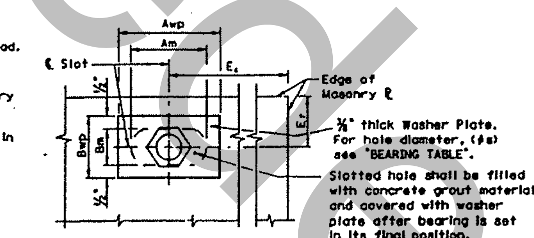
SECTION A-A



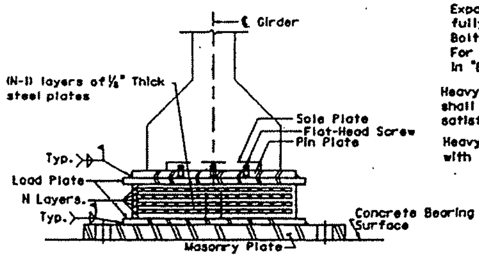
PIN DETAIL FOR FIXED BEARINGS



ANCHOR BOLT DETAIL FOR ALL BEARINGS



TYPICAL SLOTTED HOLE DETAIL
MASONRY PLATE
(FOR EXPANSION BEARINGS ONLY)



ELEVATION

STATE	FEDERAL PROJECT NO.	SHEET	TOTAL SHEETS
N. J.			

STRUCTURE NO.

STRUCTURE NAME

NOTE TO DESIGNER:

THIS SHEET IS NOT TO BE PLACED INTO THE CONTRACT SET OF PLANS AS IS. HOWEVER, INDIVIDUAL DETAILS MAY BE UTILIZED FOR SHOP DRAWING REVIEW.

GENERAL NOTES:

* 1. Elastomeric Bearings shall be designed in conformance with the AASHTO LRFD Bridge Design Specifications, with current Interims, as modified by Section 3 of the NJDOT Design Manual for Bridges and Structures, and the NJDOT Standard Specifications for Road and Bridge Construction with current Supplemental Specifications, as modified by the Special Provisions.

2. Tapered sole plates may be required when the bottom of the beam and the top of the bearings are not parallel to each other. A tapered sole plate shall be placed between the beam and the external load plate if either of the following conditions exist:

   a. Longitudinal grade of the bottom flange is one percent or more.
   b. The required taper is 1/8" or more.

3. The top of pedestals shall be level.

4. Indicate the maximum design reactions (DL + LL) at the supports.

5. The continuous weld connecting the load plate to the sole plate shall be allowed to cool after each pass. However the temperature of the steel adjacent to the elastomer shall not exceed 200° F Temperature shall be controlled by the welding procedure.

6. The size of weld (W) shall be determined by the designer. Minimum weld size shall be 5/16".

7. Anchor Bolt shall be threaded as shown in "ANCHOR BOLT DETAIL FOR ALL BEARINGS". The nut shall be tightened to the satisfaction of the Engineer and the Anchor Bolt tip shall be removed 1/2" above the top of the nut. Anchor Bolts, Plates, Washer Plates and Nuts shall conform to the requirements of NJDOT Standard Specifications for Road and Bridge Construction.

8. This drawing represents straight simple span bridge structure. For clarity purposes no lateral bracings are shown.

9. All anchor bolts shall be cast-in-place.

10. If the design indicates that there will be no tension under any loading condition, the plate and nuts are not required.

11. The furnishing of Reinforced Elastomeric Bearings shall conform to the provisions of Subsection 503.08 of the Standard Specifications.

12. The Designer shall reference the criteria of Subsection 1.24.20 of the Bridges and Structures Design Manual for submission of final plans.

* The note should be modified to reflect applicable year and updated Specifications.

xx Manufacturer shall provide the weld size (minimum size of weld shall be 5/16").

ELASTOMERIC BEARING TABLE

LOCATION	FIX/EXP.	ITEM NO.	QUANTITY REQUIRED	MAX. DESIGN REACTION (KIPS)	SHAPE FACTOR	LOAD ℄ THICKNESS T2 (IN)	ONE WAY ● LONG. MOVEMENT (IN)	ELASTOMER LAYERS				MASONRY ℄									BRG.	ANCHOR BOLTS		WELD SIZE	WASHER ℄		SOLE PLATE				DL+SDL R(PS)	LL W/O IMP R(PS)	HOLE DIA. FOR PIN (IN)	φP PIN DIA. (IN)
								THICKNESS (IN)	N LAYERS	Lm (IN)	Wm (IN)	T1 (IN)	Fm (IN)	Gm (IN)	Am (IN)	Bm (IN)	Er (IN)	Ez (IN)	ET (IN)	φm (IN)	H (IN)	φ (IN)	BOLTS PER BRG.	W (IN)	Awp (IN)	Bwp (IN)	C (IN)	D (IN)	T3 (IN)	T4 (IN)				

● One way longitudinal movement is the maximum movement (Expansion or Contraction) of the Superstructure when bearings are set at 68° F. This includes 1" of tolerance. When the bearings are to be set at temperatures other than 68°, reference AASHTO LRFD Bridge Design Specifications, Articles 3.12.2.1 and 3.12.2.2 for guidance for setting temperatures and bearing movement.

CONTROL SECTION		JOB NO.	
DES. BY		CHK. BY	
REV. BY			
ST. BY		CHK. BY	
SCS. BY			

IN CHARGE OF

BDC04MB-01

STANDARD DRAWING PLATE 2.5-1

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

REINFORCED ELASTOMERIC BEARING

ROUTE : SECTION :

MUNICIPALITY COUNTY

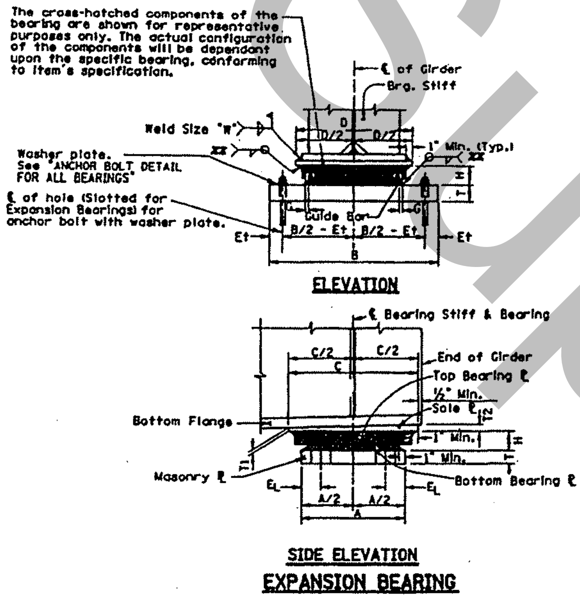
SCALE : NONE

BRIDGE SHEET NO. OF

STATE	FEDERAL PROJECT NO.	SHEET	TOTAL SHEETS
N. J.			

STRUCTURE NO.

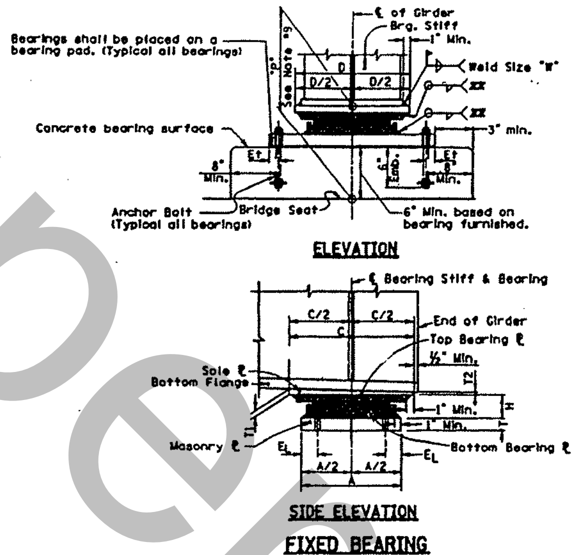
STRUCTURE NAME



ELEVATION

SIDE ELEVATION

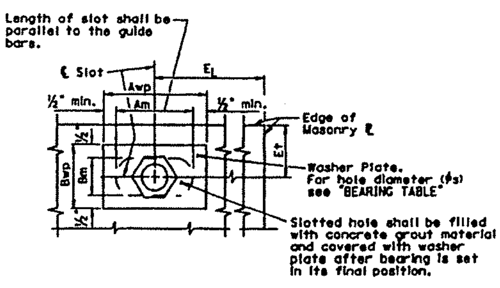
EXPANSION BEARING



ELEVATION

SIDE ELEVATION

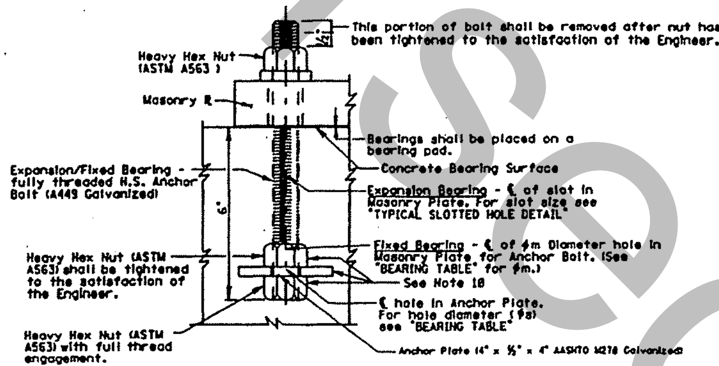
FIXED BEARING



TYPICAL SLOTTED HOLE DETAIL

MASONRY PLATE

(FOR EXPANSION BEARINGS ONLY)



ANCHOR BOLT DETAIL FOR ALL BEARINGS

NOTE TO DESIGNER:

THIS SHEET IS NOT TO BE PLACED INTO THE CONTRACT SET OF PLANS AS IS. HOWEVER, INDIVIDUAL DETAILS MAY BE UTILIZED FOR SHOP DRAWING REVIEW.

GENERAL NOTES:

✱ 1. High Load Pot Bearings shall be designed in conformance with the AASHTO LRFD Bridge Design Specifications, with current interims, as modified by Section 3 of the NJDOT Design Manual for Bridges and Structures, and the NJDOT Standard Specifications for Road and Bridge Construction with current Supplemental Specifications, as modified by the Special Provisions.

2. The furnishing of Pot Bearings shall conform to the provisions of Subsection 503.08 of the Standard Specifications.

3. The Designer shall reference the criteria of Subsection 1.24.20 of the Bridges and Structures Design Manual for submission of final plans.

4. Generally the sole plate shall be made 2" wider than the bottom flange. This will provide 1" on each side of the flange for a downward weld attachment to the sole plate. The length of the sole plate shall be 2" longer than the top bearing plate. The minimum thickness of the sole plate shall be ¾". When the slope of the bottom flange exceeds 0.5 percent, a tapered sole plate shall be used.

5. The width of the masonry plate will be dependent on the anchor bolt location. The length of the masonry plate shall be at least 2" greater than the bottom bearing plate. Thickness of the masonry plate shall be determined by the Designer.

6. Top and bottom bearing plates shall be welded to the sole plate and masonry plate respectively. The size of weld (W) shall be determined by the designer. Minimum weld size shall be 5/16".

7. On skewed structures, especially large skews, the designer shall investigate that there is no interference between the bearing components and any of the bracing members (bottom laterals, diaphragms, connection plates, etc.). A detail shall be shown on the plans for each significantly different configuration.

8. Anchor Bolt shall be threaded as shown in "ANCHOR BOLT DETAIL FOR ALL BEARINGS". The nut shall be tightened to the satisfaction of the Engineer and the Anchor Bolt tip shall be removed ½" above the top of the nut. Anchor Bolts, Plates, Washer Plates and Nuts shall conform to the requirements of NJDOT Standard Specification for Road and Bridge Construction.

9. This drawing represents straight simple span bridge structure. For clarity purposes no lateral bracings are shown.

10. If the design indicates that there will be no tension under any loading condition, the plate and nuts are not required.

✱ The note should be modified to reflect applicable year and updated Specifications.

BEARING TABLE

							MASONRY ℄								BRG.	ANCHOR BOLTS		WELD SIZE	WASHER ℄		SOLE PLATE				
LOCATION	FIX/EXP.	ITEM NO.	QUANTITY REQUIRED	CAPACITY (KIPS)	ONE WAY ✱ LONGIT. MOVEMENT (in)	(G) GUIDE CLEARANCE (in)	A (in)	B (in)	T (in)	Am (in)	Bm (in)	Ef (in)	EL (in)	φm (in)	H (in)	φ (in)	BOLTS PER BRG.	W (in)	Awp (in)	Bwp (in)	C (in)	D (in)	T1 (in)	T2 (in)	φs (in)

✱ One way longitudinal movement is the maximum movement (Expansion or Contraction) of the Superstructure when bearings are set at 68° F. This includes 1" of tolerance. When the bearings are to be set at temperatures other than 68°, reference AASHTO LRFD Bridge Design Specifications, Articles 3.12.2.1 and 3.12.2.2 for guidance for setting temperatures and bearing movement.

✱✱ Manufacturer shall provide the weld size. Minimum size of weld shall be 5/16".

CONTROL SECTION		JOB NO.	
DES. BY		CHK. BY	
DWN. BY			
EST. BY		CHK. BY	
SPECS. BY			
IN CHARGE OF			

BOC04MB-01

STANDARD DRAWING PLATE 2.5-2

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

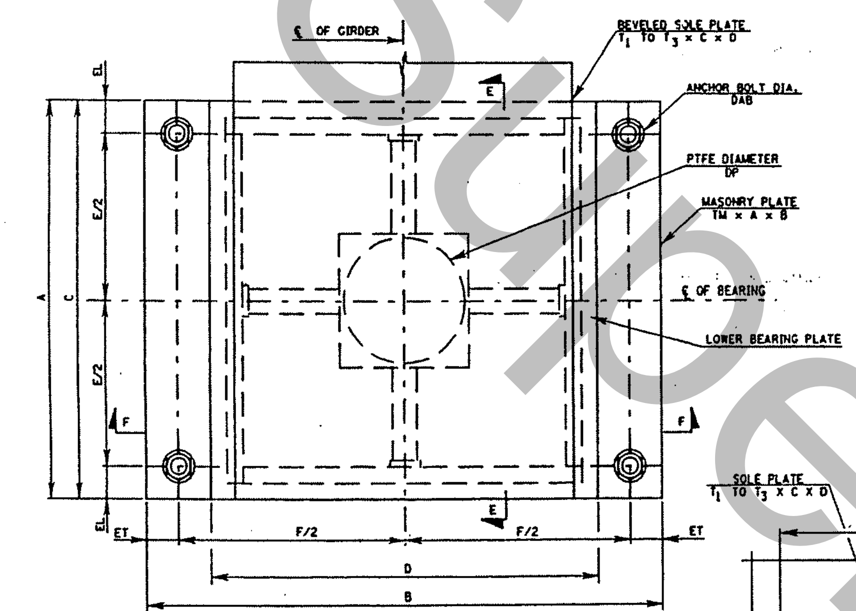
POT BEARING

ROUTE : SECTION :

MUNICIPALITY COUNTY

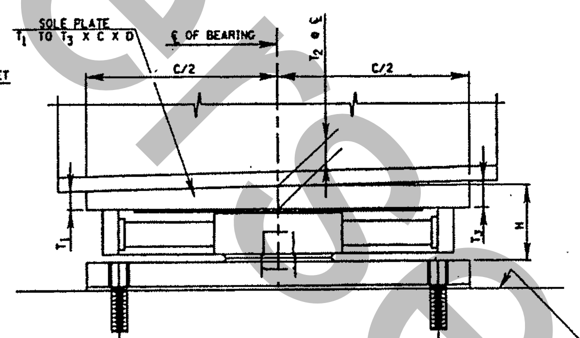
SCALE : NONE

BRIDGE SHEET NO. OF

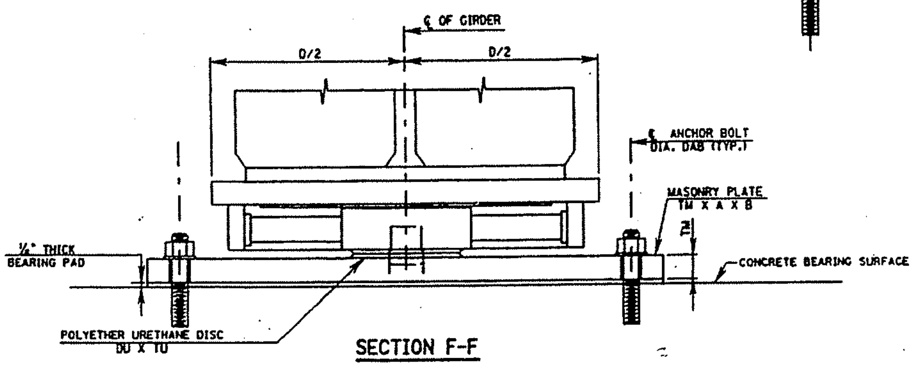


NOTE:
FOR CLARITY PTFE AND STAINLESS STEEL SHEET NOT SHOWN ON PLAN & SIDE VIEWS.

PLAN VIEW - SEISMIC ISOLATION BEARING



SECTION E-E



SECTION F-F

NOTE TO DESIGNER:
THE BEARING PARAMETERS SHOWN ARE CONCEPTUAL. DIMENSIONS SHALL BE BASED ON ACTUAL DESIGN.

SEISMIC ISOLATION BEARING TABLE

TYPE	BEARING HEIGHT INCLUDING T_2 H (IN)	PTFE DIAMETER DP (IN)	POLYETHER URETHANE DIA. DU (IN)	POLYETHER URETHANE THICK. TU (IN)	SOLE PLATE LENGTH C (IN)	SOLE PLATE WIDTH D (IN)	SOLE PLATE THICKNESS T_1 (IN)	SOLE PLATE THICKNESS T_2 (IN)	SOLE PLATE THICKNESS T_3 (IN)	MASONRY PLATE LENGTH A (IN)	MASONRY PLATE WIDTH B (IN)	MASONRY PLATE THICKNESS TM (IN)	ANCHOR BOLTS NO. OF BOLTS	ANCHOR BOLTS DIA. DAB (IN)	ANCHOR BOLTS EDGE DIST. ET (IN)	ANCHOR BOLTS EDGE DIST. EL (IN)	ANCHOR BOLTS MIN. EMBED. DEPTH (IN)

STATE	FEDERAL PROJECT NO.	SHEET	TOTAL SHEETS
N. J.			

STRUCTURE NO.

STRUCTURE NAME

NOTE TO DESIGNER:

THIS SHEET IS NOT TO BE PLACED INTO THE CONTRACT SET OF PLANS AS IS. HOWEVER, INDIVIDUAL DETAILS MAY BE UTILIZED FOR SHOP DRAWING REVIEW.

GENERAL NOTES:

1. SEISMIC ISOLATION BEARINGS SHALL BE DESIGNED IN CONFORMANCE WITH THE AASHTO GUIDE SPECIFICATIONS FOR SIESMIC ISOLATION DESIGN, AND THE CURRENT NJDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION WITH CURRENT SUPPLEMENTAL SPECIFICATIONS, AS MODIFIED BY THE SPECIAL PROVISIONS.
2. ALL STEEL PLATES SHALL CONFORM TO AASHTO M270 GR. 50 EXCEPT AS NOTED.
3. ALL STEEL PLATES SHALL CONFORM TO THE FLATNESS REQUIREMENTS OF THE AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES DIV. II, SEC. 18.
4. ANCHOR BOLTS SHALL CONFORM TO ASTM A449, THE HEX NUTS SHALL CONFORM TO ASTM A563, AND THE FLAT WASHERS SHALL CONFORM TO ASTM F436. THE BOLTS, NUTS AND WASHERS SHALL BE HOT-DIP GALVANIZED PER ASTM A153 (AASHTO M232). FOR DETAILS OF ANCHOR BOLTS SEE STANDARD PLATES 2.5-1 AND 2.5-2.
5. ANCHOR BOLT PLATE WASHERS SHALL CONFORM TO AASHTO M270 GR. 36 OR 50, AND SHALL BE GALVANIZED PER ASTM A123.
6. THE POLYETHER ELEMENT SHALL BE IN ACCORDANCE WITH THE AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES DIV. II, SEC. 18.
7. PTFE IS TO BE VIRGIN, AND ETCHED ON ONE SIDE FOR BONDING INTO MACHINED RECESS THE MAXIMUM COEFFICIENT OF FRICTION SHALL NOT EXCEED THE DESIGN VALUE.
8. THE STAINLESS STEEL SHEET SHALL CONFORM TO ASTM A240, TYPE 316, SHALL BE 12 GAUGE AND SHALL RECEIVE A NO. 8 BRIGHT MIRROR FINISH AS PER SPECIFICATION.
9. ALL WELDING SHALL BE PERFORMED IN ACCORDANCE WITH ANSI/AASHTO/ AWS D1.5 BRIDGE WELDING CODE.
10. ORIENTATION, MODEL, LOCATION AND DATE OF FABRICATION IS TO BE MARKED ON EACH INDIVIDUAL BEARING AND ALSO ON THE SHOP DRAWINGS.
11. PTFE AND STAINLESS STEEL SURFACES SHALL BE PROTECTED FROM DAMAGE AS WELL AS AIRBORN DEBRIS AND CONTAMINANTS AT ALL TIMES PRIOR TO FINAL ASSEMBLY. THESE SURFACES SHALL BE INSPECTED FOR SUCH DAMAGE AND DEBRIS BEFORE FINAL ASSEMBLY.
12. COMPLETED BEARINGS SHALL BE INDIVIDUALLY STEEL BANDED FOR SHIPPING AND HANDLING.
13. BEARINGS SHALL BE STORED IN A CLEAN, DRY, LEVEL, UPRIGHT POSITION.
14. TESTING SHALL BE CONDUCTED AS PER THE REQUIREMENTS OF THE AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES DIV. II, SEC. 18.
15. AT NO TIME, MAY ANY BEARING BE DISASSEMBLED WITHOUT AUTHORIZATION FROM THE BEARING MANUFACTURER.
16. ALL MILL SCALE TO BE REMOVED FROM BEARING PLATES VIA SANDBLASTING (SSPC-SP6)
17. CONTRACTOR IS TO ADJUST BEARING SEAT ELEVATIONS TO ACCOMODATE FINISHED BEARING HEIGHT.
18. THE FURNISHING OF SEISMIC ISOLATION BEARINGS SHALL CONFORM TO THE PROVISIONS OF SUBSECTION 503.08 OF THE STANDARD SPECIFICATIONS.
19. THE DESIGNER SHALL REFERENCE THE CRITERIA OF SUBSECTION 1.24.20 OF THE BRIDGES AND STRUCTURES DESIGN MANUAL FOR SUBMISSION OF FINAL PLANS.

BDC04MB-01

STANDARD DRAWING PLATE 2.5-3

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

SEISMIC ISOLATION BEARING

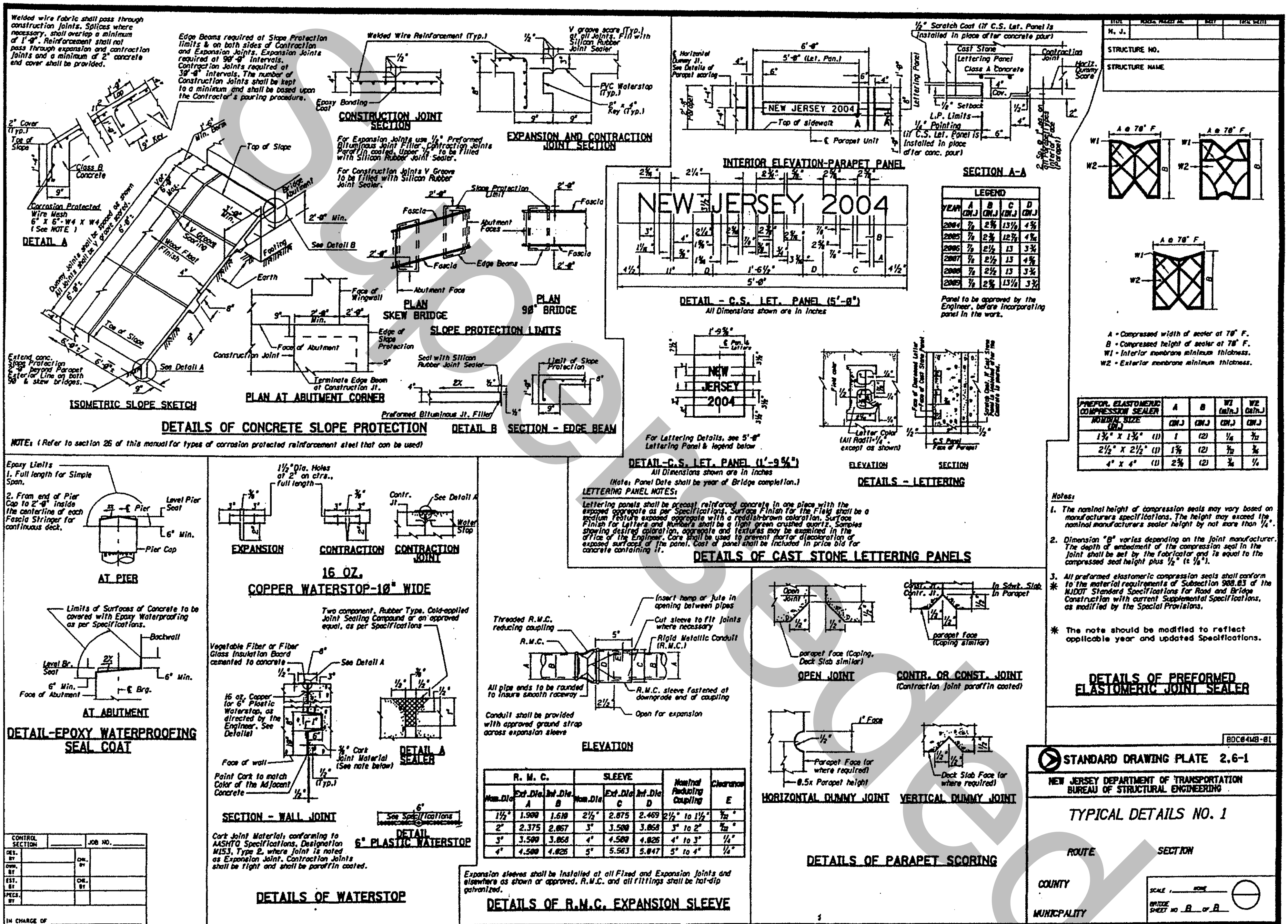
ROUTE :　　SECTION :

MUNICIPALITY　　COUNTY

SCALE : NONE

BRIDGE SHEET NO. OF

CONTROL SECTION		JOB NO.	
DES. BY		CHK. BY	
DRN. BY			
EST. BY		CHK. BY	
PECS. BY			

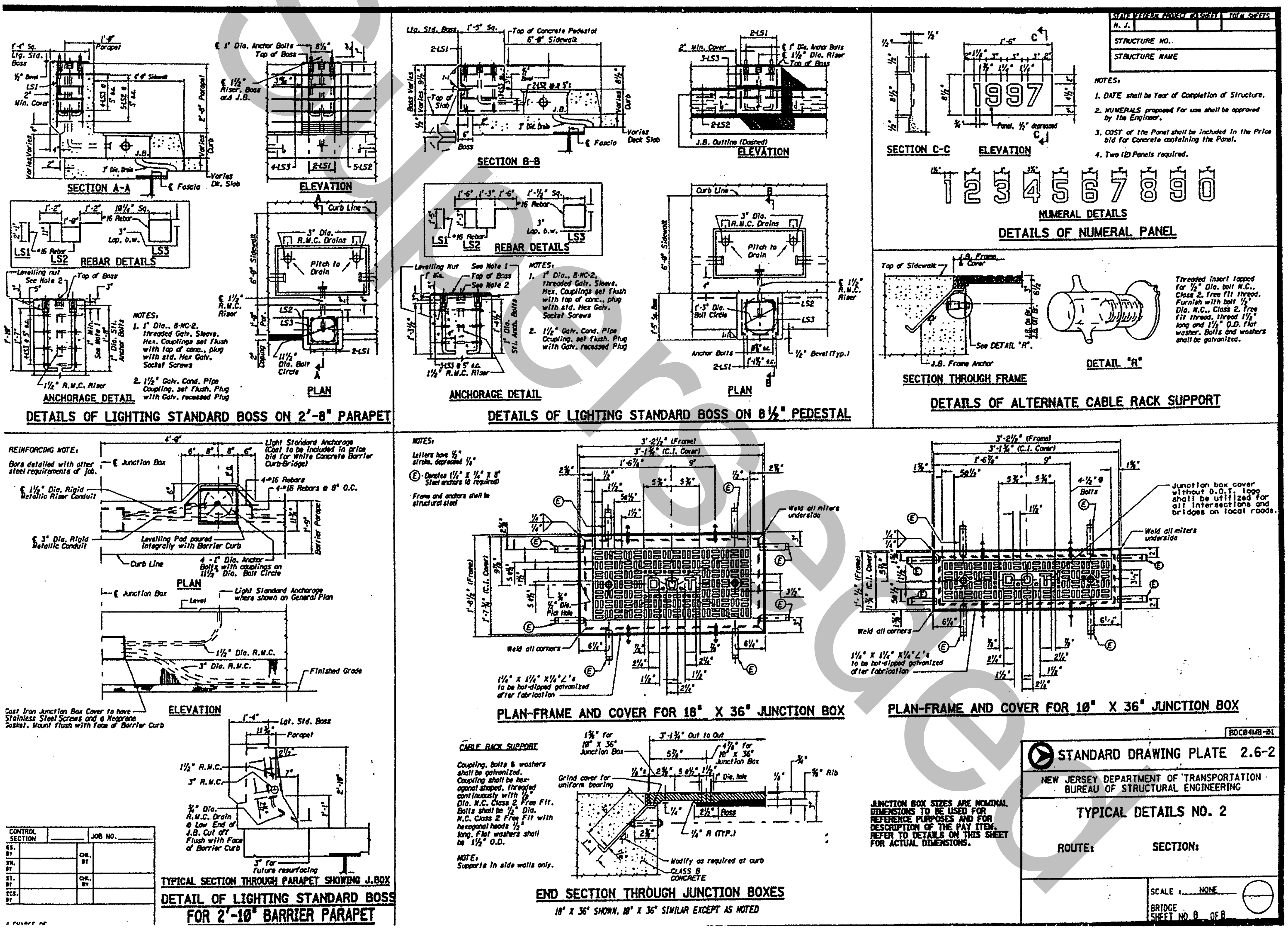


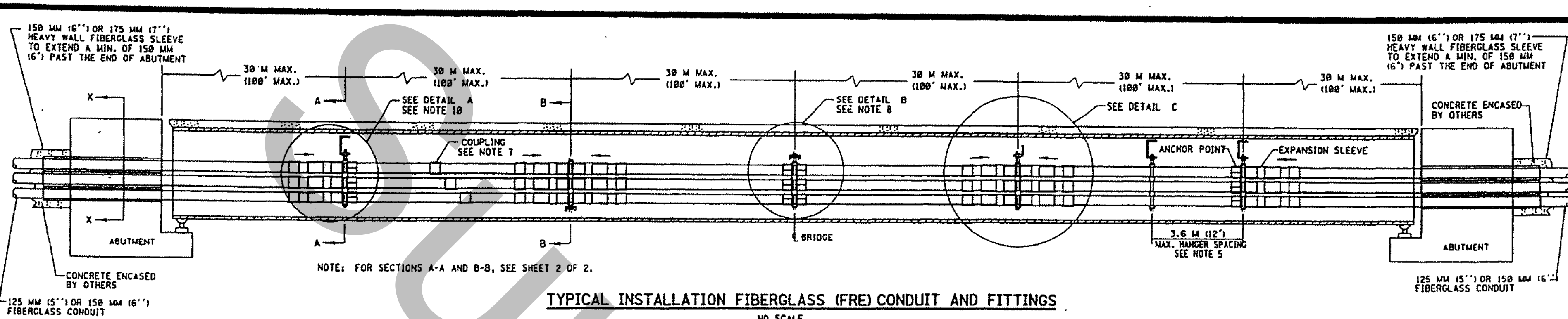
LEGEND

YEAR	A (IN.)	B (IN.)	C (IN.)	D (IN.)
2004	7/8	2 5/8	13 1/2	4 5/8
2005	7/8	2 3/8	12 7/8	4 7/8
2006	7/8	2 1/2	13	3 3/4
2007	7/8	2 1/2	13	4 5/8
2008	7/8	2 1/2	13	3 3/4
2009	7/8	2 5/8	13 1/2	3 3/4

PREFOR. ELASTOMERIC COMPRESSION SEALER NOMINAL SIZE (IN.)	A (IN.)	B (IN.)	W1 (MIN.)	W2 (MIN.)
1 3/4" X 1 3/4" (1)	1	(2)	1/8	3/32
2 1/2" X 2 1/2" (1)	1 5/8	(2)	3/32	3/8
4" X 4" (1)	2 3/8	(2)	3/8	1/4

R.M.C. Nom. Dia	R.M.C. Ext. Dia. A	R.M.C. Int. Dia. B	SLEEVE Nom. Dia	SLEEVE Ext. Dia C	SLEEVE Int. Dia D	Nominal Reducing Coupling	Clearance E
1 1/2"	1.900	1.610	2 1/2"	2.875	2.469	2 1/2" to 1 1/2"	7/32"
2"	2.375	2.067	3"	3.500	3.068	3" to 2"	7/32"
3"	3.500	3.068	4"	4.500	4.026	4" to 3"	1/4"
4"	4.500	4.026	5"	5.563	5.047	5" to 4"	1/4"

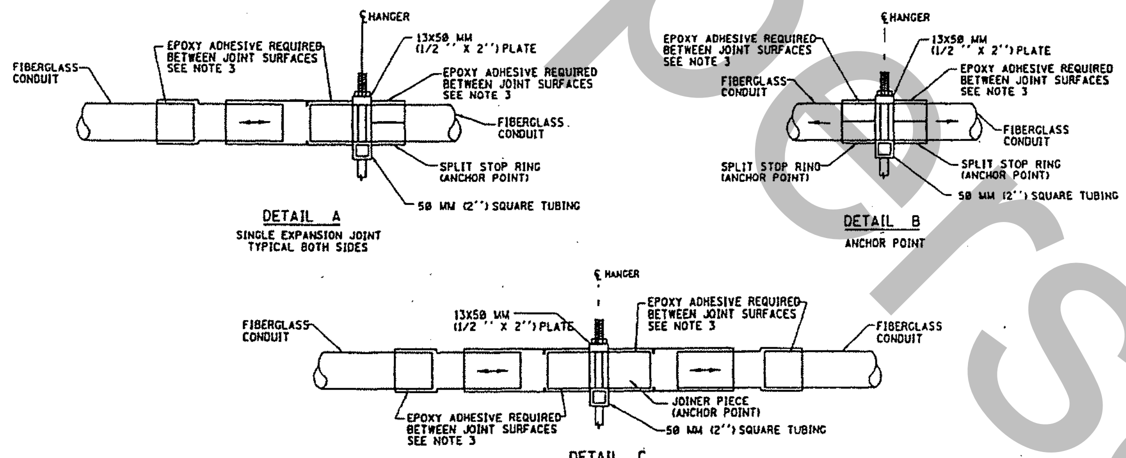

Superseded
DETAILS OF LIGHTING STANDARD BOSS ON 2'-8" PARAPET
SECTION A-A
ELEVATION
REBAR DETAILS
ANCHORAGE DETAIL
PLAN
NOTES:
1. 1" Dia., 8-NC-2, threaded Galv. Sleeve. Hex. Couplings set flush with top of conc., plug with std. Hex Galv. Socket Screws
2. 1½" Galv. Cond. Pipe Coupling, set flush. Plug with Galv. recessed Plug
DETAILS OF LIGHTING STANDARD BOSS ON 8½" PEDESTAL
SECTION B-B
ELEVATION
REBAR DETAILS
ANCHORAGE DETAIL
PLAN
NOTES:
1. DATE shall be Year of Completion of Structure.
2. NUMERALS proposed for use shall be approved by the Engineer.
3. COST of the Panel shall be included in the Price bid for Concrete containing the Panel.
4. Two (2) Panels required.
SECTION C-C
ELEVATION
1997
1 2 3 4 5 6 7 8 9 0
NUMERAL DETAILS
DETAILS OF NUMERAL PANEL
Threaded insert tapped for ½" Dia. bolt N.C., Class 2, free fit thread. Furnish with bolt ½" Dia. N.C., Class 2, free fit thread, thread 1½" long and 1½" O.D. flat washer. Bolts and washers shall be galvanized.
SECTION THROUGH FRAME
DETAIL "R"
DETAILS OF ALTERNATE CABLE RACK SUPPORT
REINFORCING NOTE:
Bars detailed with other steel requirements of job.
PLAN
ELEVATION
Cast Iron Junction Box Cover to have Stainless Steel Screws and a Neoprene Gasket. Mount flush with face of Barrier Curb
TYPICAL SECTION THROUGH PARAPET SHOWING J.BOX
DETAIL OF LIGHTING STANDARD BOSS FOR 2'-10" BARRIER PARAPET
NOTES:
Letters have ½" stroke, depressed ⅛"
Ⓔ - Denotes 1¼" X ¼" X 8" Steel anchors (8 required)
Frame and anchors shall be structural steel
Junction box cover without D.O.T. logo shall be utilized for all intersections and bridges on local roads.
PLAN-FRAME AND COVER FOR 18" X 36" JUNCTION BOX
PLAN-FRAME AND COVER FOR 10" X 36" JUNCTION BOX
CABLE RACK SUPPORT
Coupling, bolts & washers shall be galvanized. Coupling shall be hexagonal shaped, threaded continuously with ½" Dia. N.C. Class 2 Free Fit. Bolts shall be ½" Dia. N.C. Class 2 Free Fit with hexagonal heads ½" long. Flat washers shall be 1½" O.D.
NOTE:
Supports in side walls only.
END SECTION THROUGH JUNCTION BOXES
18" X 36" SHOWN, 10" X 36" SIMILAR EXCEPT AS NOTED
JUNCTION BOX SIZES ARE NOMINAL DIMENSIONS TO BE USED FOR REFERENCE PURPOSES AND FOR DESCRIPTION OF THE PAY ITEM. REFER TO DETAILS ON THIS SHEET FOR ACTUAL DIMENSIONS.
BDC04UB-01
STANDARD DRAWING PLATE 2.6-2
NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING
TYPICAL DETAILS NO. 2
ROUTE:
SECTION:
SCALE: NONE
BRIDGE SHEET NO. 8 OF 8
STRUCTURE NO.
STRUCTURE NAME
CONTROL SECTION
JOB NO.



NOTE: FOR SECTIONS A-A AND B-B, SEE SHEET 2 OF 2.

TYPICAL INSTALLATION FIBERGLASS (FRE) CONDUIT AND FITTINGS

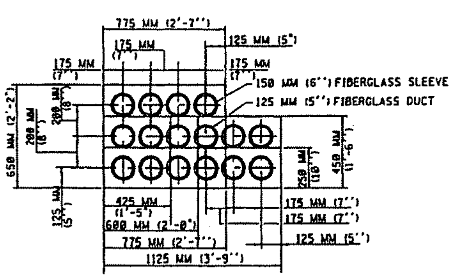
NO SCALE



DETAIL A
SINGLE EXPANSION JOINT TYPICAL BOTH SIDES

DETAIL B
ANCHOR POINT

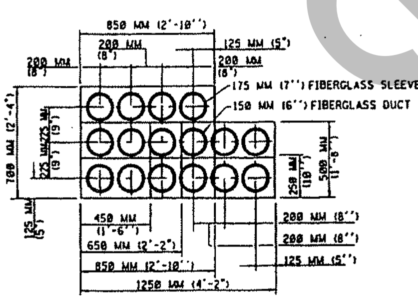
DETAIL C
BACK TO BACK EXPANSION JOINT OPTIONAL



125 MM (5'') FIBERGLASS CONDUIT WITH 150 MM (6'') FIBERGLASS SLEEVE

SECTION X-X

SPACING OF DUCTS THRU ABUTMENTS FOR VARIOUS NUMBER OF CONDUITS FROM ONE TO THREE CONDUITS HIGH AND FROM TWO TO SIX CONDUITS WIDE



150 MM (6'') FIBERGLASS CONDUIT WITH 175 MM (7'') FIBERGLASS SLEEVE

SECTION X-X

SPACING OF DUCTS THRU ABUTMENTS FOR VARIOUS NUMBER OF CONDUITS FROM ONE TO THREE CONDUITS HIGH AND FROM TWO TO SIX CONDUITS WIDE

SUGGESTED INSTALLATION PROCEDURES AND DESIGN DATA

NOTES:

1. FIBERGLASS CONDUIT AND FITTINGS TO BE FIBER REINFORCED EPOXY (FRE) MANUFACTURED IN ACCORDANCE WITH NEMA SPECIFICATIONS TC-14.
2. CONDUIT SHALL BE MANUFACTURED TO DIMENSIONS BASED ON IRON PIPE SIZE (I.P.S.) OUTSIDE DIAMETERS
   a. 125 MM (5'') CONDUIT 141 MM (5.563'') O.D. WT. 1.55 KG/M (1.04#/FT.)
   b. 150 MM (6'') CONDUIT 168 MM (6.625'') O.D. WT. 1.86 KG/M (1.25#/FT.)
3. CEMENTING OF CONDUITS SHALL BE IN ACCORDANCE WITH MANUFACTURERS INSTRUCTIONS. WHEN JOINING CONDUITS AND FITTINGS, AVOID THE USE OF EXCESSIVE EPOXY ADHESIVE WHICH CAN BUILD UP, AND WHEN HARDENED REDUCE THE INTERNAL DIAMETER.
4. EXPANSION JOINTS TO BE INSTALLED IN THE VICINITY OF BRIDGE EXPANSION JOINTS AND NOT MORE THAN 30 M (100 FOOT) SPACING BETWEEN JOINTS.
5. MAXIMUM SPACING BETWEEN HANGERS IS 3.6 M (12 FEET.)
6. MAXIMUM CABLE WEIGHT 29.8 KG/M (20#/FT.)
7. SELECT CONDUIT LENGTHS SO THAT COUPLINGS WILL NOT COINCIDE WITH HANGER LOCATIONS.
8. CEMENT SPLIT STOP RINGS ON CONDUIT AND BUTT TO BOTH SIDES OF HANGER FOR ANCHOR POINT. (DETAIL B)
9. INSTALL EXPANSION JOINTS AND STOP RINGS AS DETAILED.
10. INSTALL SPLIT STOP RING ANCHOR POINTS OPPOSITE EXPANSION SLEEVES.

APPROVED VENDORS FOR BRIDGE MATERIAL

AMERICAN U-TEL INC.
9760 SMITH ROAD
WILLOUGHBY OHIO 44094
MIKE WEISS (216) 946 - 6027

METRA INDUSTRIAL CORP.
P. O. BOX 30845
COLUMBUS OHIO 43230
JIM WEAVER (614) 475 - 7755

P & C INC.
4838 E. 355 th. ST.
WILLOUGHBY OHIO 44094
ALEX McKENZIE (404) 388 - 0428

THIS SHEET FOR DESIGN INFORMATION ONLY. NOT TO BE INCLUDED IN CONTRACT PLANS

PLATE 2.7 - 1

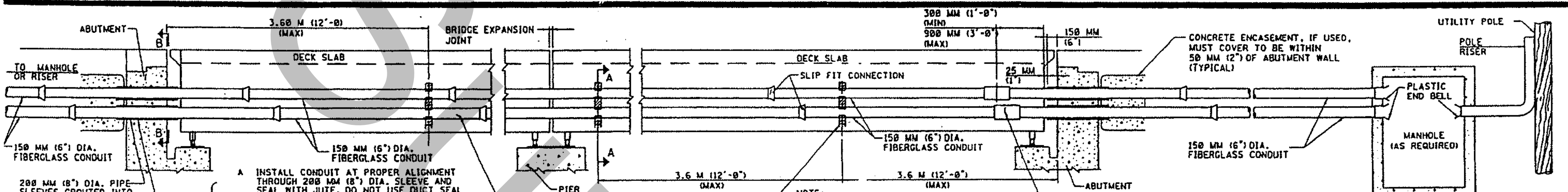
TYPICAL HANGER INSTALLATION OF 125 MM (5'') OR 150 MM (6'') FIBERGLASS CONDUITS FOR STEEL GIRDER BRIDGES

DRAWN BY C. FUEHRER | CHECKED R.P. | APPROVED Original Signed By B. Corne
DATE 1JUNE92 | SCALE NONE | TITLE Mgr. D.P. Eng'r. & Design

PUBLIC SERVICE ELECTRIC AND GAS COMPANY
DISTRIBUTION SYSTEMS/ELECTRIC BUSINESS UNIT

DU-24-S-15346-2
SHEET 1 OF 2 SHEETS

ADDED BOLT HOLE "C-C" / ADDED APPROVED VENDORS — REVISIONS



A INSTALL CONDUIT AT PROPER ALIGNMENT THROUGH 200 MM (8") DIA. SLEEVE AND SEAL WITH JUTE. DO NOT USE DUCT SEAL

B FACTORY INTEGRAL BELL END CAPPED IF CONDUIT RUN TO MANHOLE IS NOT DONE AT SAME TIME AS BRIDGE WORK

C FIBERGLASS CONDUIT IS TO EXTEND UP TO THE FIRST MANHOLE ON EITHER SIDE OF THE BRIDGE

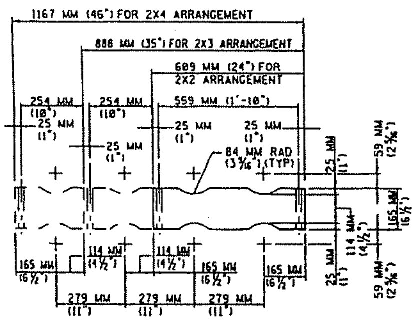
NOTE: BEGIN JOB BY USING FULL 3 M (10') LENGTH AT ONE END AND WORKING TOWARDS THE OTHER END. INSTALL EXPANSION JOINT LAST (SEE OTHER END)

NOTE: CONDUIT PACKAGE MUST NOT BE SUSPENDED BELOW BRIDGE STRINGERS - IF BOLTS ARE TOO LONG THEY MUST BE CUT OFF AND ENDS GALVANIZED

EXPANSION JOINT - INSTALL ONE EXPANSION (NOTES 3, 4 & 8) JOINT PER CONDUIT AS NEAR AS PRACTICAL TO BRIDGE ABUTMENT ON ONE SIDE ONLY, INSTALL THIS ITEM LAST (SEE OTHER END)

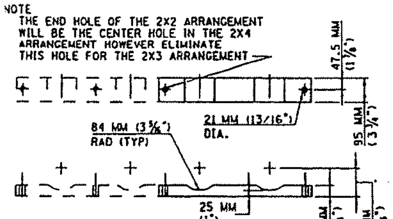
NOTE: DETAILS FOR MANHOLE(S) OR RISERS AS SPECIFIED BY THE DESIGNATED GPU ENERGY REPRESENTATIVE

PROFILE



DETAIL A

NOTE
THE END HOLE OF THE 2X2 ARRANGEMENT WILL BE THE CENTER HOLE IN THE 2X4 ARRANGEMENT HOWEVER ELIMINATE THIS HOLE FOR THE 2X3 ARRANGEMENT



DETAIL B

NOTE: UTILITY CROSSARMS MAY BE USED AS SEPARATORS, PROVIDED SEPARATION DISTANCES ARE MAINTAINED, SEE NOTE 5
DETAIL "A" CAN BE MADE BY USING TWO 89 X 114 MM (3½"x4½") CROSSARMS MOUNTED BACK TO BACK
DETAIL "B" CAN BE MADE BY USING A SINGLE 89 X 114 MM (3½"X4½") CROSSARM
CONDUIT BEVELS CAN THEN BE CUT TO MAINTAIN DESIRED SEPARATIONS

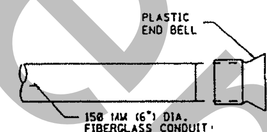
NOTE: CONDUIT BEVELS NEED NOT BE SEMI-CIRCULAR, BUT ALL DIMENSIONS MUST BE HELD. THE BEVELS MUST BE SUCH THAT THEY DO NOT ALLOW LATERAL MOVEMENT OF THE CONDUIT

NOTE: MANUFACTURED CONDUIT SUPPORT SYSTEMS MAY BE SUBSTITUTED FOR THE PRESSURE TREATED WOOD SYSTEM SHOWN. THESE ARE AVAILABLE FROM:

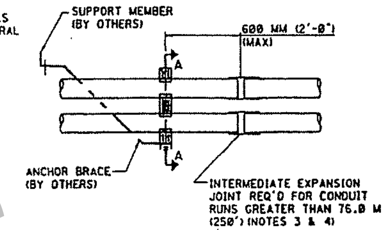
CONDUX INTERNATIONAL - BOX 247
- MANKATO, MINNESOTA 56001
- 800-533-2077

GEORGE-INGRAHAM CORP - PO BOX 1869
- STONE MOUNTAIN, GEORGIA
- 30086-1869
- 800-631-6283
- FAX 404-296-0952

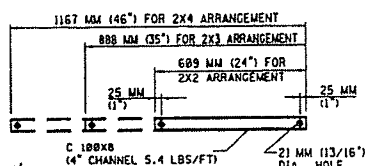
METRA INDUSTRIAL CORP - METRA INDUSTRIAL CORP
P O BOX 30845
COLUMBUS, OHIO 43230
800-872-3828
FAX 614-475-7759



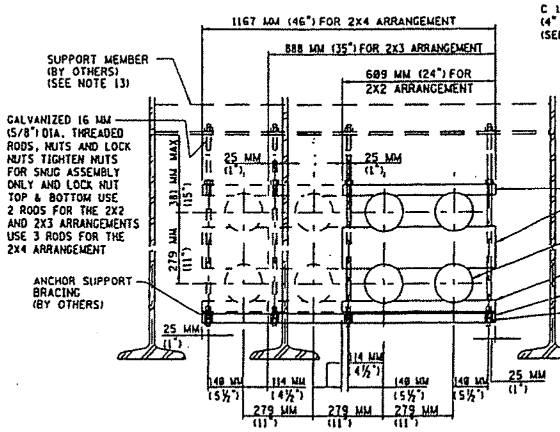
END BELL
(AT MANHOLE LOCATION)
(SEE NOTE 13)



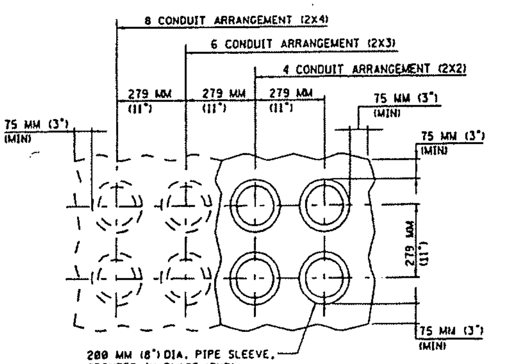
ANCHOR SUPPORT DETAIL
(SEE NOTE 12)



DETAIL C



SECTION A - A



SECTION B - B

BILL OF MATERIALS

ITEM NO	DESCRIPTION	QUANTITY OF ITEMS NEEDED FOR 2 conduits	4 conduits	6 conduits	8 conduits
1	150 MM (6") AIRTIGHT EXPANSION JOINTS	AS REQUIRED SEE NOTES 3, 4, & 13 →			
2	150 MM (6") DIA. FIBERGLASS CONDUIT	NOMINAL 3 M (10') LENGTHS			
3	STAINLESS STEEL OR ALUMINUM PIPE SLEEVES	4	8	12	16
4	FLANGE END BELL, PLASTIC	AS REQUIRED →			
5	CONDUIT SUPPORT SYSTEMS	AS REQUIRED →			
6	EPOXY CEMENT	AS REQUIRED →			

GENERAL NOTES

1. THE JOINING SYSTEM FOR THE FIBERGLASS CONDUIT SHALL BE NON-ADHESIVE, NON-MECHANICAL SLIP-FIT TYPE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S DIRECTIONS AND GOOD WORK PRACTICE.
2. WHENEVER FIBERGLASS CONDUIT IS CUT, SMOOTH THE ROUGH (INSIDE AND OUTSIDE) BY SANDING WITH EMORY CLOTH.
3. INSTALL ONE EXPANSION JOINT PER 38 M (125') OF CONDUIT RUN. EXPANSION JOINTS SHALL BE CAPABLE OF LONGITUDINAL MOVEMENTS OF 75 MM (3") ± (MIN) FOR RUNS OF 76 M (250') OR LESS. INSTALL BOTH EXPANSION JOINTS NEAR ABUTMENTS AND INSTALL ONE ANCHOR SUPPORT NEAR MIDPOINT BETWEEN EXPANSION JOINTS (SEE NOTE 11)
4. THE MANUFACTURER WILL AT THE REQUEST OF THE CONTRACTOR, COMPLETELY ASSEMBLE AN EXPANSION JOINT AND INCORPORATE IT INTO A FULL LENGTH OF CONDUIT.
5. PRESSURE TREATED WOOD SEPARATORS SHALL BE MADE FROM "DENSE STRUCTURAL SOUTHERN PINE" OR "DENSE SELECT STRUCTURAL FIR" AND SEPARATORS SHALL BE TREATED WITH PENTACHLOROPHENOL PRESERVATIVE. SIMILARLY TREATED UTILITY CROSSARMS ARE SUITABLE PROVIDED ALL DIMENSIONS SHOWN IN DETAILS "A" AND "B" ARE MAINTAINED.
6. 200 MM (8") DIA. PIPE SLEEVES WILL BE MADE OF ALUMINUM, SCH 40 (MIN) OR NON - MAGNETIC STAINLESS STEEL, SCH 40 (MIN)
7. CONDUITS AND EXPANSION JOINTS MUST BE INSTALLED SO AS TO MAINTAIN AIRTIGHT INTEGRITY FOR PNEUMATIC LINES.
8. HANGER ASSEMBLY DESIGN AND CONDUIT SUPPORT SPACINGS WERE BASED ON A COMBINED WEIGHT/M (WEIGHT/FOOT) OF CONDUIT AND CABLE OF (6.7 KG/M (11.2 LBS/FT)
9. ALL STRUCTURAL STEEL SHALL MEET THE REQUIREMENTS OF ASTM A36/ A36M-94 UNLESS OTHERWISE NOTED. ALL STRUCTURAL STEEL PLATES, SHAPES, HANGERS AND APPURTENANCES SHALL BE HOT - DIP GALVANIZED
10. DISTRIBUTOR FOR ALUMINUM & NON - MAGNETIC STAINLESS STEEL PIPE SLEEVES JOSEPH T RYERSON & SON INC , PHILADELPHIA, PA. 215-724-0700
11. TO CONTROL CONDUIT MOVEMENTS DUE TO TEMPERATURE CHANGES AND CABLE PULLING, INSTALL ONE ANCHOR SUPPORT PER 38 M (125') OF CONDUIT. ANCHOR SUPPORTS SHALL BE DESIGNED FOR A 2669 N (600 POUND) FORCE IN EITHER DIRECTION OF CONDUIT RUN. THE ANCHOR SUPPORT SHALL USE CLAMPS, CABLE TIES, ETC TO PREVENT LONGITUDINAL MOVEMENTS OF THE CONDUIT AT THIS LOCATION AND SHALL BE APPROVED BY THE DESIGNATED GPU ENERGY REPRESENTATIVE (SEE ANCHOR DETAIL)
12. THE USE OF CAST-IN-PLACE OR DRILLED-IN ANCHORS IN THE DECK SLAB OR PRECAST BEAMS IS STRICTLY PROHIBITED BY THE NEW JERSEY DOT
13. REFER TO ANY SPECIFIC REQUIREMENTS OF THE MANUFACTURER USED, FOR INSTALLATION DETAILS

THIS SHEET FOR DESIGN INFORMATION ONLY. NOT TO BE INCLUDED IN CONTRACT PLANS.

PLATE 2.7-4

FIBERGLASS CONDUIT MANUFACTURERS (AS OF 2 - 97)

CHAMPION FIBERGLASS, INC
P O BOX 699
SPRING, TEXAS 77383-0699
713-353-5052

CONTRACTORS TO VERIFY WITH SHOP DRAWINGS THAT ALL CONDUITS HAVE THE FOLLOWING MINIMUM PROPERTIES:

PIPE I D = 162.05 MM (6.380") IPS-TYPE HW
WALL THICKNESS = 2.3 mm (0.09")
TENSILE STRENGTH = 62 MPA (9.0KSI
IMPACT RESISTANCE = 190 NM @ 21°C (140 FT-LBS AT 70°F)
TEMPERATURE RATING OF CONDUIT
50°C OPERATING
100°C EMERGENCY
STIFFNESS = 345 KPA (50 LBF/IN2)
HEAT DISTORTION = PER ASTM-D648

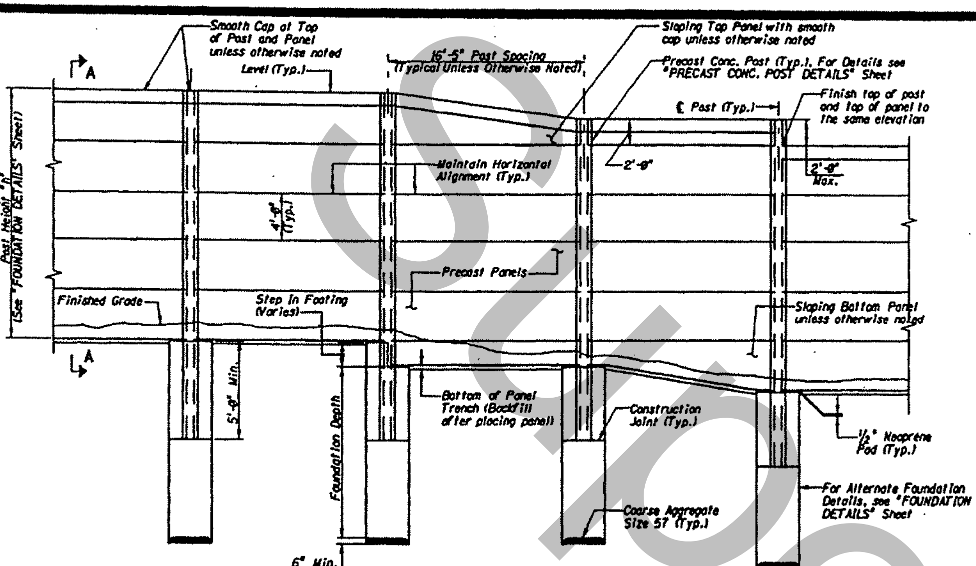
NO	DATE	REVISION	BY	CK	AUT
4	7-13-92	UPDATE TO NEW SPEC	JD	JH	
3	3-5-87	REVISED NOTE 8	AMD	JH	
2	8/86	REDRAWN	MS	DB	
1	10/82	CHANGED MANUFACTURER REP.	WW	EE	

GPU ENERGY Reading, PA

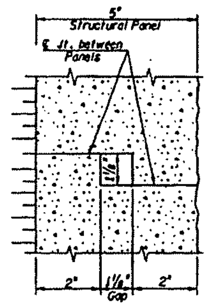
DISTRIBUTION STANDARD

STANDARD INSTALLATION OF 150 MM (6") FIBERGLASS CONDUIT UNDER HIGHWAY BRIDGES

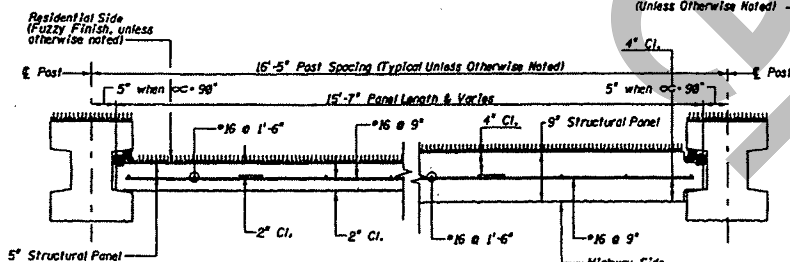
J. L. KANE, JR.
J. H. HOLMES
12/22/72
SCALE: NONE
SHT 1 OF 1
D-68289



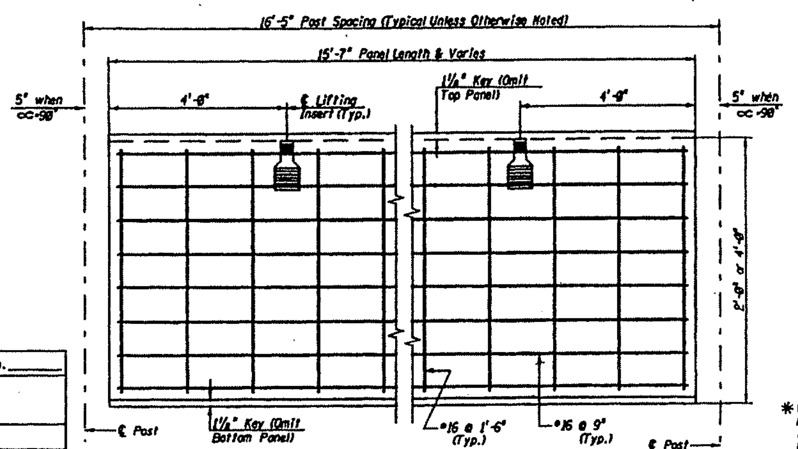
TYPICAL NOISE BARRIER UNIT
(CAISSON FOUNDATION SHOWN)



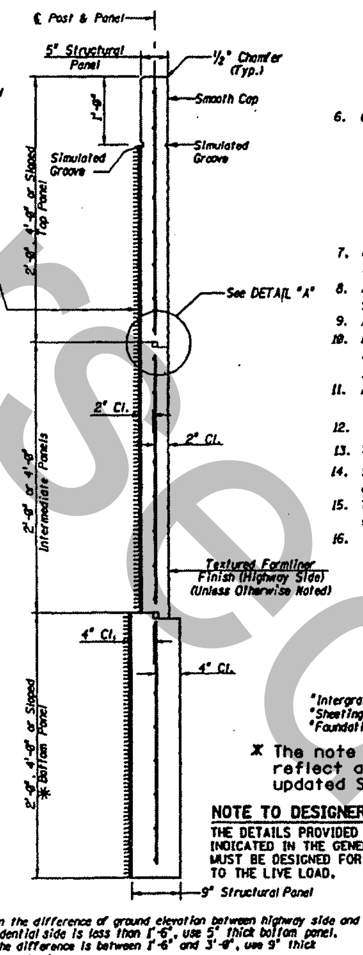
DETAIL "A"



TYPICAL PANEL SECTION PLAN



TYPICAL PANEL SECTION ELEVATION



* When the difference of ground elevation between highway side and residential side is less than 1'-6", use 5" thick bottom panel. If the difference is between 1'-6" and 3'-0", use 9" thick bottom panel.

SECTION: A-A

GENERAL NOTES

1. DESIGN SPECIFICATIONS
   1996 AASHTO Standard Specifications for Highway Bridges (with Interims) as modified by Section 3A of NJDOT Design Manual for Bridges and Structures and 1989 AASHTO Guide Specifications for Structural Design of Sound Barriers (with Interims).
2. X CONSTRUCTION SPECIFICATIONS
   The NJDOT Standard Specifications for Road and Bridge Construction with current Supplemental Specifications, as modified by the Special Provisions.
3. LIVE LOAD
   Wind pressure: 33 PSF corresponding to a wind velocity of 80 mph, as specified in Table 47.2 of Section 47 of NJDOT Design Manual for Bridges and Structures.
   Ice Load: 3 PSF
   Seismic Load for Seismic Performance Category (SPC) 'B'. Maximum Value of 'A' (Acceleration Coefficient)= _____ . Soil Profile = _____ .
4. CONCRETE DESIGN STRESSES
   (a) Precast Members (Post and Panels):
   Specified Compressive Strength f'c = 5,000 PSI
   Extreme Fiber in Compression fc = 2,000 PSI
   (b) Cast-In-Place Members:
   Specified Compressive Strength f'c = 3,000 PSI
   Extreme Fiber in Compression fc = 1,200 PSI
5. REINFORCEMENT STEEL
   Deformed Bars (ASTM A615, Grade 60)
   Allowable Tensile Stress fs = 24,000 PSI
   Deformed Welded Wire Fabric may be used as an alternate. The Welded Wire designation and spacing shall meet the minimum area of steel as determined by design. Refer to Section 915.01 (F) of the 1996 NJDOT Standard Specifications for Road and Bridge Construction for guidance concerning corrosion protection of the welded wire fabric reinforcement.
6. CLASSES OF CONCRETE
   (a) Class of Concrete Used:
   Class P Concrete for Posts and Panels
   Class B Concrete for Foundations and Pedestals
   (b) Class Design Strengths (Mix Design Requirements)
   (In accordance with Section 914 of Specifications)
   Class P = 5,500 PSI
   Class B = 3,700 PSI
7. Position panels using recessed lifting inserts as shown. Recessed insert holes in top panels and in posts shall be sealed with non-shrink cement mortar tinted to match color of panels and posts.
8. All concrete posts and panels shall be tinted utilizing an integral color in accordance with the Special Provisions.
9. All panels and posts shall be installed to true vertical (i.e. Faces of panels shall be flush).
10. Horizontal panel joints on each side of the post shall line up within 1" tolerance, providing that the first matching panel joint from the ground shall have zero tolerance and the last matching joint shall have 1" tolerance.
11. All precast members shall be fabricated to plan dimensions within the tolerances specified in Section 522 of the NJDOT Standard Specifications for Road and Bridge Construction.
12. Excavated foundation pits shall be kept dry during placement of crushed stone and concrete.
13. Spread footing and caissons shall be designed by the Designer based on actual subsurface conditions.
14. Shop drawings shall show complete noise barrier plan and elevations, including all steps and details and dimensions necessary for fabrication and erection.
15. The Contractor shall verify locations of all existing utilities prior to construction in the vicinity of the proposed noise barrier.
16. The concrete posts and panels shall be precast or prestressed utilizing a formliner. The formliner shall be as indicated in the NJDOT Standard Specifications for Road and Bridge Construction as modified by the Special Provisions.

SUMMARY OF QUANTITIES

PAY ITEM NO.	STANDARD ITEM NO.	DESCRIPTION	UNIT	CONTRACT QUANTITY
		NOISE BARRIER, ROADWAY	S.F.	
		NOISE BARRIER, FOUNDATION	UNIT	
		TEMPORARY SHEETING	S.F.	

"Intergral Coloring Pigment" shall be included in the bid price for "Noise Barrier, Roadway".
"Sheeting Left In Place" shall be included in the bid price for "Noise Barrier, Foundation".
"Foundation Excavation" shall be included in the bid price for "Noise Barrier, Foundation".

BDC04MB-01

X The note should be modified to reflect applicable year and updated Specifications.

NOTE TO DESIGNER

THE DETAILS PROVIDED ARE FOR THE LIVE LOAD INDICATED IN THE GENERAL NOTES. THE DETAILS MUST BE DESIGNED FOR ANY MODIFICATIONS TO THE LIVE LOAD.

STANDARD DRAWING PLATE 2.8-1

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

NOISE WALL BARRIERS
PRECAST CONCRETE PANEL DETAILS

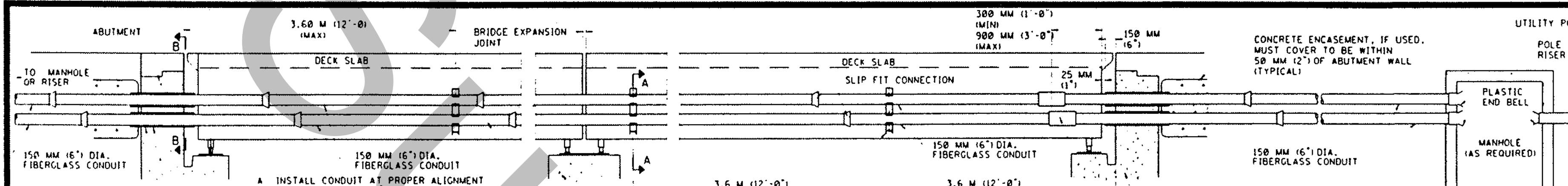
ROUTE ____ SECTION ____
MUNICIPALITY ____ COUNTY ____

REVISION	BY	CKD	DATE

SHEET NO. ____ OF ____

CONTROL SECTION		JOB NO.	
ES. BY		CHK. BY	
WHL. BY			
ST. BY		CHK. BY	
ECS. BY			

N CHARGE OF ____



200 MM (8") DIA. PIPE SLEEVES GROUTED INTO OPENING IN ABUTMENT AT PROPER ALIGNMENT (SEE NOTES 6 & 10)

TYP BOTH ABUTMENTS

A. INSTALL CONDUIT AT PROPER ALIGNMENT THROUGH 200 MM (8") DIA. SLEEVE AND SEAL WITH JUTE. DO NOT USE DUCT SEAL

B. FACTORY INTEGRAL BELL END CAPPED IF CONDUIT RUN TO MANHOLE IS NOT DONE AT SAME TIME AS BRIDGE WORK

C. FIBERGLASS CONDUIT IS TO EXTEND UP TO THE FIRST MANHOLE ON EITHER SIDE OF THE BRIDGE

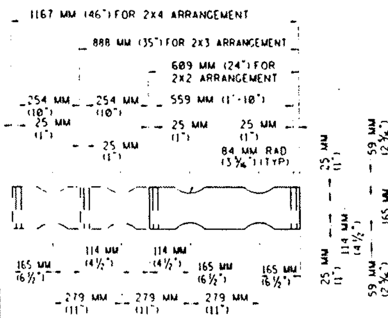
NOTE: BEGIN JOB BY USING FULL 3 M (10') LENGTH AT ONE END AND WORKING TOWARDS THE OTHER END. INSTALL EXPANSION JOINT LAST (SEE OTHER END)

NOTE: CONDUIT PACKAGE MUST NOT BE SUSPENDED BELOW BRIDGE STRINGERS - IF BOLTS ARE TOO LONG THEY MUST BE CUT OFF AND ENDS GALVANIZED

EXPANSION JOINT - INSTALL ONE EXPANSION (NOTES 3, 4 & 8) JOINT PER CONDUIT AS NEAR AS PRACTICAL TO BRIDGE ABUTMENT ON ONE SIDE ONLY, INSTALL THIS ITEM LAST (SEE OTHER END)

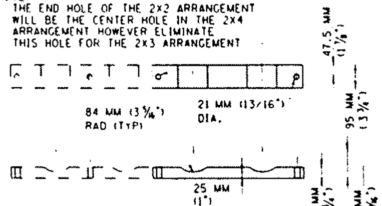
NOTE: DETAILS FOR MANHOLE(S) OR RISERS AS SPECIFIED BY THE DESIGNATED GPU ENERGY REPRESENTATIVE

PROFILE



DETAIL A

NOTE: THE END HOLE OF THE 2X2 ARRANGEMENT WILL BE THE CENTER HOLE IN THE 2X4 ARRANGEMENT HOWEVER ELIMINATE THIS HOLE FOR THE 2X3 ARRANGEMENT



DETAIL B

NOTE: UTILITY CROSSARMS MAY BE USED AS SEPARATORS, PROVIDED SEPARATION DISTANCES ARE MAINTAINED. SEE NOTE 5

DETAIL "A" CAN BE MADE BY USING TWO 89 X 114 MM (3 1/2" x 4 1/2") CROSSARMS MOUNTED BACK TO BACK

DETAIL "B" CAN BE MADE BY USING A SINGLE 89 X 114 MM (3 1/2" x 4 1/2") CROSSARM

CONDUIT BEVELS CAN THEN BE CUT TO MAINTAIN DESIRED SEPARATIONS

NOTE: MANUFACTURED CONDUIT SUPPORT SYSTEMS MAY BE SUBSTITUTED FOR THE PRESSURE TREATED WOOD SYSTEM SHOWN. THESE ARE AVAILABLE FROM:

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GEORGE-INGRAHAM CORP - PO BOX 1869
- STONE MOUNTAIN, GEORGIA
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- 800-631-6283
- FAX 404-296-0952

METRA INDUSTRIAL CORP - METRA INDUSTRIAL CORP
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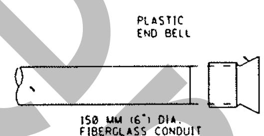
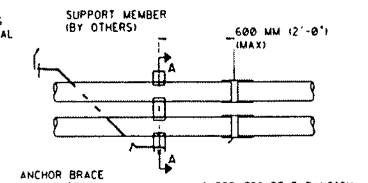
NOTE: CONDUIT BEVELS NEED NOT BE SEMI-CIRCULAR, BUT ALL DIMENSIONS MUST BE HELD. THE BEVELS MUST BE SUCH THAT THEY DO NOT ALLOW LATERAL MOVEMENT OF THE CONDUIT



END BELL

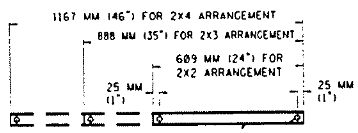
(AT MANHOLE LOCATION) (SEE NOTE 13)



INTERMEDIATE EXPANSION JOINT REQ'D FOR CONDUIT RUNS GREATER THAN 76.0 M (250') (NOTES 3 & 4)

ANCHOR SUPPORT DETAIL

(SEE NOTE 12)



C 100X8 (4" CHANNEL 5.4 LBS/FT) (SEE NOTE 9)

21 MM (13/16") DIA. HOLE

DETAIL C

ITEM NO	DESCRIPTION	QUANTITY OF ITEMS NEEDED FOR			
		2 conduits	4 conduits	6 conduits	8 conduits
1	150 MM (6") AIRTIGHT EXPANSION JOINTS	AS REQUIRED SEE NOTES 3, 4, & 13 →			
2	150 MM (6") DIA. FIBERGLASS CONDUIT	NOMINAL 3 M (10') LENGTHS			
3	STAINLESS STEEL OR ALUMINUM PIPE SLEEVES	4	8	12	16
4	FLANGE END BELL, PLASTIC	AS REQUIRED →			
5	CONDUIT SUPPORT SYSTEMS	AS REQUIRED →			
6	EPOXY CEMENT	AS REQUIRED →			

BILL OF MATERIALS

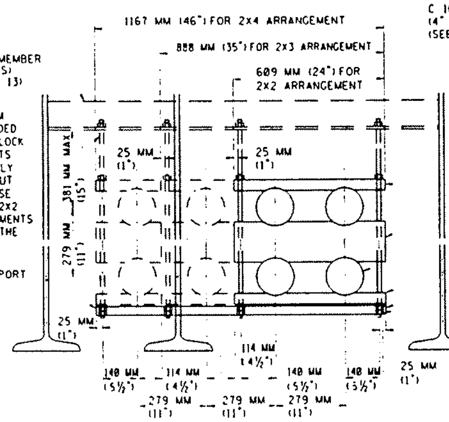
GENERAL NOTES

1. THE JOINING SYSTEM FOR THE FIBERGLASS CONDUIT SHALL BE NON-ADHESIVE, NON-MECHANICAL SLIP-FIT TYPE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S DIRECTIONS AND GOOD WORK PRACTICE.
2. WHENEVER FIBERGLASS CONDUIT IS CUT, SMOOTH THE ROUGH (INSIDE AND OUTSIDE) BY SANDING WITH EMORY CLOTH.
3. INSTALL ONE EXPANSION JOINT PER 38 M (125') OF CONDUIT RUN. EXPANSION JOINTS SHALL BE CAPABLE OF LONGITUDINAL MOVEMENTS OF 75 MM (3") ± (MIN) FOR RUNS OF 76 M (250') OR LESS. INSTALL BOTH EXPANSION JOINTS NEAR ABUTMENTS AND INSTALL ONE ANCHOR SUPPORT NEAR MIDPOINT BETWEEN EXPANSION JOINTS (SEE NOTE 11)
4. THE MANUFACTURER WILL AT THE REQUEST OF THE CONTRACTOR, COMPLETELY ASSEMBLE AN EXPANSION JOINT AND INCORPORATE IT INTO A FULL LENGTH OF CONDUIT.
5. PRESSURE TREATED WOOD SEPARATORS SHALL BE MADE FROM "DENSE STRUCTURAL SOUTHERN PINE" OR "DENSE SELECT STRUCTURAL FIR" AND SEPARATORS SHALL BE TREATED WITH PENTACHLOROPHENOL PRESERVATIVE. SIMILARLY TREATED UTILITY CROSSARMS ARE SUITABLE PROVIDED ALL DIMENSIONS SHOWN IN DETAILS "A" AND "B" ARE MAINTAINED.
6. 200 MM (8") DIA. PIPE SLEEVES WILL BE MADE OF ALUMINUM, SCH 40 (MIN) OR NON - MAGNETIC STAINLESS STEEL, SCH 40 (MIN)
7. CONDUITS AND EXPANSION JOINTS MUST BE INSTALLED SO AS TO MAINTAIN AIRTIGHT INTEGRITY FOR PNEUMATIC LINES.
8. HANGER ASSEMBLY DESIGN AND CONDUIT SUPPORT SPACINGS WERE BASED ON A COMBINED WEIGHT/M (WEIGHT/FOOT) OF CONDUIT AND CABLE OF 16.7 KG/M (11.2 LBS/FT)
9. ALL STRUCTURAL STEEL SHALL MEET THE REQUIREMENTS OF ASTM A36/A36M-94 UNLESS OTHERWISE NOTED. ALL STRUCTURAL STEEL PLATES, SHAPES, HANGERS AND APPURTENANCES SHALL BE HOT - DIP GALVANIZED
10. DISTRIBUTOR FOR ALUMINUM & NON - MAGNETIC STAINLESS STEEL PIPE SLEEVES JOSEPH T RYERSON & SON INC , PHILADELPHIA, PA. 215-724-0700
11. TO CONTROL CONDUIT MOVEMENTS DUE TO TEMPERATURE CHANGES AND CABLE PULLING, INSTALL ONE ANCHOR SUPPORT PER 38 M (125') OF CONDUIT. ANCHOR SUPPORTS SHALL BE DESIGNED FOR A 2669 N (600 POUND) FORCE IN EITHER DIRECTION OF CONDUIT RUN. THE ANCHOR SUPPORT SHALL USE CLAMPS, CABLE TIES, ETC TO PREVENT LONGITUDINAL MOVEMENTS OF THE CONDUIT AT THIS LOCATION AND SHALL BE APPROVED BY THE DESIGNATED GPU ENERGY REPRESENTATIVE (SEE ANCHOR DETAIL)
12. THE USE OF CAST-IN-PLACE OR DRILLED-IN ANCHORS IN THE DECK SLAB OR PRECAST BEAMS IS STRICTLY PROHIBITED BY THE NEW JERSEY DOT
13. REFER TO ANY SPECIFIC REQUIREMENTS OF THE MANUFACTURER USED, FOR INSTALLATION DETAILS

SUPPORT MEMBER (BY OTHERS) (SEE NOTE 13)

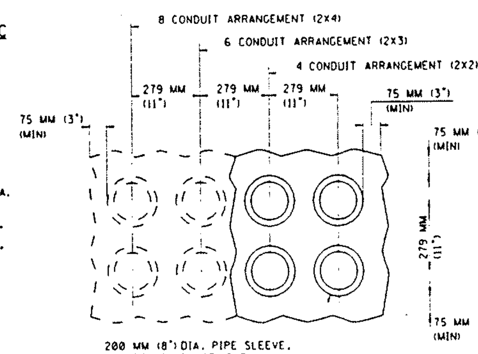
GALVANIZED 16 MM (5/8") DIA. THREADED RODS, NUTS AND LOCK NUTS TIGHTEN NUTS FOR SNUG ASSEMBLY ONLY AND LOCK NUT TOP & BOTTOM USE 2 RODS FOR THE 2X2 AND 2X3 ARRANGEMENTS USE 3 RODS FOR THE 2X4 ARRANGEMENT

ANCHOR SUPPORT BRACING (BY OTHERS)



SEE DETAIL "B"
SEE DETAIL "A"
150 MM (6") DIA. FIBERGLASS CONDUIT
SEE DETAIL "B"
SEE DETAIL "C"
USE DOUBLE NUTS AT BOTTOM

SECTION A - A



200 MM (8") DIA. PIPE SLEEVE. GROUTED IN PLACE (TYP) (NOTE 7)

SECTION B - B

FIBERGLASS CONDUIT MANUFACTURERS (AS OF 2 - 97)

CHAMPION FIBERGLASS, INC
P O BOX 699
SPRING, TEXAS 77383-0699
713-353-5052

CONTRACTORS TO VERIFY WITH SHOP DRAWINGS THAT ALL CONDUITS HAVE THE FOLLOWING MINIMUM PROPERTIES:

PIPE I D : 162.05 MM (6.380") IPS-TYPE HW
WALL THICKNESS = 2.3 mm (0.09")
TENSILE STRENGTH : 62 MPA (9.0KSI)
IMPACT RESISTANCE = 190 NM @ 21°C (140 FT-LBS AT 70°F)
TEMPERATURE RATING OF CONDUIT
50°C OPERATING
100°C EMERGENCY
STIFFNESS = 345 KPA (50 LBF/(IN2))
HEAT DISTORTION = PER ASTM-D648

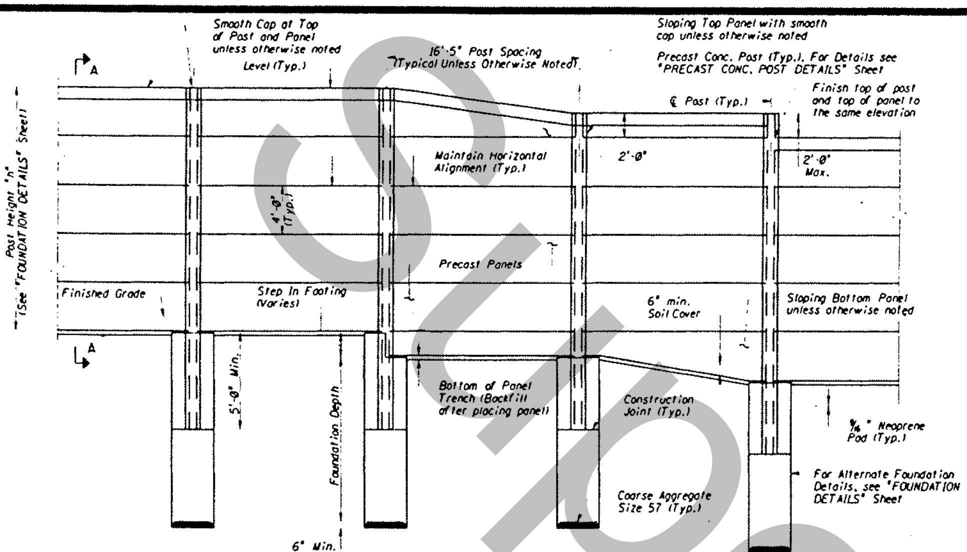
THIS SHEET FOR DESIGN INFORMATION ONLY. NOT TO BE INCLUDED IN CONTRACT PLANS.

PLATE 2.7-4

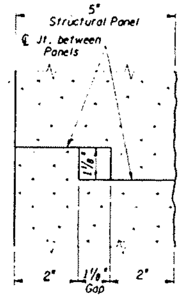
Reading, PA

DISTRIBUTION STANDARD

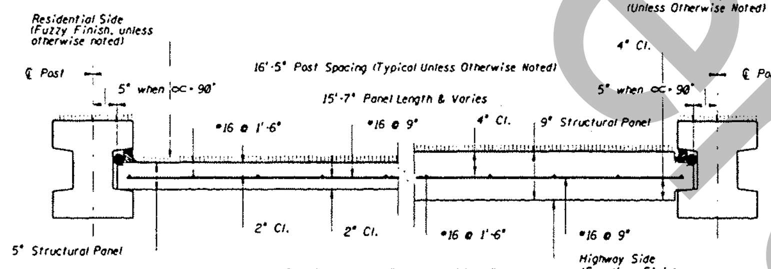
STANDARD INSTALLATION OF 150 MM (6") FIBERGLASS CONDUIT UNDER HIGHWAY BRIDGES



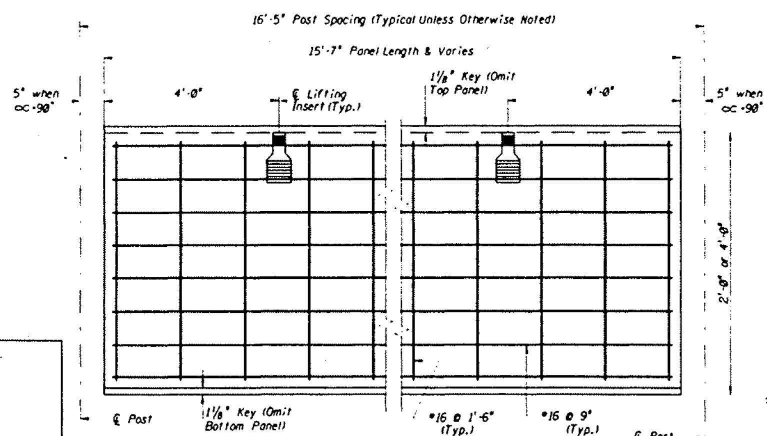
TYPICAL NOISE BARRIER UNIT
(CAISSON FOUNDATION SHOWN)



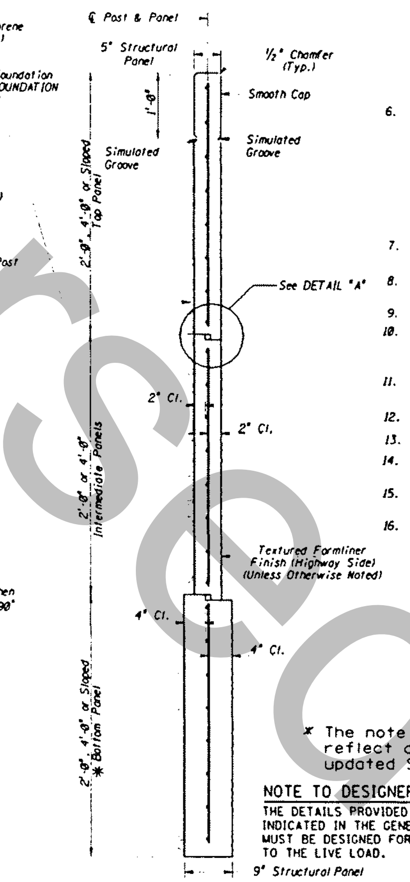
DETAIL "A"



TYPICAL PANEL SECTION PLAN



TYPICAL PANEL SECTION ELEVATION



* When the difference of ground elevation between highway side and residential side is less than 1'-6", use 5" thick bottom panel. If the difference is between 1'-6" and 3'-0", use 9" thick bottom panel.

SECTION: A-A

GENERAL NOTES

1. DESIGN SPECIFICATIONS
   1996 AASHTO Standard Specifications for Highway Bridges (with interims) as modified by Section 3A of NJDOT Design Manual for Bridges and Structures and 1989 AASHTO Guide Specifications for Structural Design of Sound Barriers (with Interims).
2. ✗ CONSTRUCTION SPECIFICATIONS
   The NJDOT Standard Specifications for Road and Bridge Construction with current Supplemental Specifications, as modified by the Special Provisions.
3. LIVE LOAD
   Wind pressure: 33 PSF corresponding to a wind velocity of 80 mph, as specified in Table 47.2 of Section 47 of NJDOT Design Manual for Bridges and Structures.
   Ice Load: 3 PSF
   Seismic Load for Seismic Performance Category (SPC) 'B', Maximum Value of 'A' (Acceleration Coefficient) = ______ , Soil Profile = ______ .
4. CONCRETE DESIGN STRESSES
   (a) Precast Members (Post and Panels):
   Specified Compressive Strength f'c = 5,000 PSI
   Extreme Fiber in Compression fc = 2,000 PSI
   (b) Cast-In-Place Members:
   Specified Compressive Strength f'c = 3,000 PSI
   Extreme Fiber in Compression fc = 1,200 PSI
5. REINFORCEMENT STEEL
   Deformed Bars (ASTM A615, Grade 60)
   Allowable Tensile Stress fs = 24,000 PSI
   Deformed Welded Wire Fabric may be used as an alternate. The Welded Wire designation and spacing shall meet the minimum area of steel as determined by design. Refer to Section 915.01 (F) of the 1996 NJDOT Standard Specifications for Road and Bridge Construction for guidance concerning corrosion protection of the welded wire fabric reinforcement.
6. CLASSES OF CONCRETE
   (a) Class of Concrete Used:
   Class P Concrete for Posts and Panels
   Class B Concrete for Foundations and Pedestals
   (b) Class Design Strengths (Mix Design Requirements)
   (In accordance with Section 914 of Specifications)
   Class P = 5,500 PSI
   Class B = 3,700 PSI
7. Position panels using recessed lifting inserts as shown. Recessed insert holes in top panels and in posts shall be sealed with non-shrink cement mortar tinted to match color of panels and posts.
8. All concrete posts and panels shall be tinted utilizing an integral color in accordance with the Special Provisions.
9. All panels and posts shall be installed to true vertical(i.e. Faces of panels shall be flush).
10. Horizontal panel joints on each side of the post shall line up within 1" tolerance, providing that the first matching panel joint from the ground shall have zero tolerance and the last matching joint shall have 1" tolerance.
11. All precast members shall be fabricated to plan dimensions within the tolerances specified in Section 522 of the NJDOT Standard Specifications for Road and Bridge Construction.
12. Excavated foundation pits shall be kept dry during placement of crushed stone and concrete.
13. Spread footing and caissons shall be designed by the Designer based on actual subsurface conditions.
14. Shop drawings shall show complete noise barrier plan and elevations, including all steps and details and dimensions necessary for fabrication and erection.
15. The Contractor shall verify locations of all existing utilities prior to construction in the vicinity of the proposed noise barrier.
16. The concrete posts and panels shall be precast or prestressed utilizing a formliner. The formliner shall be as indicated in the NJDOT Standard Specifications for Road and Bridge Construction as modified by the Special Provisions.

SUMMARY OF QUANTITIES

PAY ITEM NO.	STANDARD ITEM NO.	DESCRIPTION	UNIT	CONTRACT QUANTITY
		NOISE BARRIER, ROADWAY	S.F.	
		NOISE BARRIER, FOUNDATION	UNIT	
		TEMPORARY SHEETING	S.F.	

"Intergral Coloring Pigment" shall be included in the bid price for "Noise Barrier, Roadway".
"Sheeting Left in Place" shall be included in the bid price for "Noise Barrier, Foundation".
"Foundation Excavation" shall be included in the bid price for "Noise Barrier, Foundation".

✗ The note should be modified to reflect applicable year and updated Specifications.

NOTE TO DESIGNER
THE DETAILS PROVIDED ARE FOR THE LIVE LOAD INDICATED IN THE GENERAL NOTES. THE DETAILS MUST BE DESIGNED FOR ANY MODIFICATIONS TO THE LIVE LOAD.

STANDARD DRAWING PLATE 2.8-1

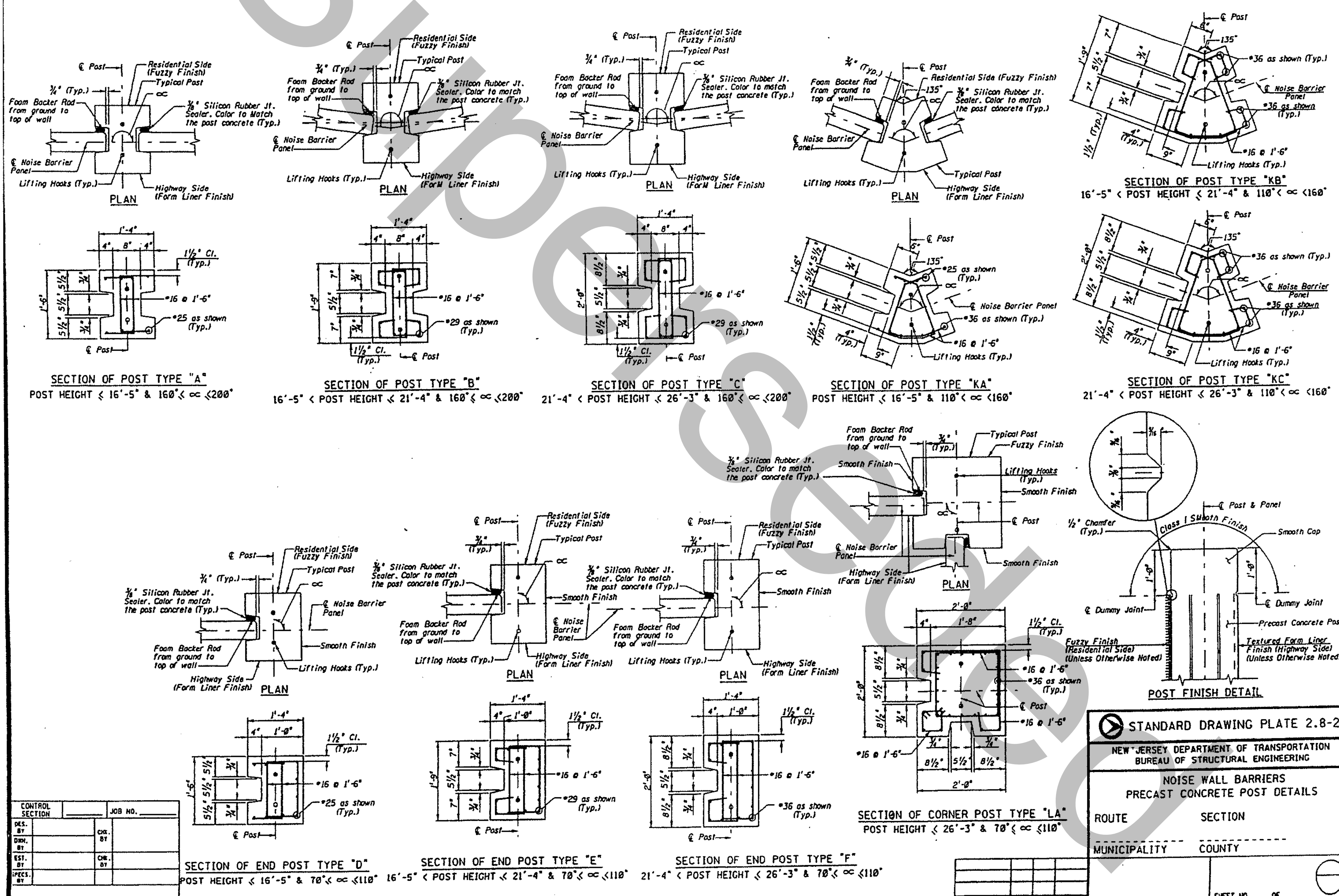
NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

NOISE WALL BARRIERS
PRECAST CONCRETE PANEL DETAILS

ROUTE SECTION

MUNICIPALITY COUNTY

SHEET NO. OF



STANDARD DRAWING PLATE 2.8-2

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

NOISE WALL BARRIERS
PRECAST CONCRETE POST DETAILS

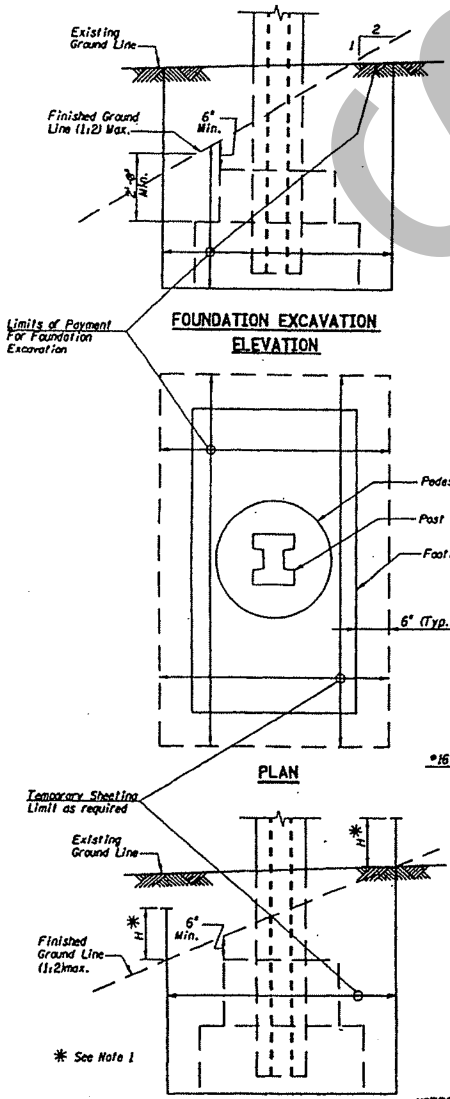
ROUTE ______ SECTION ______

MUNICIPALITY ______ COUNTY ______

SHEET NO. ____ OF ____

REVISION	BY	CKD	DATE

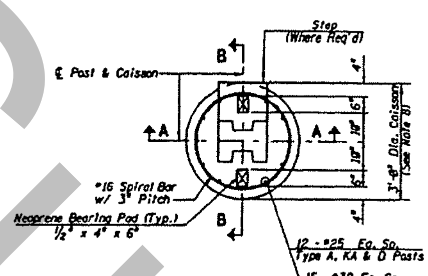
CONTROL SECTION		JOB NO.
DES. BY		CKD. BY
DWN. BY		
EST. BY		CHK. BY
SPECS. BY		



FOUNDATION EXCAVATION ELEVATION

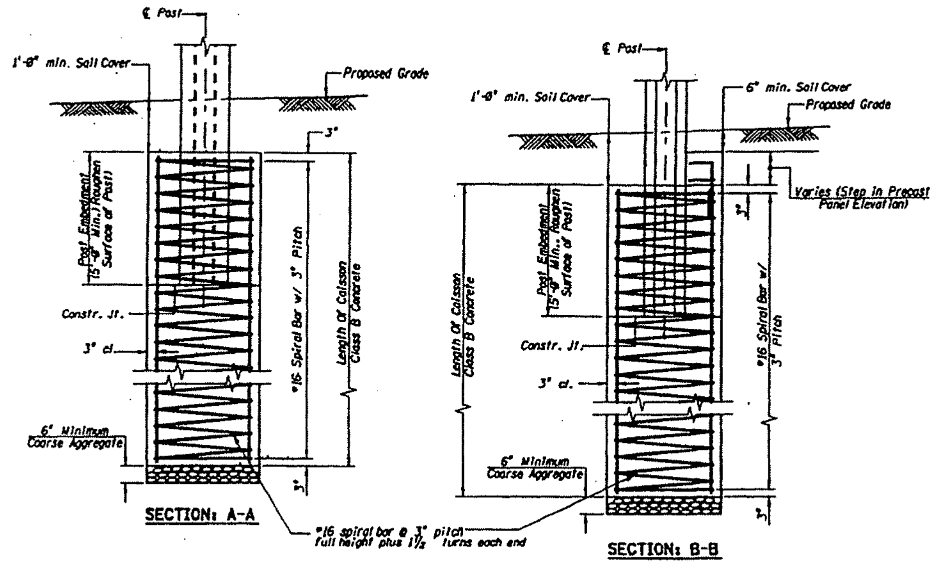
PLAN

TEMPORARY SHEETING ELEVATION



PLAN

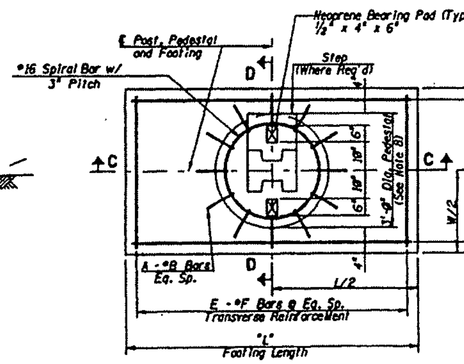
SPREAD FOOTING TABLE										
FOUND. TYPE	BAR SCHEDULE						DIMENSION SCHEDULE			
	NO. OF BARS "A"	BAR SIZE "B"	NO. OF BARS "C"	BAR SIZE "D"	NO. OF BARS "E"	BAR SIZE "F"	WIDTH "W"	LENGTH "L"	THICK. "T"	HEIGHT "H"
I										
II										
III										
IV										
V										
VI										
VII										
VIII										
IX										
X										



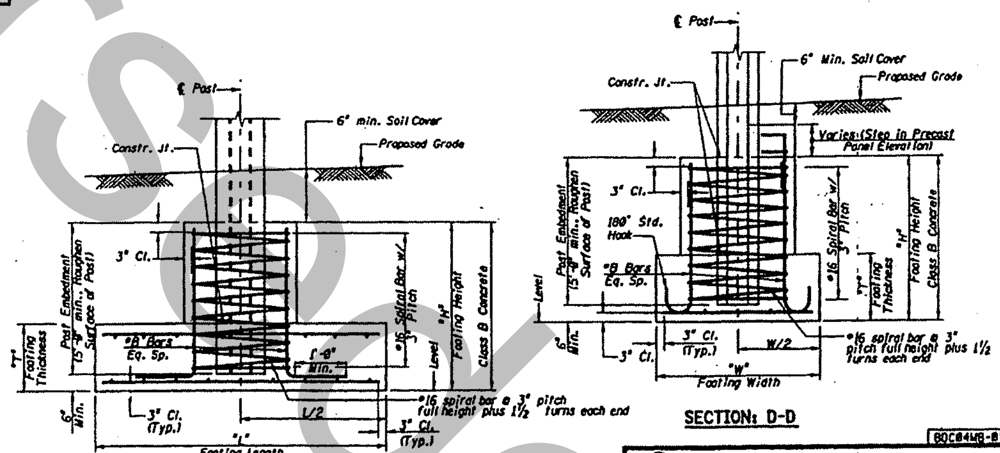
SECTION: A-A

SECTION: B-B

TYPICAL CAISSON DETAILS
(FOR MAXIMUM POST HEIGHT OF 26'-3")



PLAN



SECTION: C-C

SECTION: D-D

TYPICAL SPREAD FOOTING DETAILS
(FOR MAXIMUM POST HEIGHT OF 26'-3")

NOTES:

1. When temporary sheeting is required, H is 3'-0" when adjacent to pedestrian or vehicular traffic and 1'-0" minimum for all others.
2. If temporary sheeting is left in place, the upper portion shall be removed to 3'-0" minimum below finished ground.
2. Payment for temporary sheeting's upper limit shall be from the finished grade if grading is required and from the existing ground line if grading is not required and lower limit shall be bottom of excavation.
3. Caisson or spread footing is paid for under the item "NOISE BARRIER, FOUNDATION".
4. Coarse aggregate is paid for under the item, "NOISE BARRIER, FOUNDATION".
5. Size of the spread footing, reinforcement and depth of post embedment and length of caisson shall be designed by the designer on a project by project basis as determined the height of the wall and soil conditions.
6. "Foundation Excavation" is paid for under the item, "NOISE BARRIER, FOUNDATION".
7. "Sheeting Left In Place" is paid for under the item, "NOISE BARRIER, FOUNDATION".
8. Increase diameter to accomodate Type 'KC' and larger size posts.

CONTROL SECTION		JOB NO.	
DES. BY		CHK. BY	
DWN. BY			
EST. BY		CHK. BY	
SPECS. BY			
IN CHARGE OF			

REVISION	BY	CKD	DATE

BDC84MB-81

STANDARD DRAWING PLATE 2.8-3

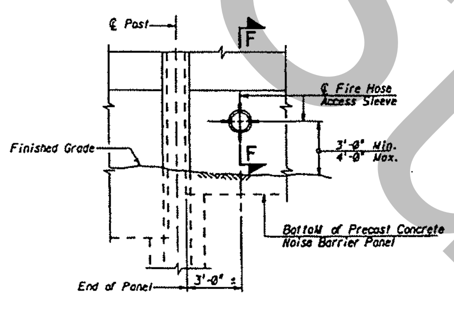
NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

NOISE WALL BARRIERS
FOUNDATION DETAILS

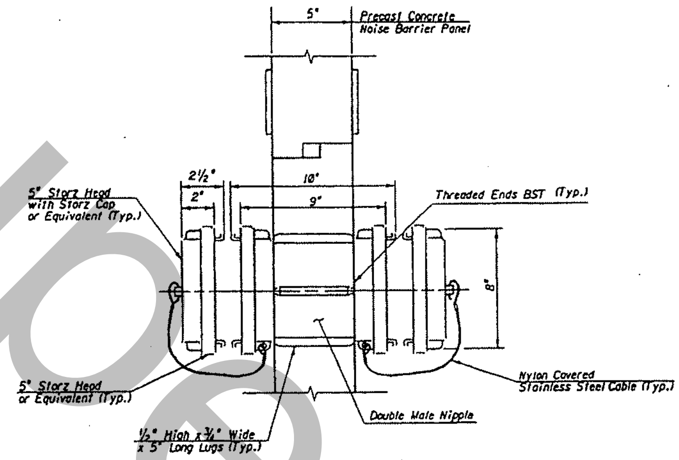
ROUTE SECTION

MUNICIPALITY COUNTY

SHEET NO. ___ OF ___



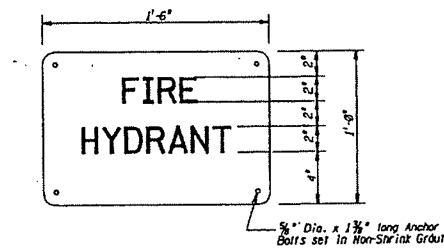
FIRE HOSE ACCESS SLEEVE ELEVATION



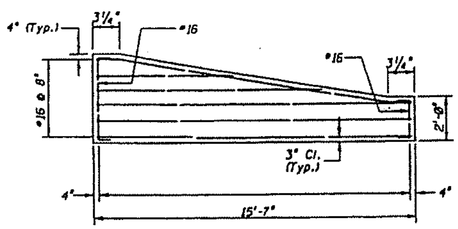
SECTION: F-F

NOTES:

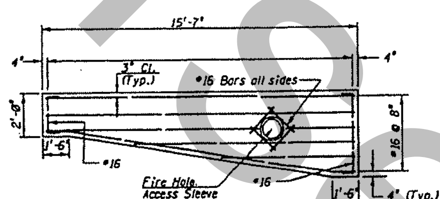
1. Fire Hose Access Sleeves must be free of burrs, and sharp corners and edges.
2. Fire Hose Access Sleeves shall be Aluminum Alloy and conform to A.S.T.M. Alloy 6061-T6. Finish shall be Hard Coat per MIL-H-8625.
3. Locations of Fire Hose Access Sleeves are indicated on Structural Plans. Cost shall be included in cost of Noise Barrier, Roadway.
4. The cost of Signs and their placement shall be included in the cost of " Noise Barrier, Roadway. "
5. Location could change at discretion of the Engineer.
6. Reinforcing bars in affected panels shall be positioned so as to provide a clear opening for fire hose access sleeves.



FIRE HYDRANT SIGN



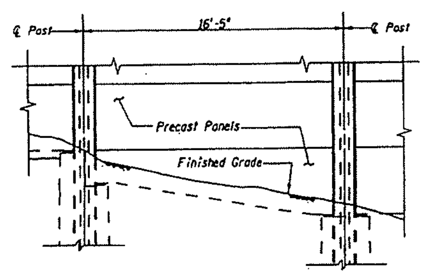
TYPICAL SLOPED PANEL ELEVATION
(TOP PANEL ONLY)



TYPICAL CLIPPED PANEL ELEVATION
(BOTTOM PANEL ONLY, 5" or 9" THICKNESS)

INSTALLATION OF SIGNS BY FIRE DEPARTMENTS ON THE INTERSTATE SYSTEM

1. The signs shall be installed as far from the travelled lanes as possible, still being visible to the firemen looking for them.
2. Signs should be affixed to existing chain link fencing.
3. Where fencing does not exist or where it is not visible from the travelled way, the signs shall be installed on standard sign supports as far from the travelled way as possible but so that they can be seen by the firemen.
4. The signs shall be installed parallel to traffic flow so that they will not be directly visible to the motoring public.
5. The standard signs shall be 1'-0" x 1'-6".
6. The signs shall have a white reflectorized background with red letters and/or figures.
7. The message on the sign may either be code numbers or letters or the symbol of a fire hydrant.



NOISE BARRIER - CLIPPED PANEL

Cost to be included in Item, "Noise Barrier, Roadway"

CONTROL SECTION		JOB NO.	
DES. BY		CHK. BY	
DRN. BY			
EST. BY		CHK. BY	
SPECS. BY			
IN CHARGE OF			

REVISION	BY	CKD	DATE

STANDARD DRAWING PLATE 2.8-4

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

NOISE WALL BARRIERS
PRECAST CONCRETE PANEL DETAILS

ROUTE SECTION

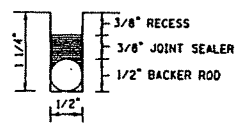
MUNICIPALITY COUNTY

SHEET NO. ___ OF ___

STATE	FEDERAL PROJECT NO.	SHEET	TOTAL SHEETS
N. J.			

STRUCTURE NO.

STRUCTURE NAME



1/2" JOINT DETAIL

INTEGRAL ABUTMENT CONSTRUCTION PROCEDURE

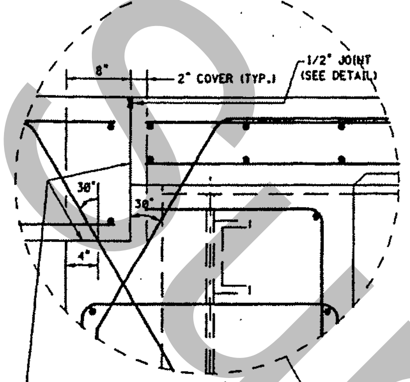
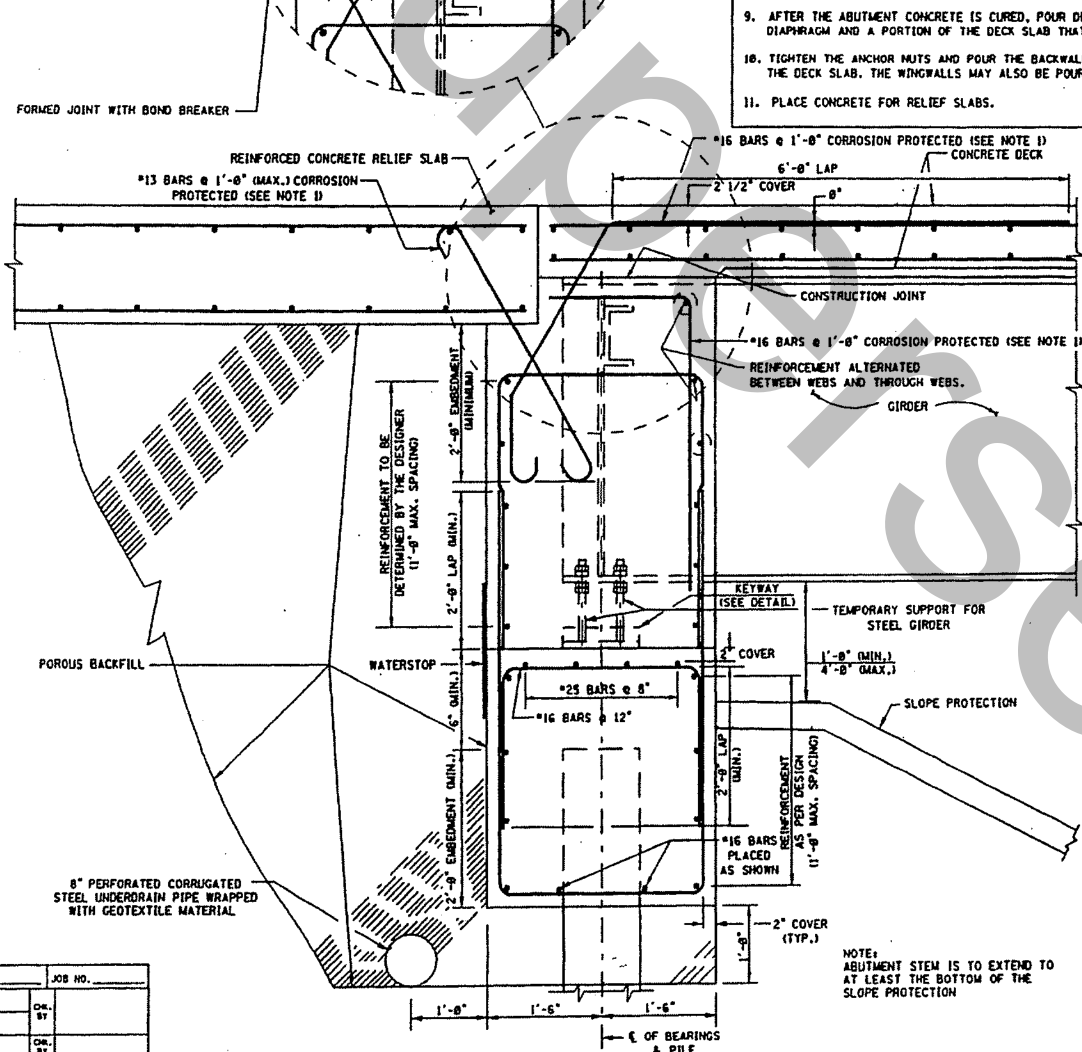
1. FOR BRIDGE LENGTHS OVER 100 FT. PRE-EXCAVATE HOLES TO A DEPTH OF 8 FT. BELOW THE STEM AT THE DIAMETER SPECIFIED IN THE FOUNDATION DESIGN REPORT.
2. DRIVE THE PILES AND CUT OFF PILES AT ELEVATIONS SHOWN.
3. BACKFILL HOLES WITH DESIGNATION I-8 SAND. IF CIP PILES ARE USED, FILL THE SHELL WITH CONCRETE.
4. PLACE THE ABUTMENT STEM CONCRETE TO REQUIRED BRIDGE SEAT ELEVATION.
5. BACKFILL ABUTMENT STEM TO 6" BELOW THE BRIDGE SEAT ELEVATION AFTER THE ABUTMENT STEM IS CURED.
6. ERECT GIRDERS AND INSTALL ALL DIAPHRAGMS.
7. PLACE ABUTMENT STEM CONCRETE TO TOP OF GIRDERS.
8. BACKFILL ABUTMENT BACKWALLS AFTER THE CONCRETE IS CURED.
9. AFTER THE ABUTMENT CONCRETE IS CURED, POUR DECK IN PROPER SEQUENCE EXCLUDING THE BACKWALL DIAPHRAGM AND A PORTION OF THE DECK SLAB THAT IS EQUAL TO THE BACKWALL DIAPHRAGM WIDTH.
10. TIGHTEN THE ANCHOR NUTS AND POUR THE BACKWALL/DIAPHRAGM FULL HEIGHT AND THE REMAINDER OF THE DECK SLAB. THE WINGWALLS MAY ALSO BE POURED CONCURRENTLY.
11. PLACE CONCRETE FOR RELIEF SLABS.

NOTE TO DESIGNER:

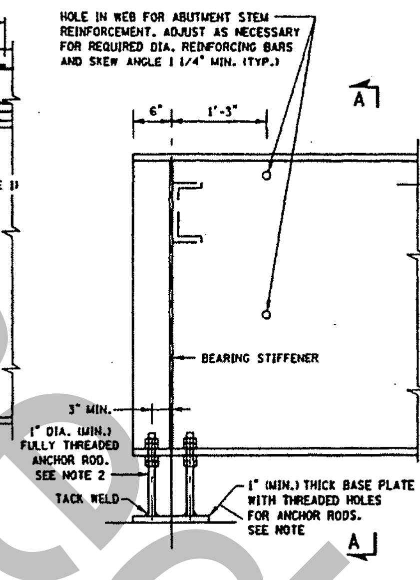
DETAILING INCLUDED WITHIN THIS DRAWING MAY BE UTILIZED IN PREPARING CONTRACT PLANS, HOWEVER, IN CONFORMANCE WITH THE PROVISIONS OF SECTION 15 OF THIS MANUAL, ALTERNATIVE DETAILING MAY BE PROVIDED.

NOTES:

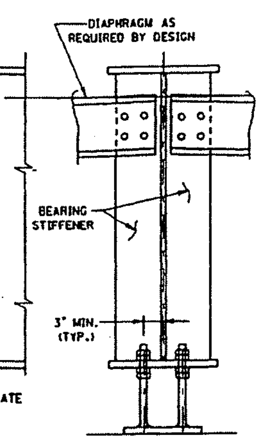
1. ALL REBARS IN THE ABUTMENT ARE TO BE CORROSION PROTECTED. (REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED)
2. THE ANCHOR RODS AND BASE PLATE TO BE DESIGNED TO SUPPORT THE DEAD LOAD OF THE GIRDERS, DIAPHRAGMS AND UTILITIES.

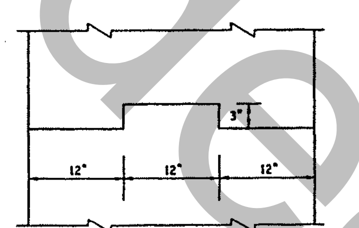
INTEGRAL ABUTMENT DETAIL
(STEEL GIRDER SUPERSTRUCTURE)



TYPICAL INTERIOR GIRDER ELEVATION



SECTION A-A



NOTE:
KEYWAY TO STOP 4" FROM SUPPORT PLATE OR CONSTRUCTION JOINT

KEYWAY DETAIL
STEEL SUPERSTRUCTURE

BDC04MB-01

STANDARD DRAWING PLATE 2.9-1

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

INTEGRAL ABUTMENTS FOR STEEL SUPERSTRUCTURE - 1 OF 2

ROUTE : SECTION :

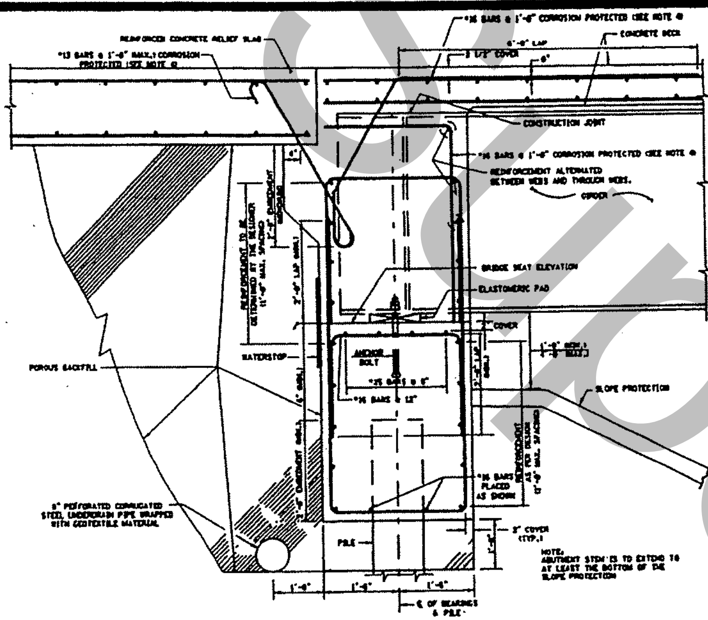
MUNICIPALITY COUNTY

SCALE : NONE

BRIDGE SHEET NO. OF

CONTROL SECTION		JOB NO.	
DES. BY		CHK. BY	
DWN. BY			
EST. BY		CHK. BY	
SPECS. BY			

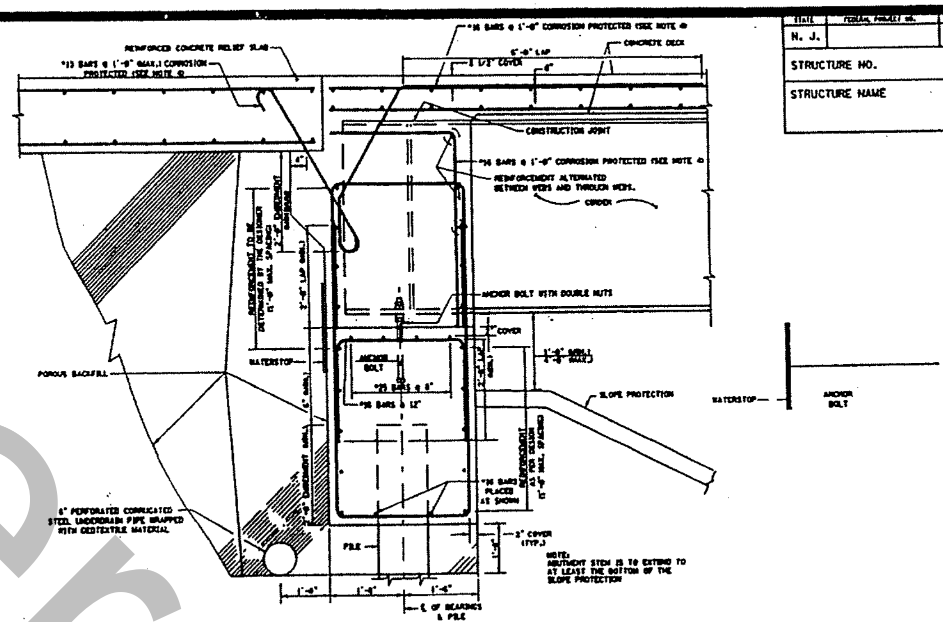
IN CHARGE OF



**INTEGRAL ABUTMENT DETAIL
STEEL GIRDER ANCHORED TO PILE CAP
AND RESTING ON ELASTOMERIC PAD**

INTEGRAL ABUTMENT CONSTRUCTION PROCEDURE

1. FOR BRIDGE LENGTHS OVER 100 FT. PRE-EXCAVATE HOLES TO A DEPTH OF 8 FT. BELOW THE STEM AT THE DIAMETER SPECIFIED IN THE FOUNDATION DESIGN REPORT.
2. DRIVE THE PILES AND CUT OFF PILES AT ELEVATIONS SHOWN.
3. BACKFILL HOLES WITH DESIGNATION I-8 SAND.
4. IF CIP PILES ARE USED, FILL THE SHELL WITH CONCRETE.
5. PLACE THE ABUTMENT STEM CONCRETE TO REQUIRED BRIDGE SEAT ELEVATION WITH ANCHOR BOLTS IN PLACE. POUR THE PILE CAPS FOR THE WING WALLS CONCURRENTLY.
6. SET THE ELASTOMERIC PAD ON THE ABUTMENT WITH THE ANCHOR BOLTS PASSING THROUGH THEM. SET THE BEAMS AND ANCHOR THEM TO THE ABUTMENT USING SLOTTED HOLES IN THE BOTTOM FLANGE. DO NOT FULLY TIGHTEN THE ANCHOR NUTS AT THIS TIME.
8. POUR THE BRIDGE DECK EXCLUDING THE ABUTMENT BACKWALL/DIAPHRAGM AND THE LAST PORTION OF THE BRIDGE DECK EQUAL TO THE BACKWALL/DIAPHRAGM WIDTH.
9. TIGHTEN THE ANCHOR NUTS AND POUR THE ABUTMENT BACKWALL/DIAPHRAGM FULL HEIGHT AND THE REMAINDER OF THE DECK SLAB. THE WING WALLS MAY ALSO BE POURED CONCURRENTLY.
10. PLACE THE DRAIN SYSTEM AND BACKFILL IN 6" LIFTS UNTILL THE DESIRED SUBGRADE ELEVATION IS REACHED.
11. POUR THE RELEIF SLAB STARTING AT THE END AWAY FROM THE ABUTMENT AND PROGRESSING TOWARD THE BACKWALL.



**INTEGRAL ABUTMENT DETAIL
STEEL GIRDER ANCHORED TO PILE CAP
AND RESTING ON NUTS**

INTEGRAL ABUTMENT CONSTRUCTION PROCEDURE

1. FOR BRIDGE LENGTHS OVER 100 FT. PRE-EXCAVATE HOLES TO A DEPTH OF 8 FT. BELOW THE STEM AT THE DIAMETER SPECIFIED IN THE FOUNDATION DESIGN REPORT.
2. DRIVE THE PILES AND CUT OFF PILES AT ELEVATIONS SHOWN.
3. BACKFILL HOLES WITH DESIGNATION I-8 SAND.
4. IF CIP PILES ARE USED, FILL THE SHELL WITH CONCRETE.
5. PLACE THE ABUTMENT STEM CONCRETE TO REQUIRED BRIDGE SEAT ELEVATION WITH ANCHOR BOLTS IN PLACE. POUR THE PILE CAPS FOR THE WING WALLS CONCURRENTLY.
6. SET THE BEAMS ON NUTS AT THE DESIRED LEVELS AND ANCHOR THEM TO THE ABUTMENT USING SLOTTED HOLES IN THE BOTTOM FLANGE. DO NOT FULLY TIGHTEN THE ANCHOR NUTS AT THIS TIME.
8. POUR THE BRIDGE DECK EXCLUDING THE ABUTMENT BACKWALL/DIAPHRAGM AND THE LAST PORTION OF THE BRIDGE DECK EQUAL TO THE BACKWALL/DIAPHRAGM WIDTH.
9. TIGHTEN THE ANCHOR NUTS AND POUR THE ABUTMENT BACKWALL/DIAPHRAGM FULL HEIGHT AND THE REMAINDER OF THE DECK SLAB. THE WING WALLS MAY ALSO BE POURED CONCURRENTLY.
10. PLACE THE DRAIN SYSTEM AND BACKFILL IN 6" LIFTS UNTILL THE DESIRED SUBGRADE ELEVATION IS REACHED.
11. POUR THE RELEIF SLAB STARTING AT THE END AWAY FROM THE ABUTMENT AND PROGRESSING TOWARD THE BACKWALL.

GENERAL NOTES

1. DIAMETER OF AUGERED HOLE SHALL BE TWICE THE SIZE OF THE PILE.
2. CUSHION SAND SHALL BE DESIGNATION I-8 SAND ACCORDING TO SUBSECTION 901.09 OF THE STANDARD SPECIFICATIONS.
3. COST OF PREBORING, USE OF CASING IF REQUIRED TO SHORE UP HOLES AND PROVISION OF CUSHION SAND SHALL BE INCLUDED IN THE UNIT PRICE OF THE PILE ITEM.
4. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED)

NOTE TO DESIGNER:

DETAILING INCLUDED WITHIN THIS DRAWING MAY BE UTILIZED IN PREPARING CONTRACT PLANS. HOWEVER, IN CONFORMANCE WITH THE PROVISIONS OF SECTION 15 OF THIS MANUAL, ALTERNATIVE DETAILING MAY BE PROVIDED.

STATE	N. J.
STRUCTURE NO.	
STRUCTURE NAME	

CONTROL SECTION		JOB NO.	
DES. BY		CHK. BY	
DWN. BY			
EST. BY		CHK. BY	
SPECS. BY			
IN CHARGE OF			

BDC04MB-01

STANDARD DRAWING PLATE 2.9-2

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

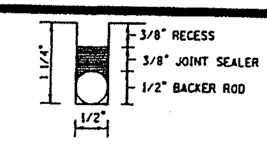
**INTEGRAL ABUTMENTS FOR
STEEL SUPERSTRUCTURE - 2 OF 2**

ROUTE : SECTION :

MUNICIPALITY COUNTY

SCALE : NONE

BRIDGE SHEET NO. OF



1/2" JOINT DETAIL

INTEGRAL ABUTMENT CONSTRUCTION PROCEDURE

1. FOR BRIDGE LENGTHS OVER 100 FT. PRE-EXCAVATE HOLES TO A DEPTH OF 8 FT. BELOW THE STEM AT THE DIAMETER SPECIFIED IN THE FOUNDATION DESIGN REPORT.
2. DRIVE THE PILES AND AND CUT OFF PILES AT ELEVATIONS SHOWN.
3. BACKFILL HOLES WITH DESIGNATION I-8 SAND.
4. IF CIP PILES ARE USED, FILL THE SHELL WITH CONCRETE. PLACE THE ABUTMENT STEM CONCRETE TO REQUIRED BRIDGE SEAT ELEVATION.
5. ERECT PRESTRESSED GIRDERS ON BEARING PADS AND SOLE PLATE AS REQUIRED.
6. PLACE AND GROUT ANCHOR DOWELS.
7. BACKFILL BOTH ABUTMENT STEMS TO 6" BELOW THE BRIDGE SEAT ELEVATION AFTER THE ABUTMENT STEM IS CURED. BACKFILL SHALL BE CONDUCTED SUCH THAT THE MAXIMUM DIFFERENCE IN FILL HEIGHT BETWEEN THE TWO STEMS AS MEASURED FROM THE BOTTOM OF THE STEM DOES NOT EXCEED 2'-0".
8. PLACE CONCRETE ABOVE BRIDGE SEAT ELEVATION FOR ABUTMENT BACKWALL AND DECK SLAB, TO FACILITATE COMPLETE CONSOLIDATION OF CONCRETE BETWEEN THE TOP OF THE BRIDGE SEAT AND THE BOTTOM OF THE BEAM. VENT HOLES SHALL BE PROVIDED FOR THE INSERTION OF A 1" DIAMETER VIBRATOR IN THE FRONT FORM FROM UNDER EACH BEAM.
8. AFTER THE ABUTMENT CONCRETE IS CURED, POUR DECK IN PROPER SEQUENCE EXCLUDING THE BACKWALL DIAPHRAGM AND A PORTION OF THE DECK SLAB THAT IS EQUAL TO THE BACKWALL DIAPHRAGM WIDTH.
9. TIGHTEN THE ANCHOR NUTS AND POUR THE BACKWALL/DIAPHRAGM FULL HEIGHT. THE WINGWALLS MAY ALSO BE POURED CONCURRENTLY.
10. PLACE CONCRETE FOR RELIEF SLABS.

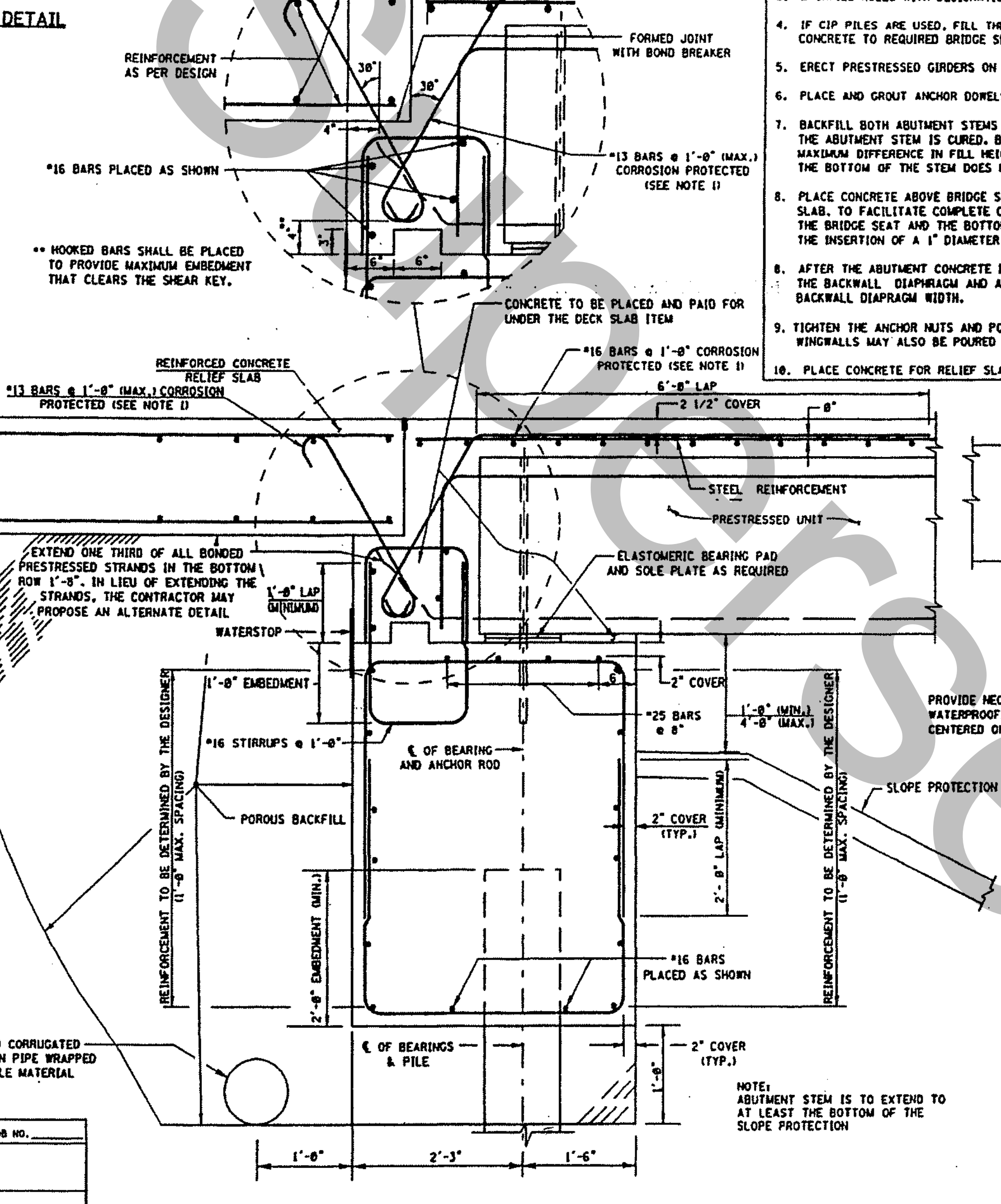
STATE	FEDERAL PROJECT NO.	SHEET
N. J.		
STRUCTURE NO.		
STRUCTURE NAME		

NOTE TO DESIGNER:

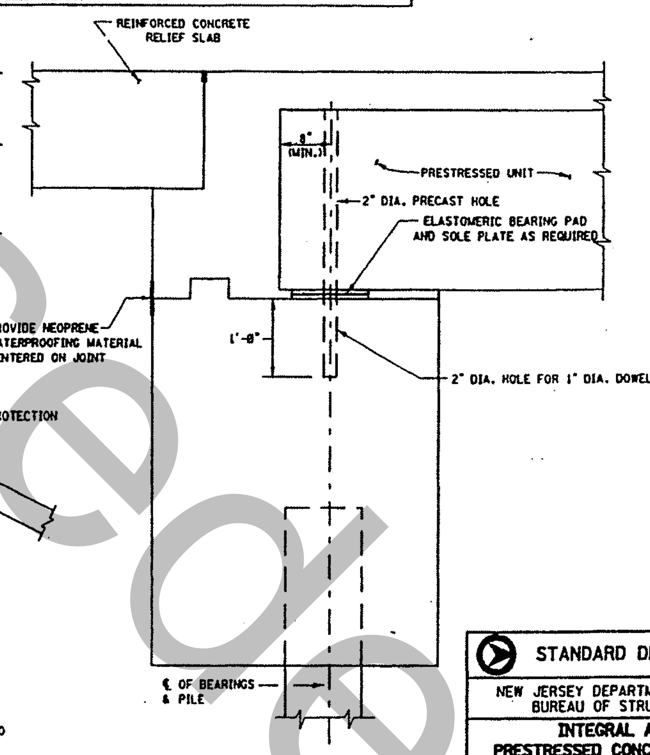
DETAILING INCLUDED WITHIN THIS DRAWING MAY BE UTILIZED IN PREPARING CONTRACT PLANS. HOWEVER, IN CONFORMANCE WITH THE PROVISIONS OF SECTION 15 OF THIS MANUAL, ALTERNATIVE DETAILING MAY BE PROVIDED.

NOTES:

1. ALL REBARS IN THE ABUTMENT ARE TO BE CORROSION PROTECTED. (REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED)
2. THE ANCHOR RODS AND BASE PLATE TO BE DESIGNED TO SUPPORT THE DEAD LOAD OF THE GIRDERS, DIAPHRAGMS AND UTILITIES.



INTEGRAL ABUTMENT DETAIL
(PRESTRESSED CONCRETE GIRDER SUPERSTRUCTURE)



TYPICAL INTERIOR GIRDER ELEVATION

CONTROL SECTION		JOB NO.	
DES. BY		CK. BY	
DWN. BY			
EST. BY		CK. BY	
SPECS. BY			
IN CHARGE OF			

BDC04MB-01

STANDARD DRAWING PLATE 2.9-3

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

INTEGRAL ABUTMENTS FOR PRESTRESSED CONCRETE SUPERSTRUCTURE

ROUTE : SECTION :

MUNICIPALITY COUNTY

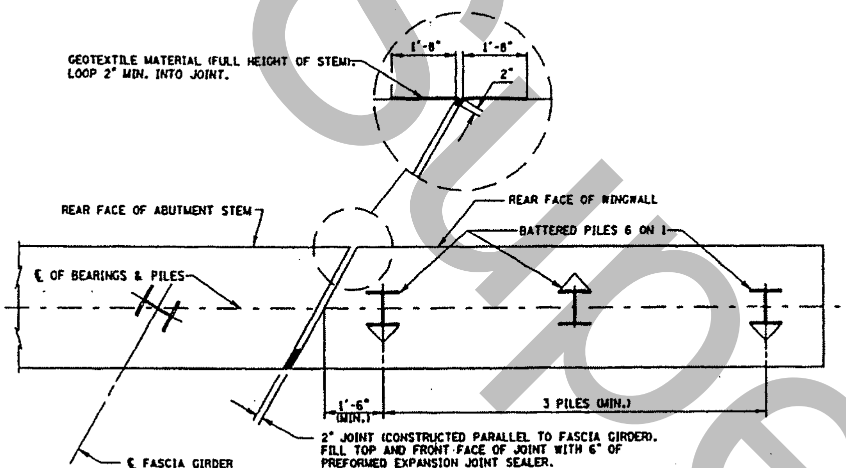
SCALE : NONE

BRIDGE SHEET NO. OF

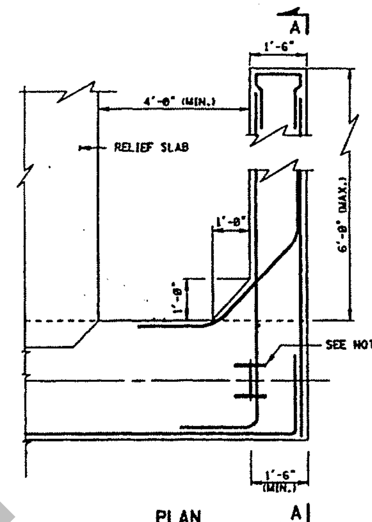
STATE	FEDERAL PROJECT NO.	SHEET	TOTAL SHEETS
N. J.			

STRUCTURE NO.

STRUCTURE NAME



PLAN
TYPICAL LAYOUT FOR SEPARATED WINGWALLS



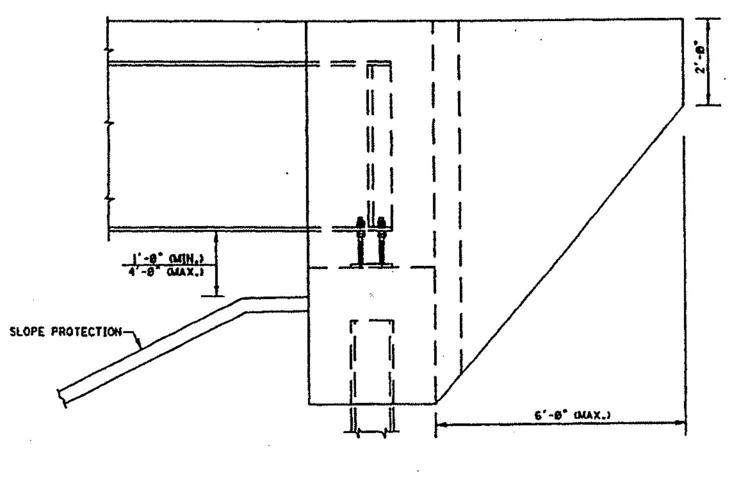
PLAN
U WALLS

NOTE TO DESIGNER:

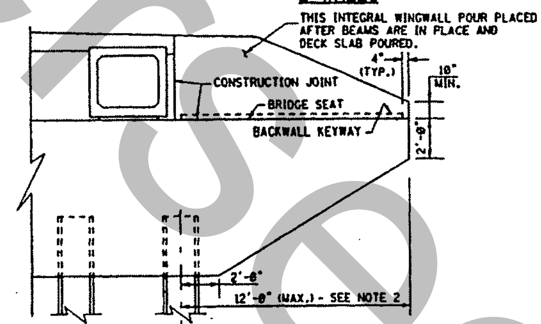
DETAILING INCLUDED WITHIN THIS DRAWING MAY BE UTILIZED IN PREPARING CONTRACT PLANS. HOWEVER, IN CONFORMANCE WITH THE PROVISIONS OF SECTION 15 OF THIS MANUAL, ALTERNATIVE DETAILING MAY BE PROVIDED.

NOTES:

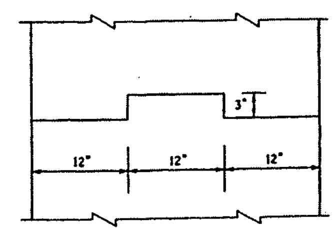
1. FOR ABUTMENTS WITH INTEGRAL U-WINGWALLS, THE CORNER PILE SHOULD BE ORIENTED WITH THE STRONG AXIS PERPENDICULAR TO THE INTEGRAL U-WINGWALLS.
2. THE 12'-0" MAXIMUM DIMENSION FOR THE PROJECTION OF INTEGRAL WINGWALLS IS MEASURED TO EITHER THE CENTERLINE OF THE FASCIA GIRDER FOR STEEL GIRDERS, OR THE EDGE OF THE FASCIA BEAM FOR PRESTRESSED BOX BEAM.
3. WHEN SEPARATED WINGWALLS ARE NECESSARY, A SINGLE LINE OF PILES, AS SHOWN IS PREFERABLE. IT IS ALSO ACCEPTABLE TO USE A CONVENTIONAL CANTILEVER WALL WITH A PILE FOOTING.



SECTION A-A

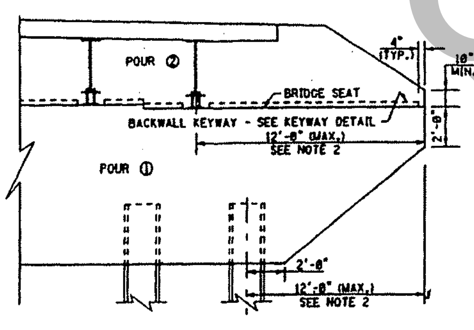


INTEGRAL WINGWALL ELEVATION
PRESTRESSED CONCRETE SUPERSTRUCTURE



NOTE:
KEYWAY TO STOP 4" FROM SUPPORT PLATE OR CONSTRUCTION JOINT

KEYWAY DETAIL FOR STEEL SUPERSTRUCTURE



INTEGRAL WINGWALL DETAIL FOR STEEL SUPERSTRUCTURE

CONTROL SECTION		JOB NO.	
DES. BY		CHK. BY	
DWN. BY			
EST. BY		CHK. BY	
SPECS. BY			
IN CHARGE OF			

BDC04MB-01

STANDARD DRAWING PLATE 2.9-4

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

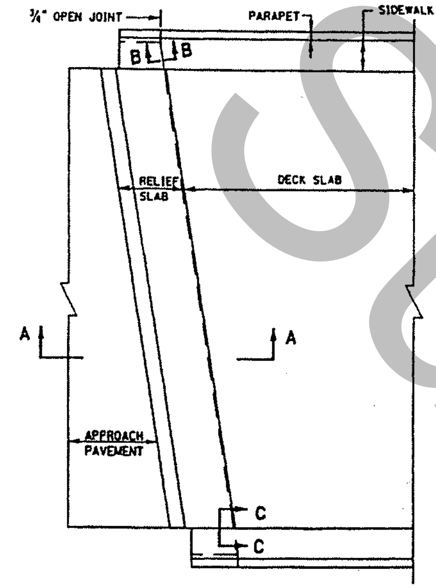
WINGWLL DETAILS FOR INTEGRAL ABUTMENTS

ROUTE : SECTION :

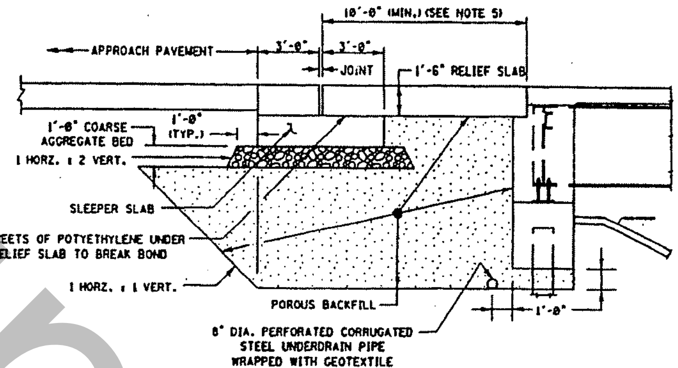
MUNICIPALITY COUNTY

SCALE : NONE

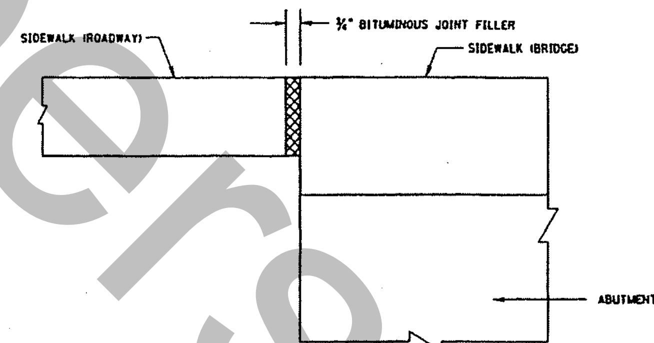
BRIDGE SHEET NO. OF



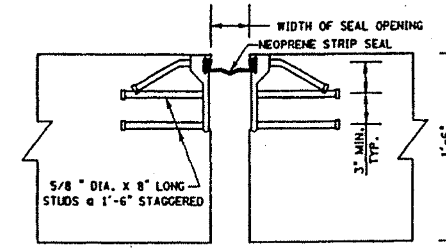
PLAN



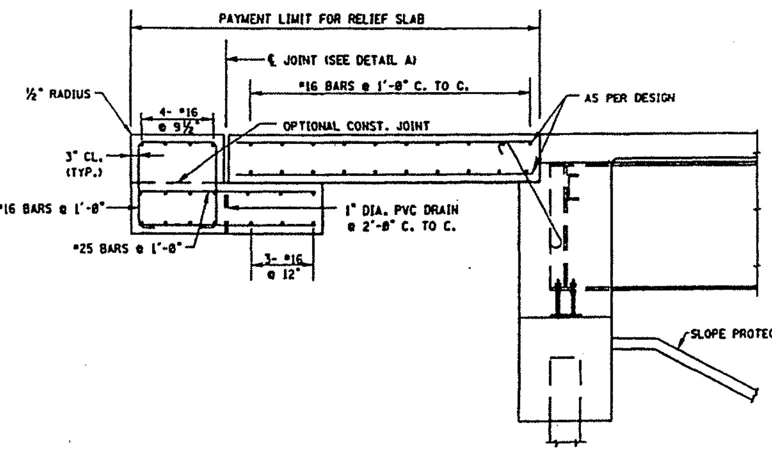
SECTION A-A



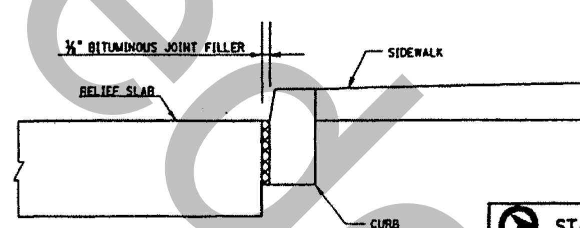
SECTION B-B



DETAIL A



SLEEPER SLAB DETAILS



SECTION C-C

STATE	FEDERAL PROJECT NO.	SHEET	TOTAL SHEETS
N. J.			

STRUCTURE NO.

STRUCTURE NAME

NOTE TO DESIGNER:

DETAILING INCLUDED WITHIN THIS DRAWING MAY BE UTILIZED IN PREPARING CONTRACT PLANS. HOWEVER, IN CONFORMANCE WITH THE PROVISIONS OF SECTION 15 OF THIS MANUAL, ALTERNATIVE DETAILING MAY BE PROVIDED.

RELIEF AND SLEEPER SLAB NOTES

(1) ALL REINFORCING BARS SHALL BE 2 1/2" CLEAR FROM CONCRETE SURFACE. EXCEPT AS NOTED.

(2) REINFORCING STEEL SHALL BE ASTM A615 (GRADE 60) AND CORROSION PROTECTED. (REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED)

(3) ANY EPOXY COATED BARS THAT ARE CUT TO FIT AND EXTERIOR BARS THAT ARE WELDED WHEN ATTACHING THE RAIL ANCHORAGE ASSEMBLIES SHALL BE TOUCHED UP WITH AN APPROVED EPOXY COATING MATERIAL.

(4) CONCRETE FOR RELIEF AND SLEEPER SLABS SHALL BE PAID UNDER THE ITEM " CONCRETE IN SUPERSTRUCTURE, DECK SLABS ".

(5) REFER TO SUBSECTION 1.15.2.A FOR GUIDANCE ON REQUIRED LENGTH OF RELIEF SLAB.

(6) REFER TO SUBSECTION 1.15.2.B FOR EXPANSION PROVISIONS MEASURES.

BDC04MB-01

STANDARD DRAWING PLATE 2.9-5

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

RELIEF SLAB AND JOINT DETAILS FOR INTEGRAL ABUTMENTS

ROUTE : SECTION :

MUNICIPALITY COUNTY

SCALE : NONE

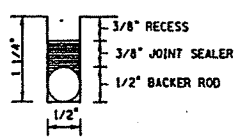
BRIDGE SHEET NO. OF

CONTROL SECTION ______ JOB NO. ______
DES. BY | CHK. BY
DWN. BY |
EST. BY | CHK. BY
SPECS. BY |
IN CHARGE OF ______

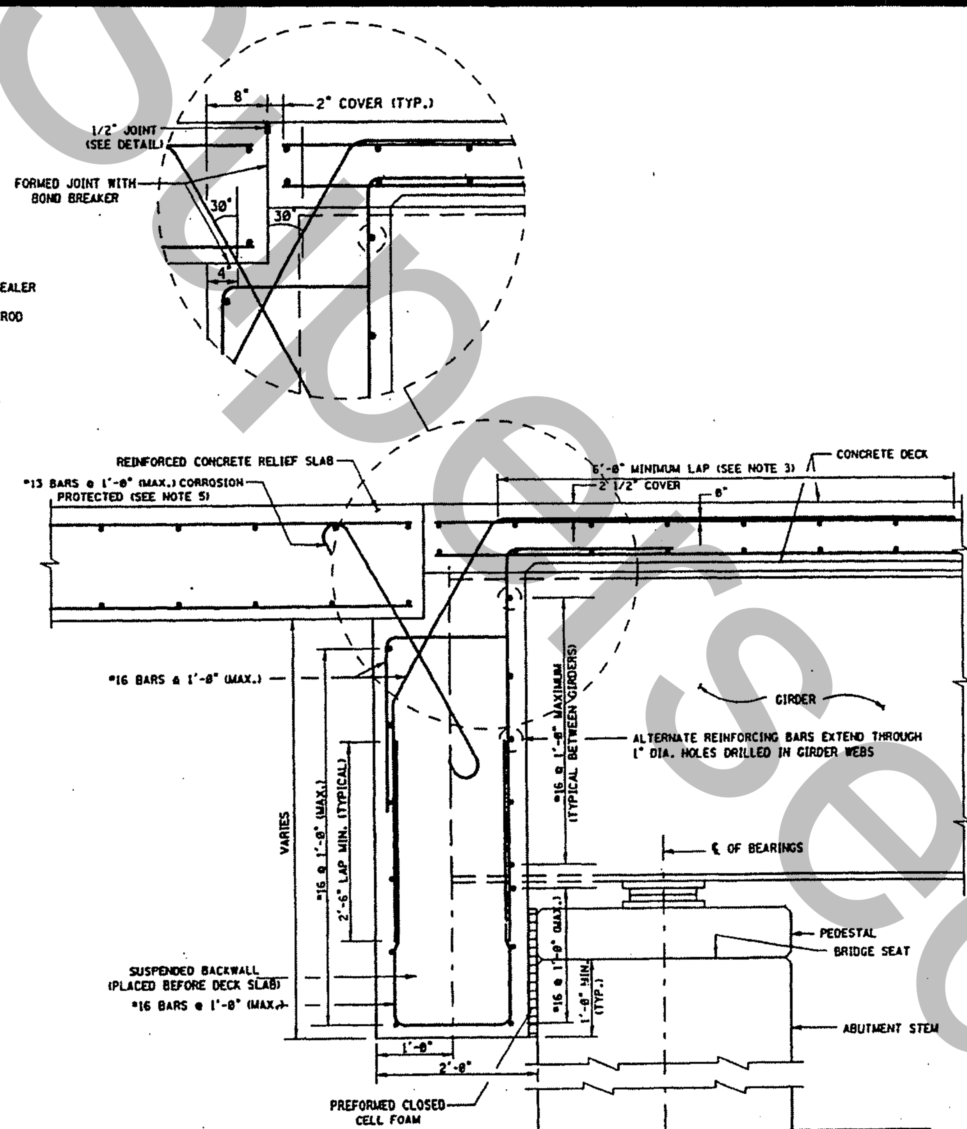
STATE	FEDERAL PROJECT NO.	SHEET	TOTAL SHEETS
N. J.			

STRUCTURE NO.

STRUCTURE NAME



1/2" JOINT DETAIL



SEMI-INTEGRAL ABUTMENT DETAIL
(SECTION AT ABUTMENT)

NOTE TO DESIGNER:

DETAILING INCLUDED WITHIN THIS DRAWING MAY BE UTILIZED IN PREPARING CONTRACT PLANS. HOWEVER, IN CONFORMANCE WITH THE PROVISIONS OF SECTION 15 OF THIS MANUAL, ALTERNATIVE DETAILING MAY BE PROVIDED.

NOTES TO DESIGNER

1. THE GAP BETWEEN THE ABUTMENT STEM AND BACKWALL SHALL BE SET AT 2" PLUS THE EXPECTED MOVEMENT FOR STEEL STRUCTURES FOR TEMPERATURE EFFECTS
2. BEARING STIFFENERS AND DIAPHRAGMS ARE REQUIRED AT THE ℄ OF BEARINGS.
3. TOP DECK REINFORCEMENT SHOULD BE DESIGNED FOR NEGATIVE MOMENT DEVELOPED FROM BACKWALL AND RELIEF SLAB.
4. EXCAVATION AND EMBANKMENT DETAILS FOR SEMI-INTEGRAL ABUTMENTS ARE GENERALLY THE SAME AS FOR CONVENTIONAL ABUTMENTS.
5. ALL REINFORCING BARS IN DECK SLAB, RELIEF SLAB AND SUSPENDED BACKWALL SHALL BE CORROSION PROTECTED. (REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED)

CONTROL SECTION		JOB NO.	
DES. BY		CHK. BY	
DWN. BY			
EST. BY		CHK. BY	
SPECS. BY			
IN CHARGE OF			

BDC04MB-01

STANDARD DRAWING PLATE 2.9-6

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

SEMI-INTEGRAL ABUTMENT DETAILS

ROUTE : SECTION :

MUNICIPALITY COUNTY

SCALE : NONE

BRIDGE SHEET NO. OF

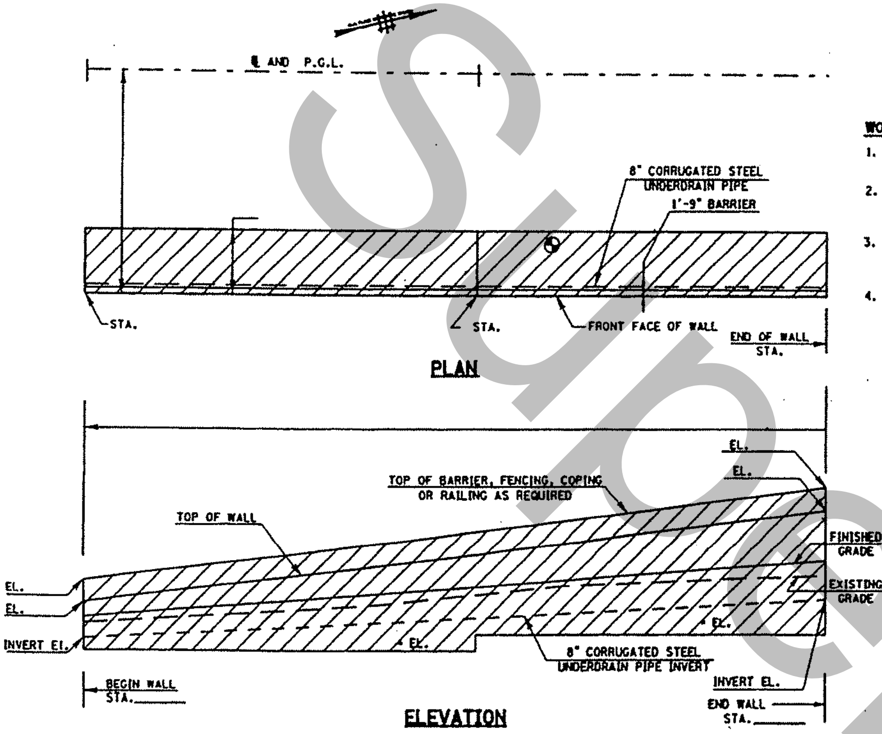
STATE	FEDERAL PROJECT NO.	SHEET	TOTAL SHEETS
N. J.			

STRUCTURE NO.

STRUCTURE NAME

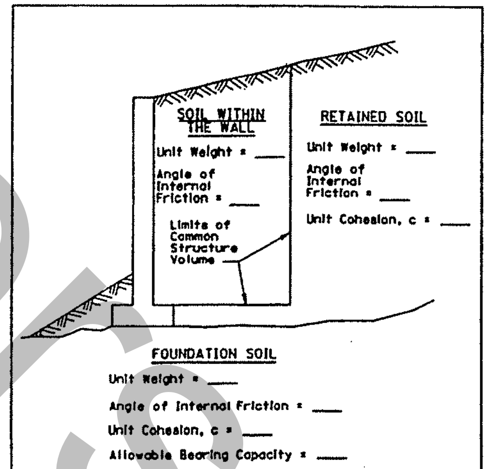
NOTE TO DESIGNER:

THIS SHEET IS NOT TO BE PLACED INTO THE CONTRACT SET OF PLANS AS IS. HOWEVER, INDIVIDUAL DETAILS SHALL BE UTILIZED IN PROVIDING PROJECT SPECIFIC REQUIREMENTS.



WORKING ITEMS:

1. WORK ITEMS WILL BE GOVERNED BY THE APPROPRIATE SECTIONS OF THE SPECIFICATIONS.
2. ALL ITEMS OF WORK TO COMPLETE THE COMMON STRUCTURE VOLUME SHALL BE FULLY DETAILED ON THE SHOP DRAWINGS AND SHALL BE CONSISTENT WITH THE DETAILS SHOWN ON THESE PLANS AND SPECIFICATIONS.
3. TEMPORARY SHEETING DESIGN AND INSTALLATION, IF REQUIRED, SHALL BE INCLUDED AS A SEPARATE ITEM AND ON A SEPARATE WORKING DRAWING FROM THE RETAINING WALL.
4. ROADWAY EXCAVATION IS NOT INCLUDED AS A WORK ITEM AND IS PAID FOR SEPARATELY.



GENERAL NOTES:

1. DESIGN SPECIFICATIONS
   (A) 1996 (16TH EDITION) AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES (WITH CURRENT INTERIMS) AS MODIFIED BY SECTION 3A OF NJDOT DESIGN MANUAL FOR BRIDGES AND STRUCTURES.
   (B) SEISMIC PERFORMANCE CATEGORY (SPC) = B.
   ACCELERATION COEFICIENT "A" = ___________
   SOIL PROFILE = ___________
*2. CONSTRUCTION SPECIFICATIONS
   THE NJDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION WITH CURRENT SUPPLEMENTAL SPECIFICATIONS, AS MODIFIED BY THE SPECIAL PROVISIONS.
3. LIVE LOADINGS
   LIVE LOAD SURCHARGE EQUAL TO 2'-0" OF EARTH PRESSURE.
4. CONCRETE DESIGN STRESSES
   (A) SPECIFIED DESIGN COMPRESSIVE STRENGTHS (f'c)
   CLASS A CONCRETE (PARAPETS) ----------------------4,000 PSI
   CLASS B CONCRETE (FOOTINGS, LEVELING PADS) -----3,000 PSI
   CLASS P CONCRETE (PRECAST UNITS)----------------5,000 PSI
   (B) CLASS DESIGN STRENGTHS
   CLASS A CONCRETE (PARAPETS) ----------------------4,600 PSI
   CLASS B CONCRETE (FOOTINGS, LEVELING PADS) -----3,700 PSI
   CLASS P CONCRETE (PRECAST UNITS)----------------5,500 PSI
   (C) ALLOWABLE STRENGTHS, EXTREME FIBER IN COMPRESSION (fc)
   CLASS A CONCRETE (PARAPETS) ----------------------1,600 PSI
   CLASS B CONCRETE (FOOTINGS, LEVELING PADS) -----1,200 PSI
   CLASS P CONCRETE (PRECAST UNITS)----------------2,000 PSI
5. REINFORCEMENT STEEL
   ASTM A615 (GRADE 60) (Fs) = 24,000 PSI
6. BORINGS
   INDICATES LOCATION OF BORINGS
   LOG NO.
7. PREAPPROVED ALTERNATES:
   AT THIS LOCATION, ALTERNATE WALL TYPES ARE PERMITTED.
   LISTED BELOW ARE THE WALL TYPES THAT MAY BE USED
   PREFABRICATED MODULAR WALLS
   MECHANICALLY STABILIZED EARTH WALL
   ALTERNATE RETAINING WALL
8. WALLS SHALL BE DESIGNED USING THE FOLLOWING PARAMETERS :
   SLIDING FACTOR OF SAFETY 1.5
   OVERTURNING FACTOR OF SAFETY 2.0

* The note should be modified to reflect applicable year and updated Specifications.

WORK ITEMS - WALL 1

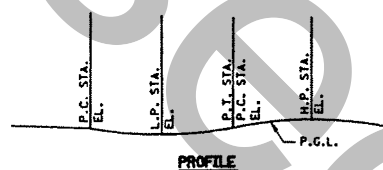
FOR INFORMATION ONLY (Price to be included in Wall Items)

DESCRIPTION	UNIT	APPROXIMATE QUANTITY		
		**	**	**
FOUNDATION EXCAVATION	C.Y.			
CONCRETE LEVELING PAD	L.F.			
CONCRETE IN STRUCTURES, FOOTINGS	C.Y.			
CONCRETE IN SUPERSTRUCTURES, PARAPET (BARRIER CURB)	L.F.			
POROUS FILL I-9	C.Y.			
8" CORRUGATED STEEL UNDERDRAIN PIPE	L.F.			
SPECIFIED BACKFILL	C.Y.			
PRECAST WALL ELEMENT	S.F.	***	***	***
BORROW EXCAVATION, ZONE-3	C.Y.			
(1)				
(1)				

(1) ADD ITEMS AS REQUIRED

** INSERT THE NAMES OF ALL FEASIBLE WALL TYPES

*** THE LIMIT OF THIS QUANTITY EXTENDS FROM TOP OF THE LEVELING PAD TO THE BOTTOM OF THE CONCRETE BARRIER



CURVE DATA

CURVE NO. 1			
	P.C.	P.I.	P.T.
STATION			
BEARING			
COORDINATES			

ESTIMATE OF QUANTITIES - WALL 1

PAY ITEM NO.	STANDARD ITEM NO.	DESCRIPTION	UNIT	CONTRACT QUANTITY
		RETAINING WALL, LOCATION NO.	S.F.	
		NO ITEM		
		NO ITEM		
		NO ITEM		

LEGEND

FOUNDATION EXCAVATION PAY LIMITS

• BOTTOM OF FOOTING ELEVATION

CONTROL SECTION		JOB NO.	
DES. BY		CHK. BY	
DWN. BY			
EST. BY		CHK. BY	
SPECS. BY			
IN CHARGE OF			

BDC04MB-01

STANDARD DRAWING PLATE 2.10-1

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

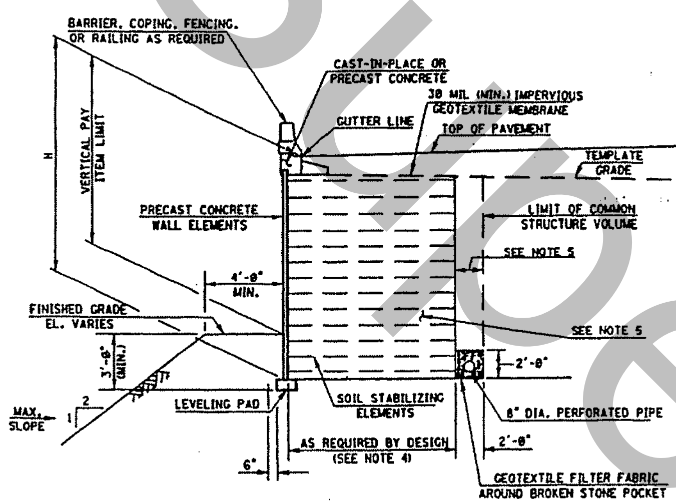
WALL 1
SAMPLE CONTROL PLAN (SHEET 1)

ROUTE : SECTION :

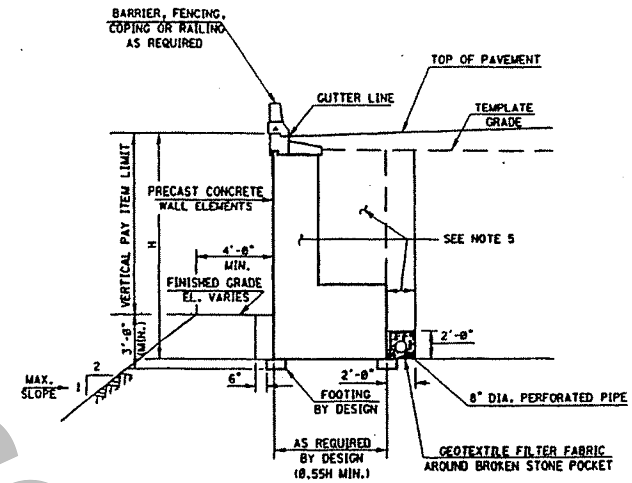
MUNICIPALITY COUNTY

SCALE : NONE

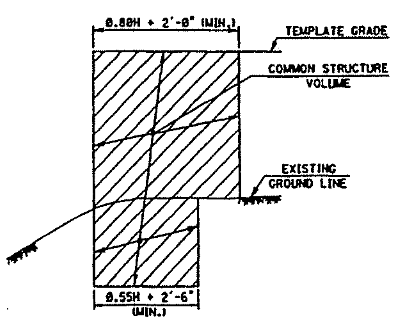
BRIDGE SHEET NO. ___ OF ___



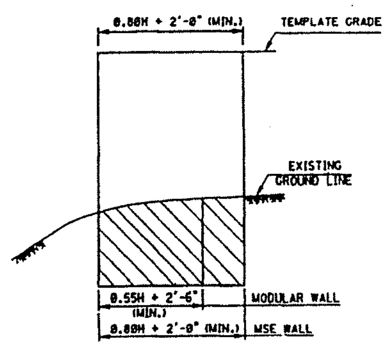
TYPICAL SECTION
MECHANICALLY STABILIZED EARTH WALL



TYPICAL SECTION
PREFABRICATED MODULAR WALL



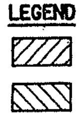
COMMON STRUCTURE VOLUME
(PAY LIMIT)



FOUNDATION EXCAVATION
(WORK LIMIT)

LIMITS FOR PROPRIETARY WALL
IN CUT AND FILL SECTION

LEGEND



NOTES:

1. PAYMENT FOR REINFORCEMENT IN FOOTINGS, BARRIER, COPING, AND PARAPETS SHALL BE INCLUDED IN THE RESPECTIVE WORK ITEMS. THE REINFORCEMENT STEEL IN BARRIER, COPING AND PARAPETS SHALL BE CORROSION PROTECTED. (REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED)

2. FOR MSE WALLS, PROVISION OF AN IMPERVIOUS MEMBRANE UPON COMPLETION OF THE SPECIFIED BACKFILL PLACEMENT OR PROVISION OF FILLER MATERIAL OR FILTER FABRIC AT THE LOCATION OF VERTICAL AND HORIZONTAL JOINTS BETWEEN PANELS SHOULD BE VERIFIED BY THE MANUFACTURER. REFER TO SUBSECTION 520.02 OF THE SPECIFICATIONS FOR GUIDANCE.

3. REFER TO SUBSECTION 520.02 OF THE STANDARD SPECIFICATIONS FOR DIRECTION ON THE TYPE OF GEO-MEMBRANE THAT SHALL BE INSTALLED. THE MEMBRANE SHALL BE PLACED SO THAT IT DRAINS AWAY FROM THE FACE OF THE WALL.

4. AS REQUIRED BY DESIGN, A MINIMUM OF 0.7H SHALL BE USED TO SATISFY REINFORCEMENT LENGTH REQUIREMENTS. 0.8H PLUS 2'-0" SHALL BE USED TO SATISFY COMMON STRUCTURE VOLUME REQUIREMENTS.

5. POROUS FILL OR BROKEN STONE MAY BE USED AS BACKFILL MATERIAL. (REFER TO SUBSECTION 520.02.6 OF THE SPECIFICATIONS).

STATE	FEDERAL PROJECT NO.	SHEET	TOTAL SHEETS
N. J.			

STRUCTURE NO.

STRUCTURE NAME

THIS SHEET FOR DESIGN INFORMATION ONLY. NOT TO BE INCLUDED IN CONTRACT PLANS

PLATE 2.10-2

BDC00MB-01

STANDARD DRAWING PLATE 2.10-2

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

WALL 1
SAMPLE CONTROL PLAN (SHEET 2)

ROUTE : SECTION :

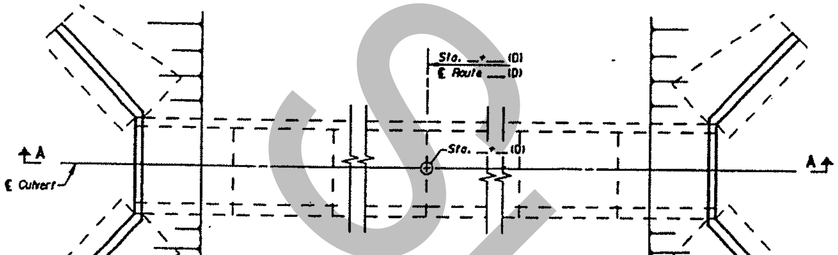
MUNICIPALITY COUNTY

SCALE : NONE

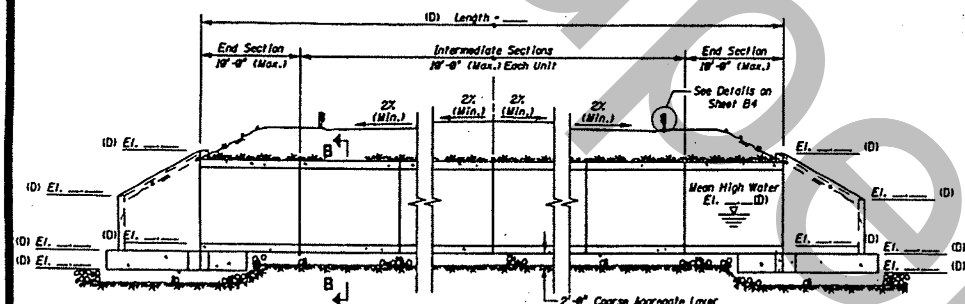
BRIDGE SHEET NO. OF

CONTROL SECTION		JOB NO.	
DES. BY			
DRN. BY		CHK. BY	
EST. BY		CHK. BY	
SPECS. BY			

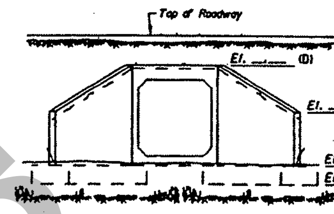
IN CHARGE OF



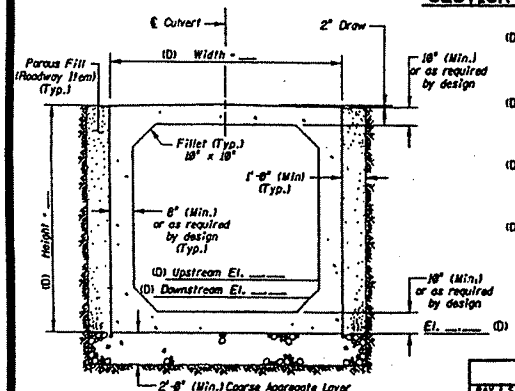
PLAN



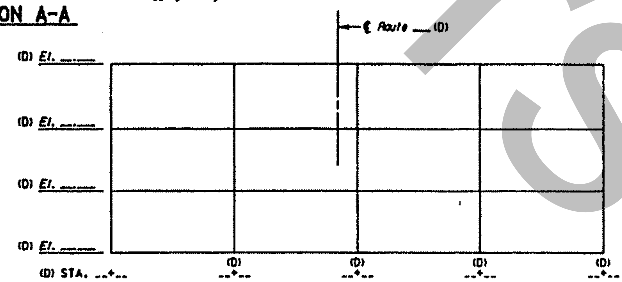
SECTION A-A



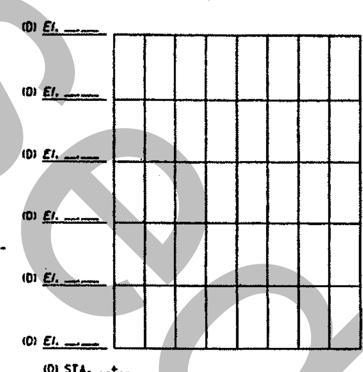
SIDE ELEVATION



SECTION B-B



STREAM BED PROFILE



PROPOSED PROFILE

INDEX OF DRAWINGS	
SHEET NO.	DESCRIPTION
B1	GENERAL PLAN & ELEVATION
B2	CULVERT DETAILS
B3	POST-TENSIONING DETAILS
B4	CAST-IN-PLACE CONCRETE APRON, EXCAVATION & GUIDERAIL DETAILS
B5	CAST-IN-PLACE WINGWALL & FOOTING DETAILS

HYDRAULIC AND HYDROLOGIC DATA		
DRAINAGE AREA (MI²)		
DESIGN DISCHARGE (FT³/S)		
DESIGN WATER SURFACE ELEVATION (FT)		
ENERGY LINE ELEVATION (FT)		
FREQUENCY	50 YR.	100 YR.

GENERAL NOTES

1. DESIGN SPECIFICATIONS:

   1996 AASHTO Standard Specifications for Highway Bridges (with current Interims) as modified by Section 3A of NJDOT Design Manual for Bridges and Structures

✕ 2. CONSTRUCTION SPECIFICATIONS:

   The NJDOT Standard Specifications for Road and Bridge Construction with current Supplemental Specifications, as modified by the Special Provisions.

3. LIVE LOAD:

   AASHTO HS20 + 25% (HS 25) or tandem 24 KIPS axles at 4'-0" centers, whichever governs.

4. CONCRETE DESIGN STRESSES:

   (a) Specified Design Compressive Strength (f'c)

   (In accordance with the Retest Limit for Pay-adjustment Item as specified in Table 914-4 of the NJDOT Standard Specifications and as modified by the Bridge Special Provisions)

   Class A....................4,000 PSI
   Class B....................3,000 PSI
   Class P....................5,000 PSI

   (The retest limit for non-pay-adjustment items shall be as specified on the last line of Table 914-4 of the NJDOT Standard Specifications and as modified by Bridge Supplementary Specifications.)

   (b) Class Design Strengths:

   (In accordance with Table 914-3 of the NJDOT Standard Specifications)

   Class A....................4,600 PSI
   Class B....................3,700 PSI
   Class P....................5,500 PSI

   (c) Allowable Stress, Extreme Fiber in Compression (fc)

   Class A....................1,600 PSI
   Class B....................1,200 PSI
   Class P....................2,000 PSI

5. REINFORCEMENT STEEL:

   (a) ASTM A615 (Grade 60) (fs) = 24,000 PSI

   Top mat of rebars shall be corrosion protected if earth fill over the precast unit is less than 2'-0". (Refer to section 26 of this manual for types of corrosion protected reinforcement steel that can be used)

6. Provide ½" Dia. 7 wire Grade 270 conforming to AASHTO M203 or ¾" Dia. high tensile strenth steel bars conforming to AASHTO M275. No splices to be permitted.

7. Install strands in precast sections. Stress each strand to a tension of 30 KSI over the cross section of any section.

8. BORINGS:

   (a) ⊕ Indicates location of borings Log No.

9. FOUNDATION DESIGN CRITERIA

   (Summary on Project to Project Basis)

✕✕ 10. Estimated Cost = (D) Based on (Insert Year) prices.

✕ The note should be modified to reflect applicable year and updated Specifications.

✕✕ Remove this note at final submission.

SUMMARY OF QUANTITIES				
PAY ITEM NO.	STANDARD ITEM NO.	DESCRIPTION	UNIT	CONTRACT QUANTITY
		CLEARING SITE, STRUCTURE (CULVERT)	LUMP SUM	
		COARSE AGGREGATE LAYER	C.Y.	
		BRIDGE EXCAVATION	C.Y.	
		FOUNDATION EXCAVATION	C.Y.	
		COFFERDAMS	LUMP SUM	
		REINFORCED CONCRETE BOX CULVERT, PRECAST	L.F.	
		CONCRETE IN STRUCTURES, FOOTINGS	C.Y.	
		CONCRETE IN STRUCTURES, RETAINING WALLS	C.Y.	
		REINFORCEMENT STEEL IN STRUCTURES	LBS.	
		REINFORCEMENT STEEL IN STRUCTURES, EPOXY COATED	LBS.	

NOTE TO THE DESIGNER:

1. The designer shall complete all the title block information and items designated with (D) prior to including any PLATES into the contract plans.
2. Insert or delete Pay Items as required.

CONTROL SECTION		JOB NO.	
DES.		CHK.	
DWN.			
EST.		CHK.	
SPEC.			

IN CHARGE ______

SUBMITTED ______

STATE	FEDERAL PROJECT NO.	SHEET	TOTAL SHEETS
N. J.			

STRUCTURE NO.

STRUCTURE NAME

BDC04MB-01

STANDARD DRAWING PLATE 2.11-1

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

SINGLE CELL PRECAST R.C. BOX CULVERT
GENERAL PLAN & ELEVATION

ROUTE ______ SECTION ______

MUNICIPALITY ______ COUNTY ______

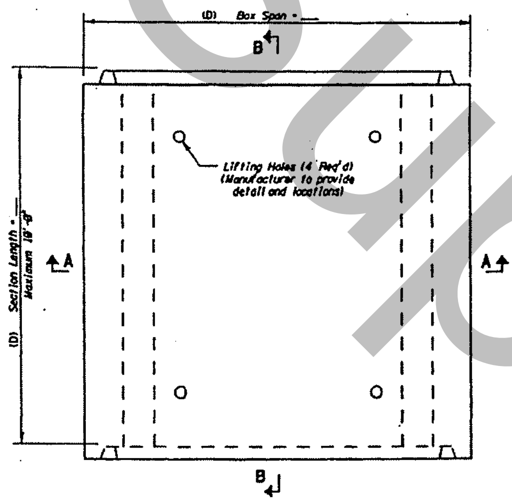
SCALE: ____

SHEET NO. ____ OF ____

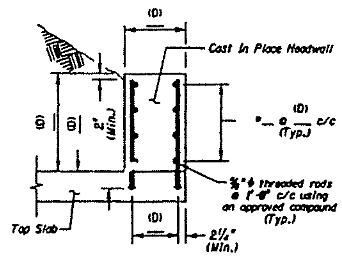
STATE	FEDERAL PROJECT NO.	SHEET	TOTAL SHEETS
N. J.			

STRUCTURE NO.

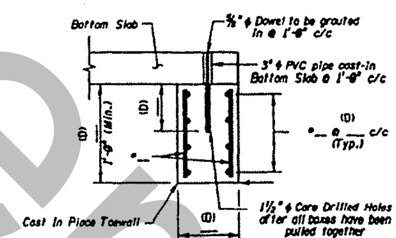
STRUCTURE NAME



PLAN



TYPICAL HEADWALL DETAIL



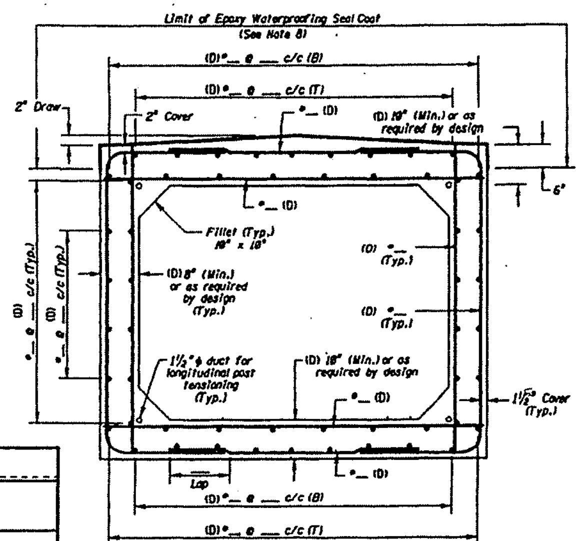
TYPICAL TOEWALL DETAIL

NOTES:

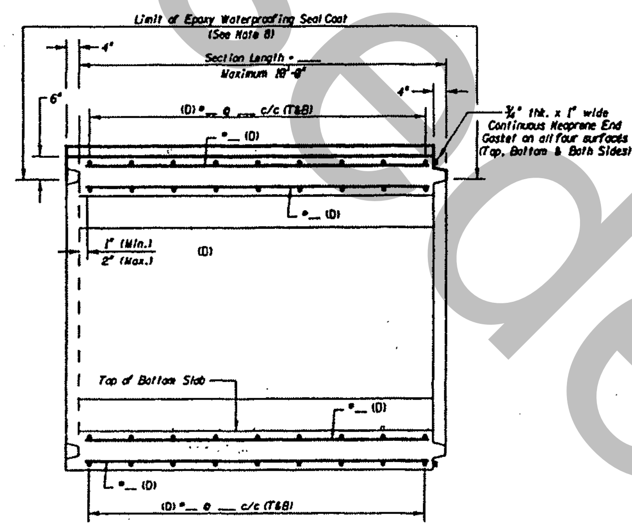
1. Precast reinforced concrete box sections shall not be used where the top slab is to be used as a riding surface.
2. Size and spacing of rebars shall be provided by the box culvert manufacturer and be submitted for approval. Manufacturer shall provide calculations signed and sealed by a Licensed Engineer in the State of New Jersey.
3. Lap slices and development lengths shall be determined by the designer in accordance with current AASHTO design criteria. The top mat of reinforcement in the top slab shall be corrosion protected when the earth fill over the precast culvert is less than 2'-0". (Refer to section 26 of this manual for types of corrosion protected reinforcement steel that can be used)
4. All lifting holes shall be filled with non-shrink grout. After the grout has cured, the area shall be coated with an epoxy waterproofing seal coat.
5. A plastic waterstop shall be provided to prevent water from entering vertical joints between the end of precast culvert sections and any cast in place appurtenances such as wingwalls, cut off walls, aprons and cast in place culvert end sections.
6. Precast end sections shall be approved on project to project basis. Short wall of the end section shall not be less than 3'-0".
7. The cost of shop and field applied waterproofing seal coat shall be included in the price bid for the item, "Reinforced Concrete Box Culvert, Precast".

(D) 8. If Cast-In-Place end sections are used, provide two rows of threaded inserts in the precast unit to facilitate the attachment of end section.

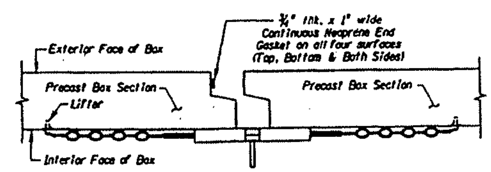
* Designer shall provide connection details.



SECTION A-A



SECTION B-B



SUGGESTED PULLING DETAIL

NOTE TO THE DESIGNER:
The designer shall complete all the title block information and items designated with (D) prior to including any PLATES into the contract plans.

- Remove this note at final submission.

BDC04MB-01

STANDARD DRAWING PLATE 2.11-2

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

SINGLE CELL PRECAST R.C. BOX CULVERT
CULVERT DETAILS

ROUTE ______ SECTION ______

MUNICIPALITY ______ COUNTY ______

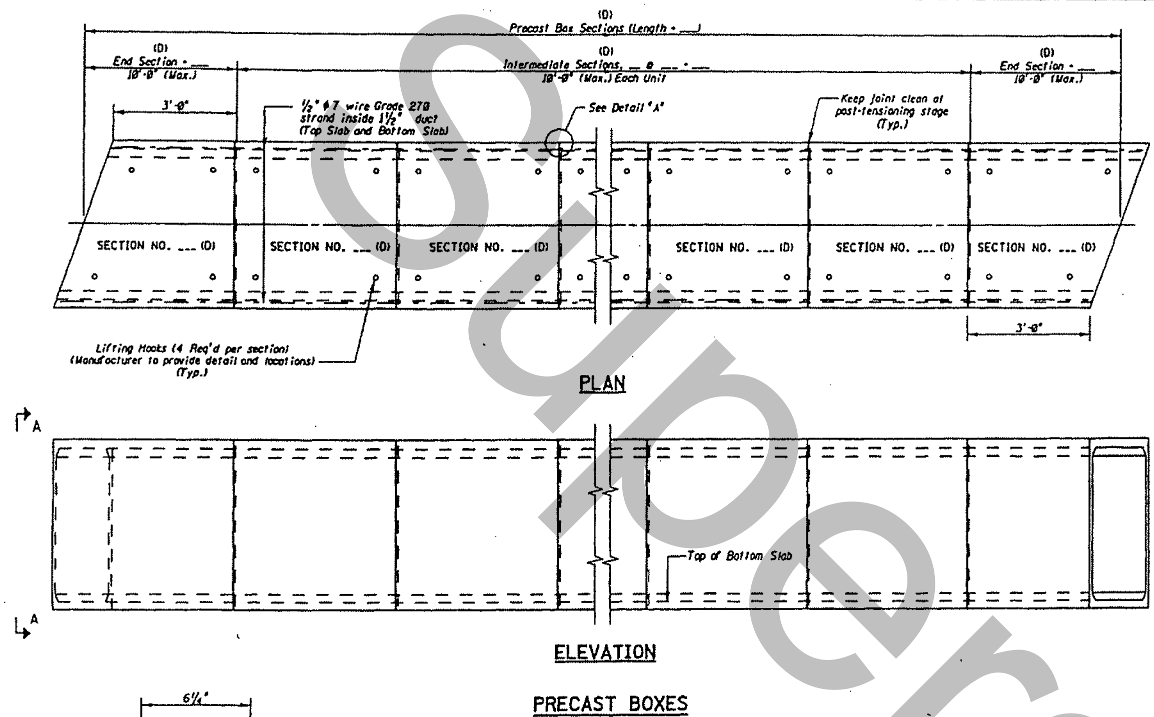
SCALE: ____

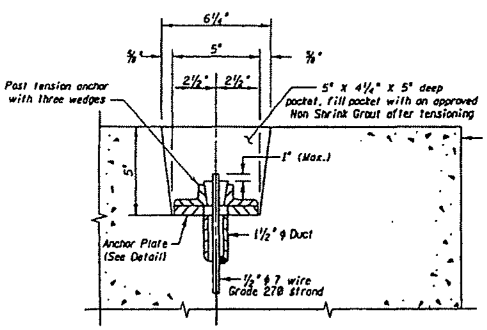
SHEET NO. ___ OF ___

CONTROL SECTION		JOB NO.	
DES.		CHK.	
DWN.			
EST.		CHK.	
SPEC.			

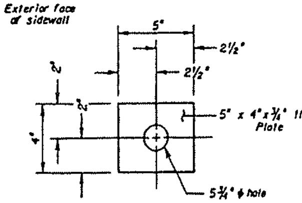
IN CHARGE ______

SUBMITTED ______

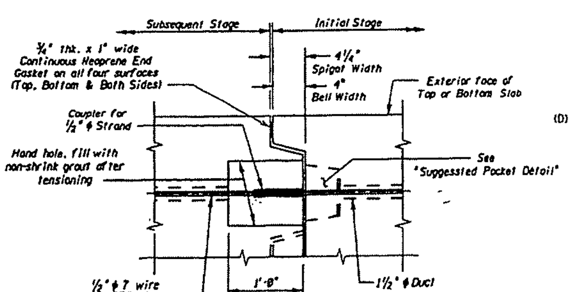




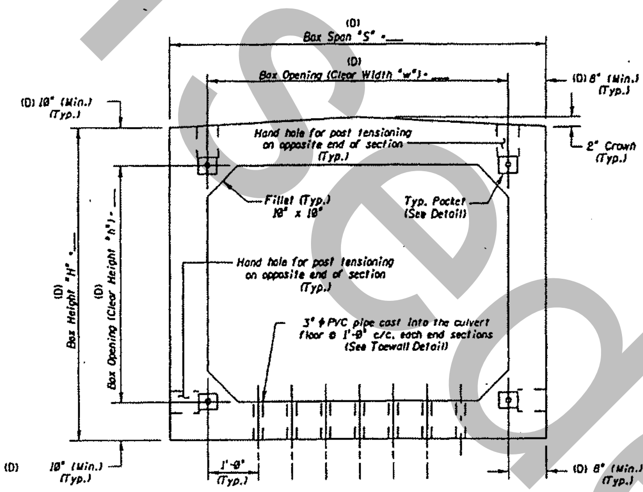
SUGGESSTED POCKET DETAIL



ANCHOR PLATE



DETAIL "A"



END ELEVATION A-A

NOTES:

1. Fabricator shall provide all details for post-tension connections.
2. Fabricator shall show post-tensioning procedures including stressing sequence steps.
3. Snug fit all joints before post-tensioning.
4. After tensioning, the exposed ends of the ties shall be removed so that no part of the ties, or of the end fittings, extend beyond a point 1" inside the anchorage pocket.
5. After stressing, grout all strand voids using an approved compound.
6. Provide seals or gaskets around the ducts at the joints to make the joints grout
7. All post-tensioning must be witnessed and approved by the Engineer.
8. After post-tensioning is approved, cut strands to provide a minimum of 2 1/4" clear from outside face of concrete, coat anchorage and strands with coat for epoxy and coat recess with epoxy bonding compound and fill with non-shrink grout. The use of epoxy bonding compound shall be in conformance with NJDOT Standard Specifications, Subsection 518.04 Subpart 2(a).
9. Post-tension and grout before backfilling and placing traffic over the box. Allow grout to achieve minimum strength before backfilling.

SECTION SCHEDULE

SECTION NO.	NO. REQUIRED	℄ DIMENSION	TOTAL LENGTH	WEIGHT LBS	CUBIC YARDS
1					
2					
3					
4					
5					
6					
TOTAL					

NOTE TO THE DESIGNER:
The designer shall complete all the title block information and items designated with (D) prior to including any PLATES into the contract plans.

STATE	FEDERAL PROJECT NO.	SHEET	TOTAL SHEETS
N. J.			

STRUCTURE NO.

STRUCTURE NAME

STANDARD DRAWING PLATE 2.11-3

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

SINGLE CELL PRECAST R.C. BOX CULVERT
POST-TENSIONING DETAILS

ROUTE SECTION

MUNICIPALITY COUNTY

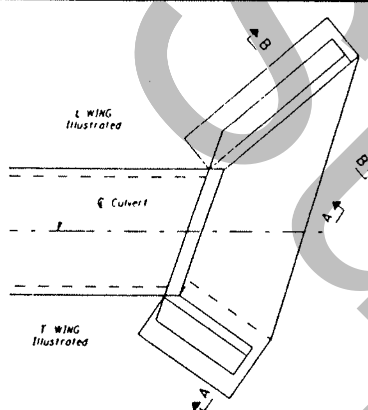
SCALE: ___

SHEET NO. ___ OF ___

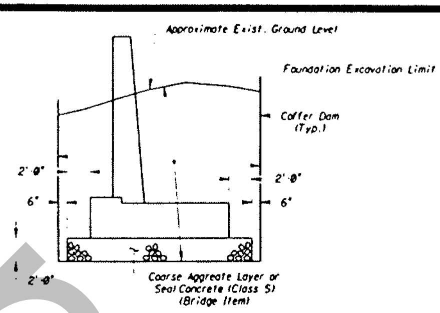
CONTROL SECTION		JOB NO.	
DES.		CHK.	
DWN.			
EST.		CHK.	
SPEC.			

IN CHARGE ___

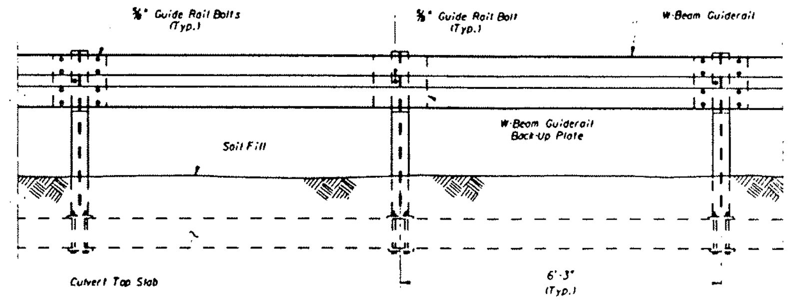
SUBMITTED ___



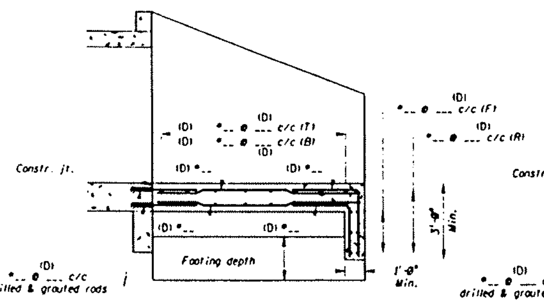
PLAN



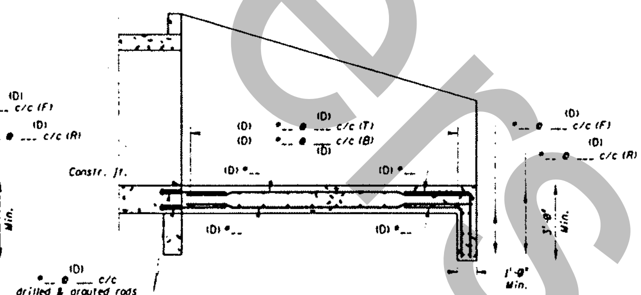
FOUNDATION EXCAVATION AND
COARSE AGGREGATE LAYER DETAIL



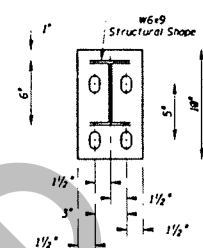
ELEVATION



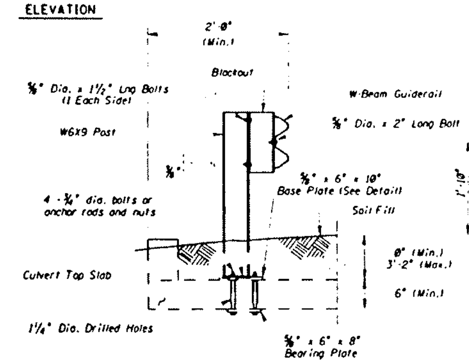
LONGITUDINAL SECTION - T WING



LONGITUDINAL SECTION - L WING

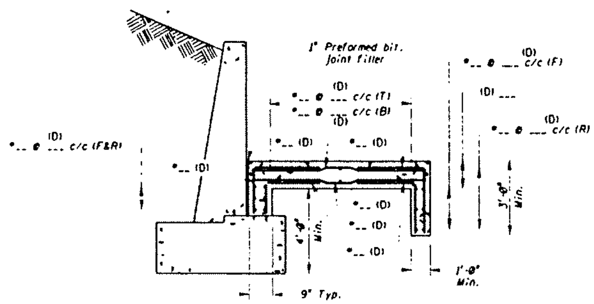


BASE PLATE DETAIL

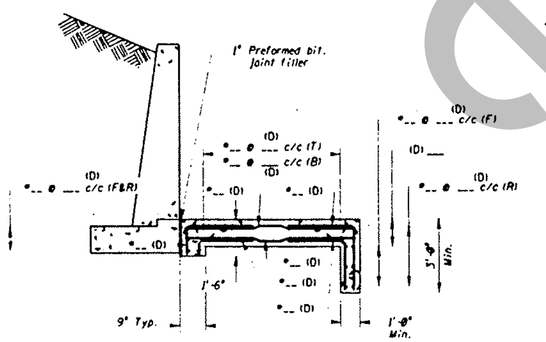


SECTION

GUIDERAIL ATTACHMENT DETAILS



SECTION A-A



SECTION B-B

CONCRETE APRON DETAILS

NOTES:

1. A minimum 3'-0" deep cut off wall (curtain wall) is required when culvert does not have a concrete apron.
2. Designer shall review the roadway plans to determine that excavation payment limits for road and bridge work are compatible.

NOTE TO THE DESIGNER:
The designer shall complete all the title block information and items designated with (D) prior to including any PLATES into the contract plans.

N. J.			
STRUCTURE NO.			
STRUCTURE NAME			

STANDARD DRAWING PLATE 2.11-4

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

SINGLE CELLPRECAST R. C. BOX CULVERT
CAST-IN-PLACE CONCRETE APRON,
EXCAVATION & GUIDERAIL DETAILS

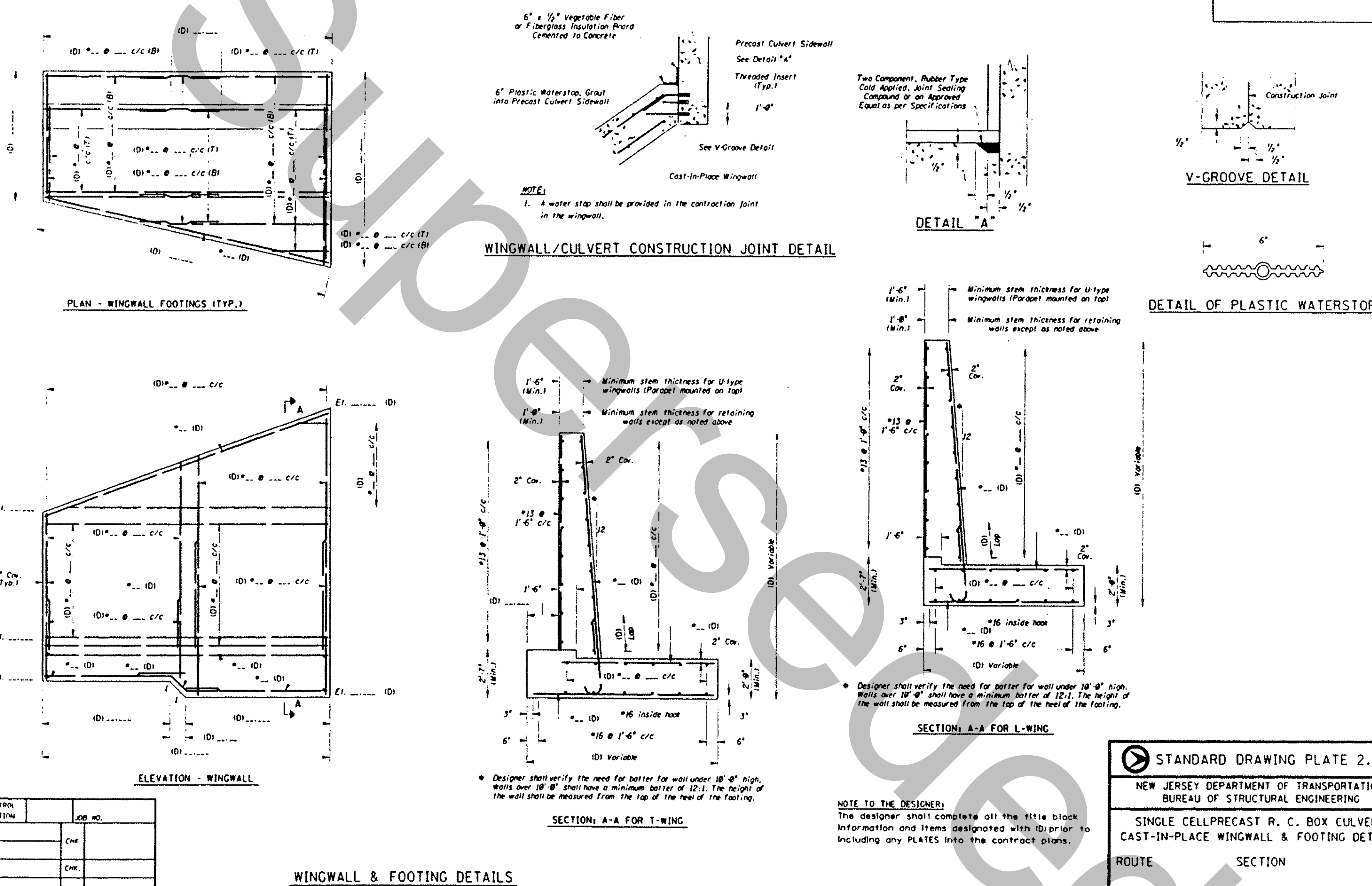
ROUTE SECTION

MUNICIPALITY COUNTY

SCALE:

SHEET NO. OF

CONTROL SECTION		JOB NO.	
DES.		CHK	
DWN.			
EST.		CHK	
SPEC			
IN CHARGE			
SUBMITTED			



NOTE:
1. A water stop shall be provided in the contraction joint in the wingwall.

• Designer shall verify the need for batter for wall under 10'-0" high. Walls over 10'-0" shall have a minimum batter of 12:1. The height of the wall shall be measured from the top of the heel of the footing.

NOTE TO THE DESIGNER:
The designer shall complete all the title block information and items designated with (D) prior to including any PLATES into the contract plans.

STANDARD DRAWING PLATE 2.11-5

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

SINGLE CELLPRECAST R. C. BOX CULVERT
CAST-IN-PLACE WINGWALL & FOOTING DETAILS

ROUTE SECTION
MUNICIPALITY COUNTY
SCALE:
SHEET NO. OF

N. J.
STRUCTURE NO.
STRUCTURE NAME

CONTROL SECTION | JOB NO.
DES. | CHK
DWN.
EST. | CHK.
SPEC
IN CHARGE
SUBMITTED

DIVISION 3

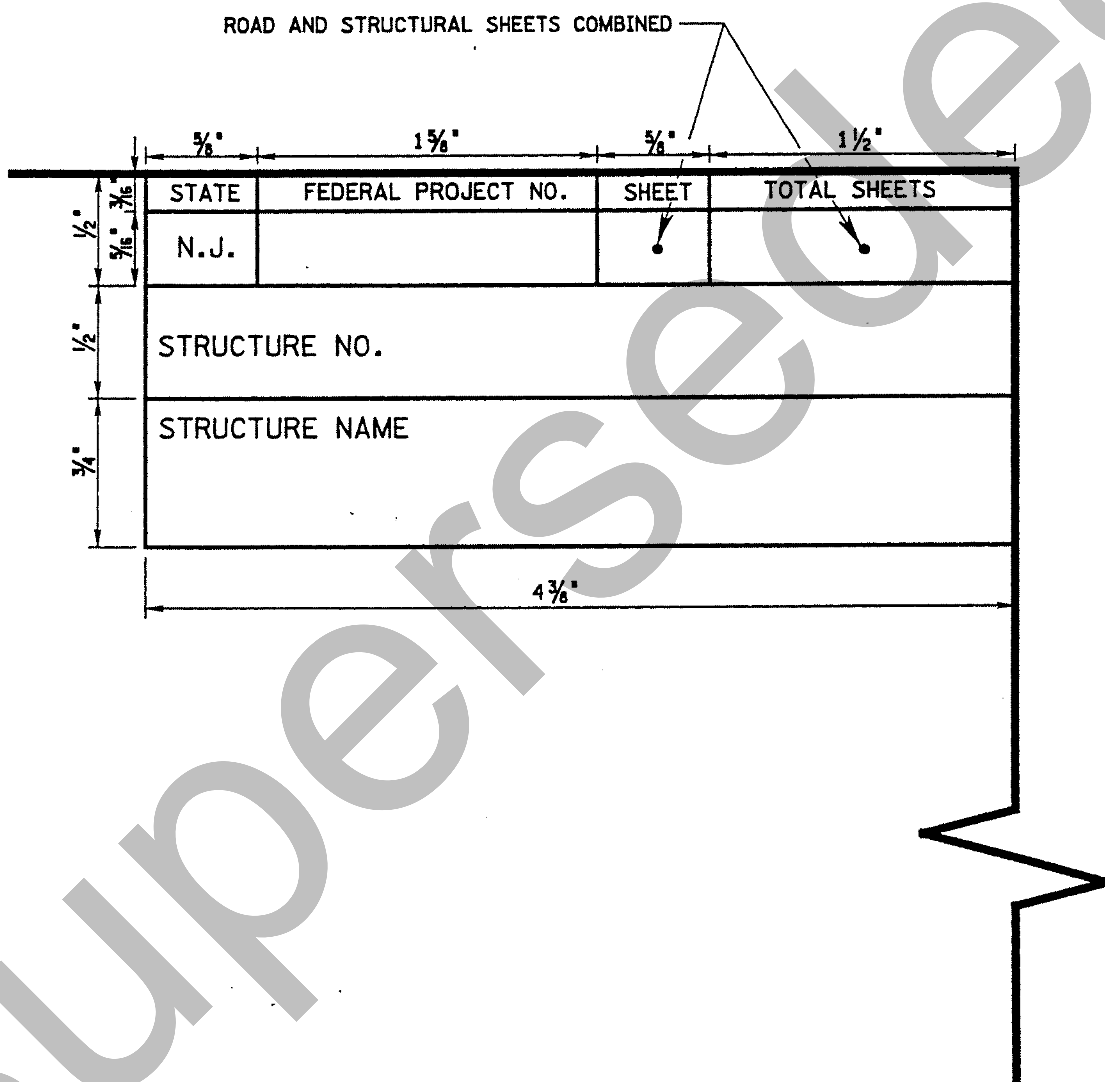
GUIDE SHEETS

DIVISION 3 - GUIDE SHEETS

CONTENTS

10. PRESTRESSED CONCRETE

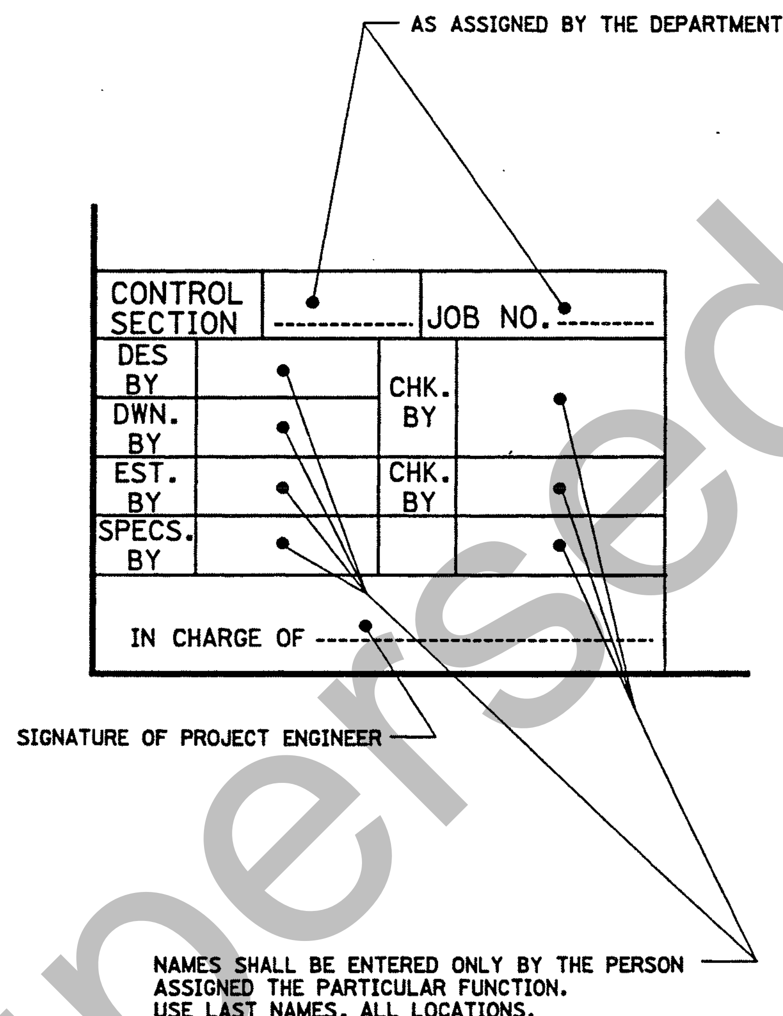
FEDERAL AID AND STRUCTURE IDENTIFICATION BLOCK	ISSUED: 2002 REV:	PLATE 3.1-1



NOTES:

1. PLACE BLOCK IN UPPER RIGHT-HAND CORNER OF 22"X36" PLAN SHEET.
2. SEE DIVISION 1, SECTION 40 OF THIS MANUAL FOR INFORMATION CONCERNING STRUCTURE NUMBERS.

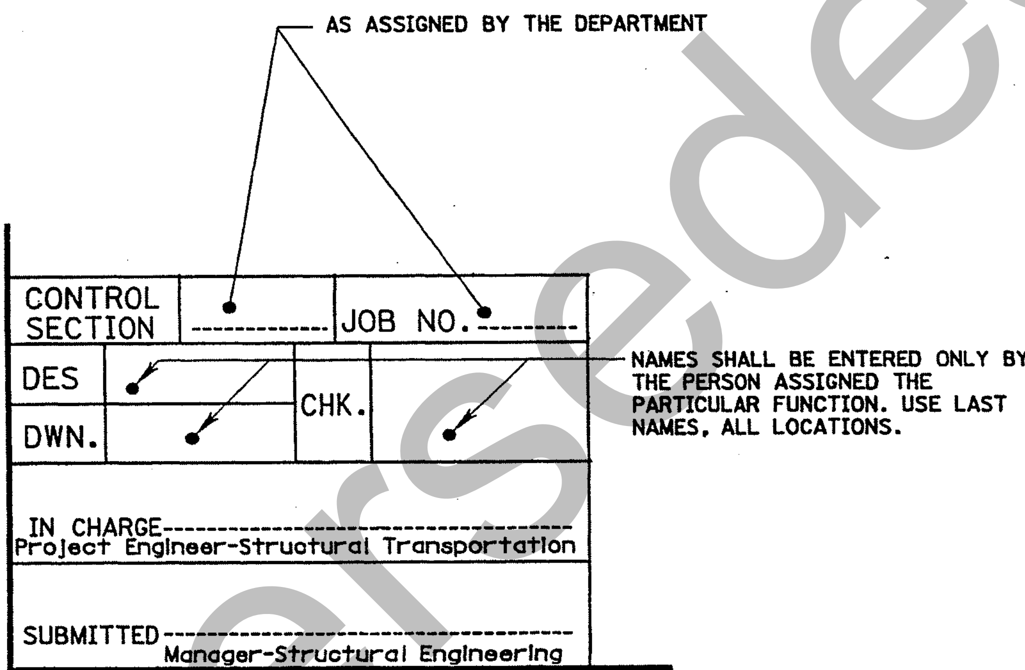
CREDIT BLOCK (CONSULTANTS)	ISSUED: 2002 REV:	PLATE 3.1-2



NOTES:

1. PLACE BLOCK IN LOWER LEFT-HAND CORNER OF 22"X36" PLAN SHEET
2. VARIATIONS OF THE ABOVE BLOCK SUBJECT TO APPROVAL.

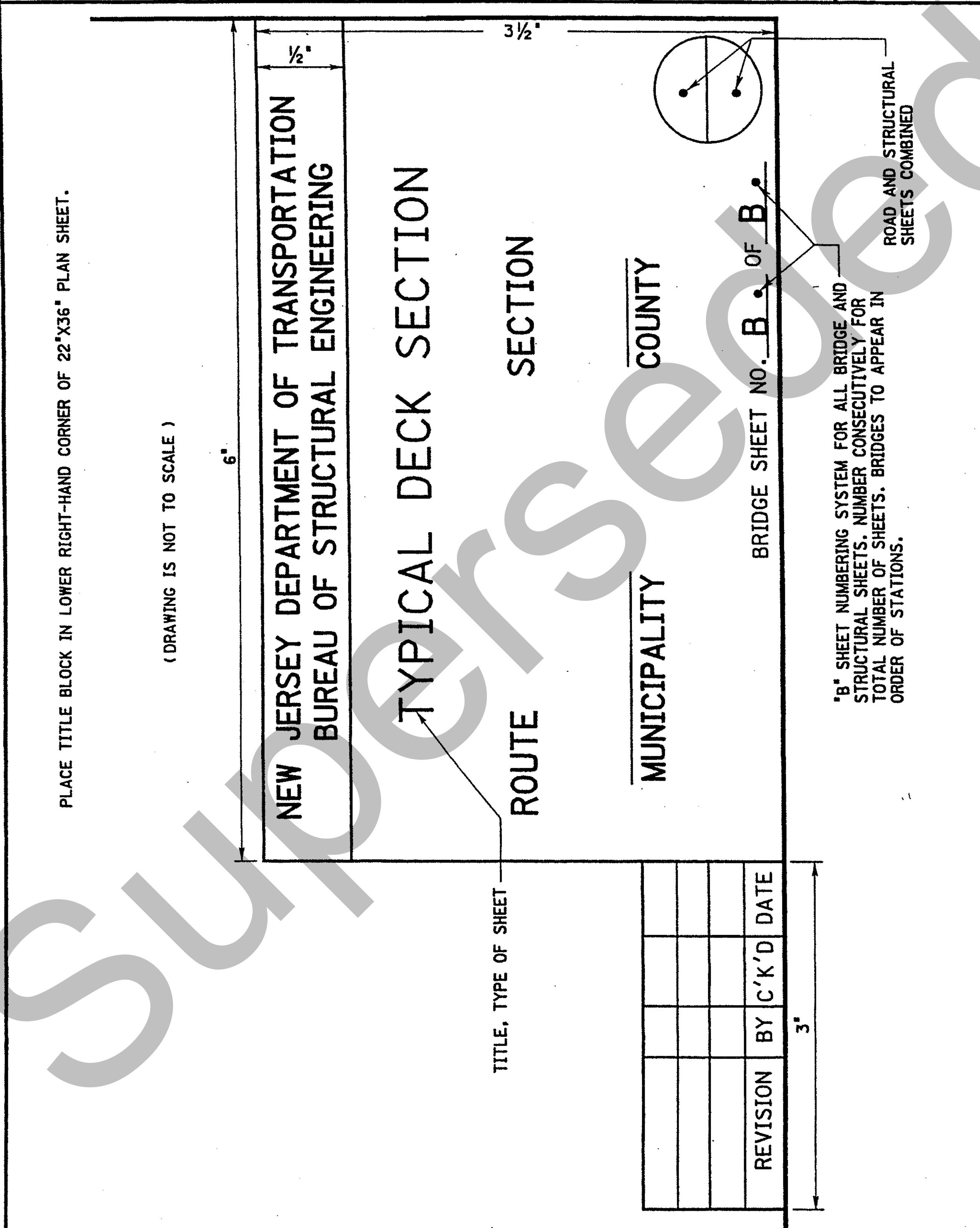
CREDIT BLOCK (IN HOUSE)	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.1-3



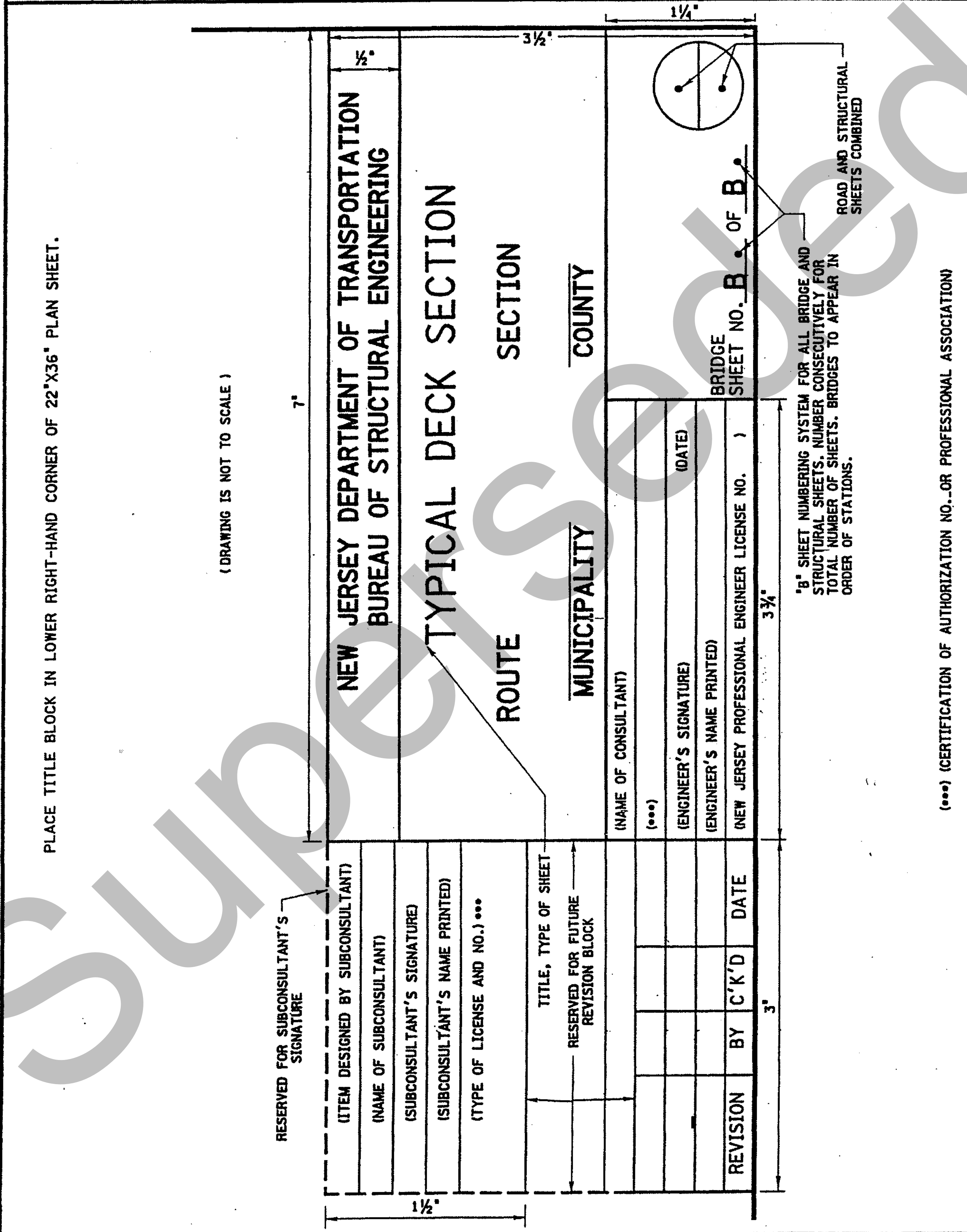
NOTE:

PLACE BLOCK IN LOWER LEFT-HAND CORNER OF 22"X36" PLAN SHEET.

TITLE BLOCK (IN HOUSE)	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.1-4



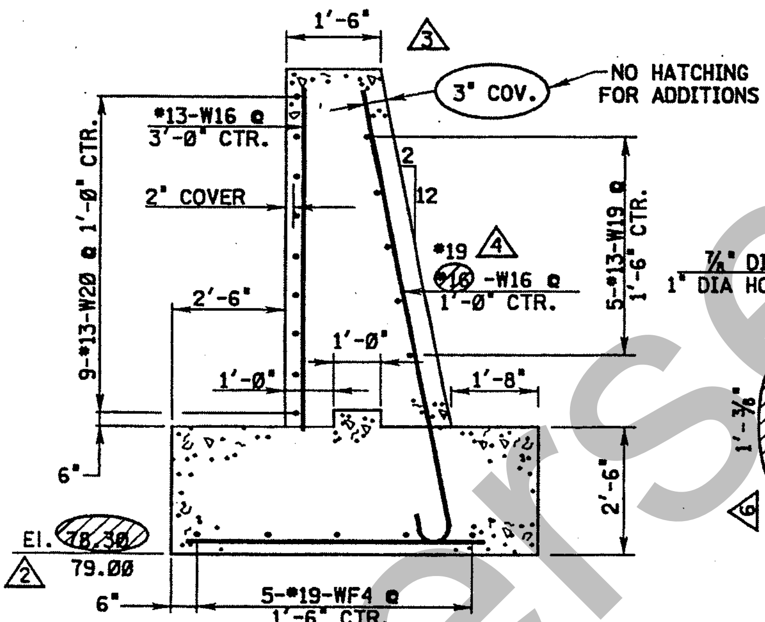
TITLE BLOCK (CONSULTANT)	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.1-5



PLAN REVISIONS	ISSUED: 2002 REV:	PLATE 3.2-1

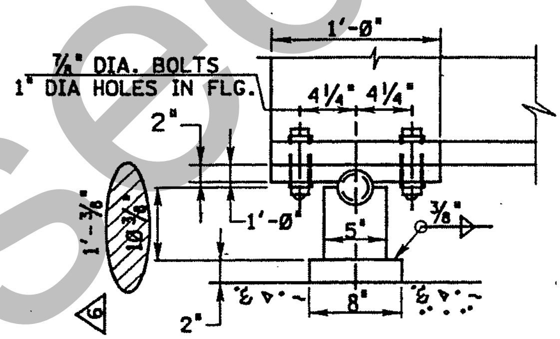
LIST OF REINFORCEMENT STEEL

No.	MARK	SIZE	LENGTH	REMARKS
26	P1	#13	12'-6"	~~DETAILED~~ STR. △1
△1 16 ~~15~~	P2	~~#16~~ #19	5'-3"	DETAILED
52	P3	#19	17'-4"	STRAIGHT



~~TYPICAL SECTION~~

△5 **SECTION D - D**



FIXED BEARING

NOTE TO DESIGNER:

SEE SECTION 1.39.1 FOR FURTHER INFORMATION.

PROCEDURE FOR MAKING REVISIONS TO DRAWINGS AND NOTES

1. ENCLOSE INCORRECT ITEM IN A HEAVY OUTLINE.
2. LIGHTLY CROSS-HATCH ENCLOSED ITEM.
3. IDENTIFY REVISIONS WITH CONSECUTIVELY NUMBERED TRIANGLES.
4. LIST REVISIONS IN TABLE.

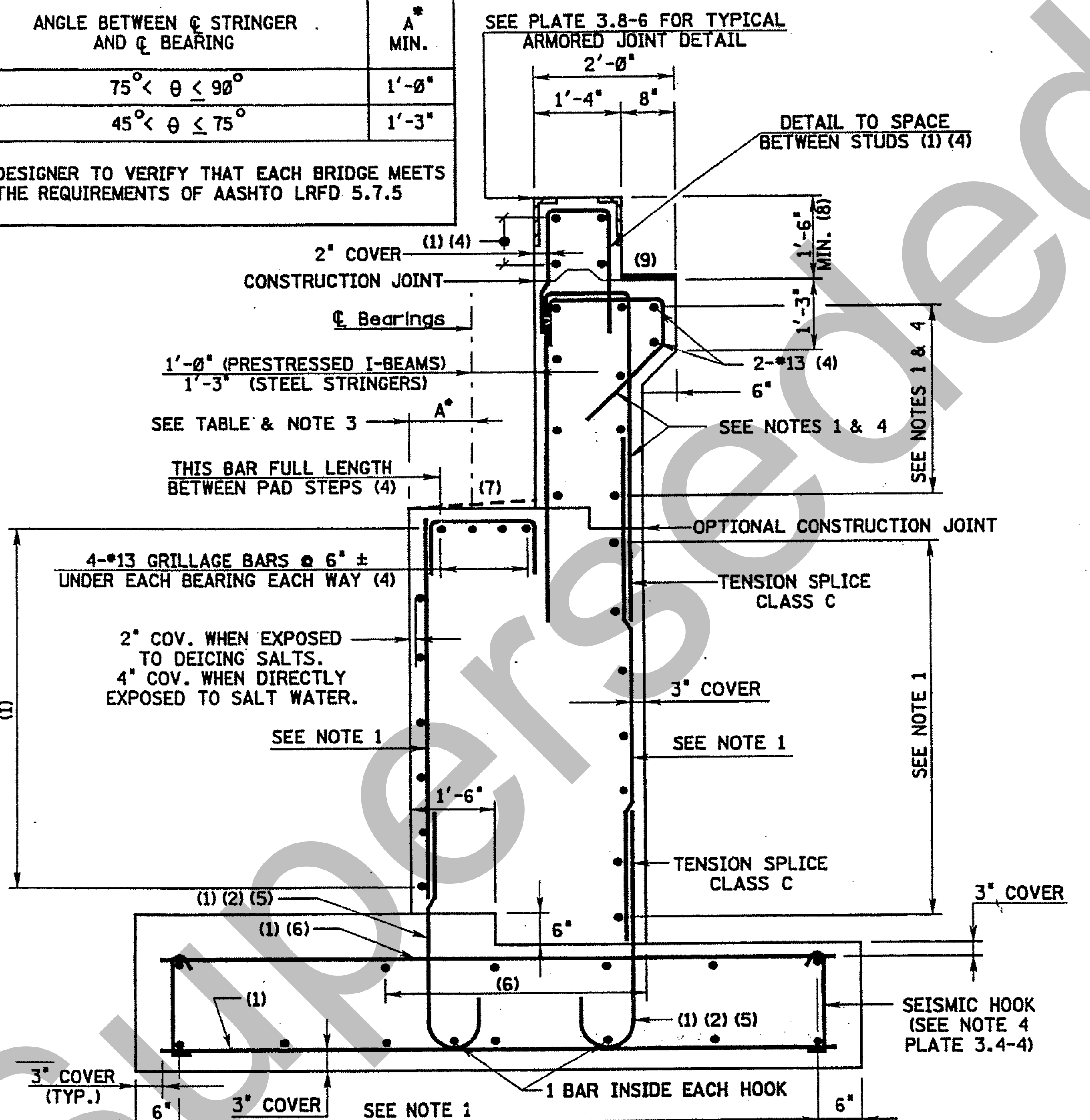
△6 BRG. DIM.	J.D.R.	O.F.M.	2-21-61
△5 SUB. TITLE	W.H.S.	D.A.T.	2-14-61
△4 REINF. SIZE	J.M.F.	L.R.M.	2-10-61
△3 DIM. ADDED	R.A.I.	J.R.	2-8-61
△2 EL. FOOTING	J.P.G.	M.D.C.	2-6-61
△1 REINF. STEEL	J.B.D.	T.K.C.	2-2-61
REVISION	BY	C'K'D	DATE

ABUTMENT SECTION FOR STRUCTURES WITH APPROACH SLABS

ISSUED: 2002	PLATE
REVISION: BDC04MB-01	3.3-1

ANGLE BETWEEN ℄ STRINGER AND ℄ BEARING	A* MIN.
75° < θ ≤ 90°	1'-0"
45° < θ ≤ 75°	1'-3"

* DESIGNER TO VERIFY THAT EACH BRIDGE MEETS THE REQUIREMENTS OF AASHTO LRFD 5.7.5

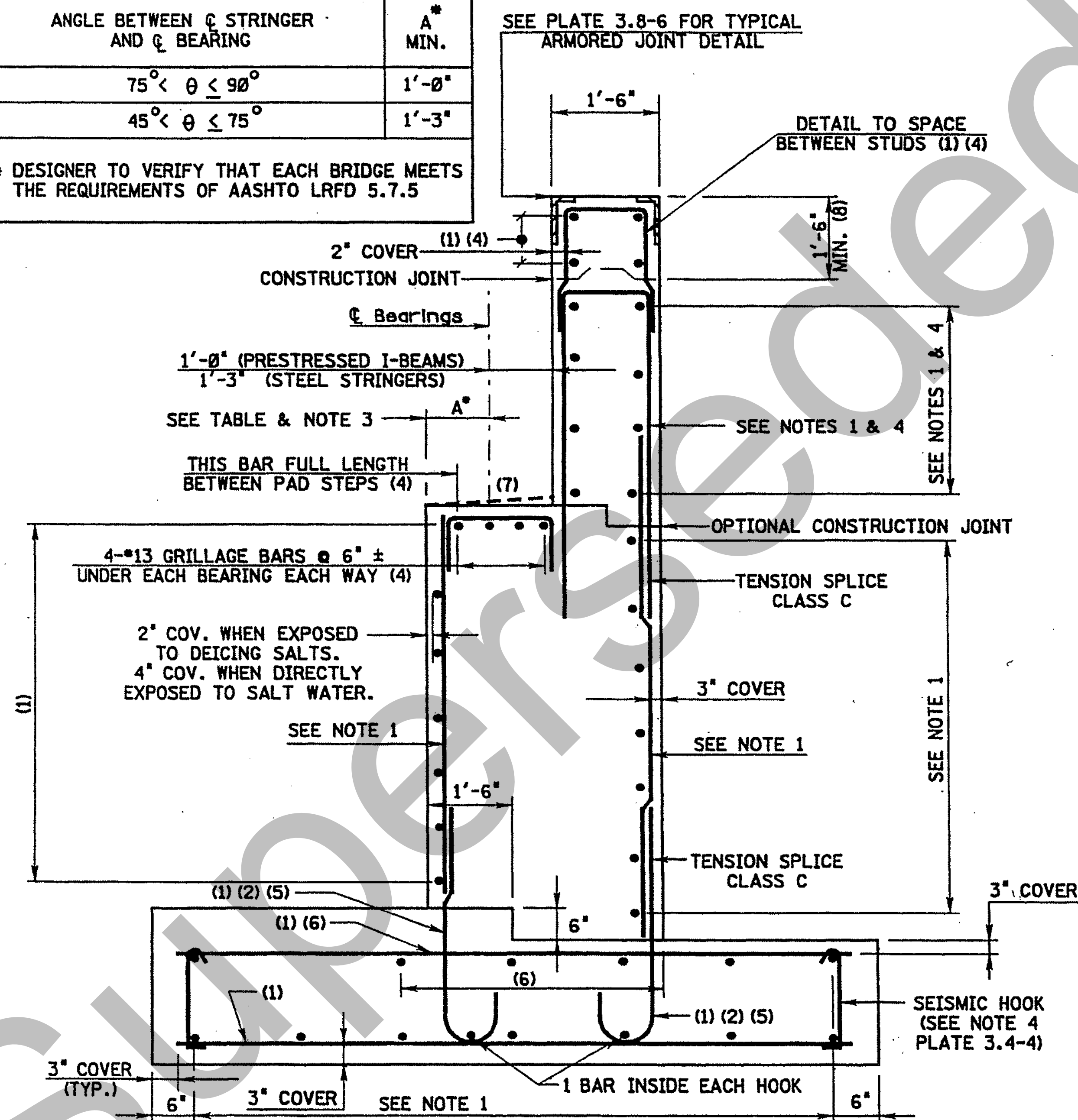


1. REINFORCEMENT NOT DESIGNATED SHALL BE AS REQUIRED BY DESIGN.
2. SEE PLATE 3.4-4 FOR ALTERNATE DOWEL DETAIL.
3. EDGE OF BRIDGE SEAT SHALL PROJECT AT LEAST 3" BEYOND THE EDGE OF THE BEARING MASONRY PLATE.
4. CORROSION PROTECTED BARS. SEE NOTE 10.
5. CORROSION PROTECTED DOWELS IN CORROSIVE ENVIRONMENTS. SEE NOTE 10.
6. TRANSVERSE STEEL IN TOP OF FOOTING SHALL BE DEVELOPED IN TENSION.
7. ABUTMENT SEATS SHALL BE SLOPED 5 % AS REQUIRED BY AASHTO 2.5.2.1.2 FOR DRAINAGE BETWEEN THE LEVEL BEARING SEAT AREAS. REFER TO GUIDE PLATE 3.3-4 FOR MORE INFORMATION.
8. HEADER TO BE CONSTRUCTED AFTER THE DECK SLAB IS IN PLACE.
9. A ¼" THICK PIECE OF PREFORMED BITUMINOUS JOINT FILLER SHALL BE LAID IN AND COVERED WITH ASPHALT ROOFING CEMENT ON THE SURFACE WHERE THE APPROACH SLAB SHALL REST.
10. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.

ABUTMENT SECTION FOR STRUCTURES WITHOUT APPROACH SLABS	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.3-2

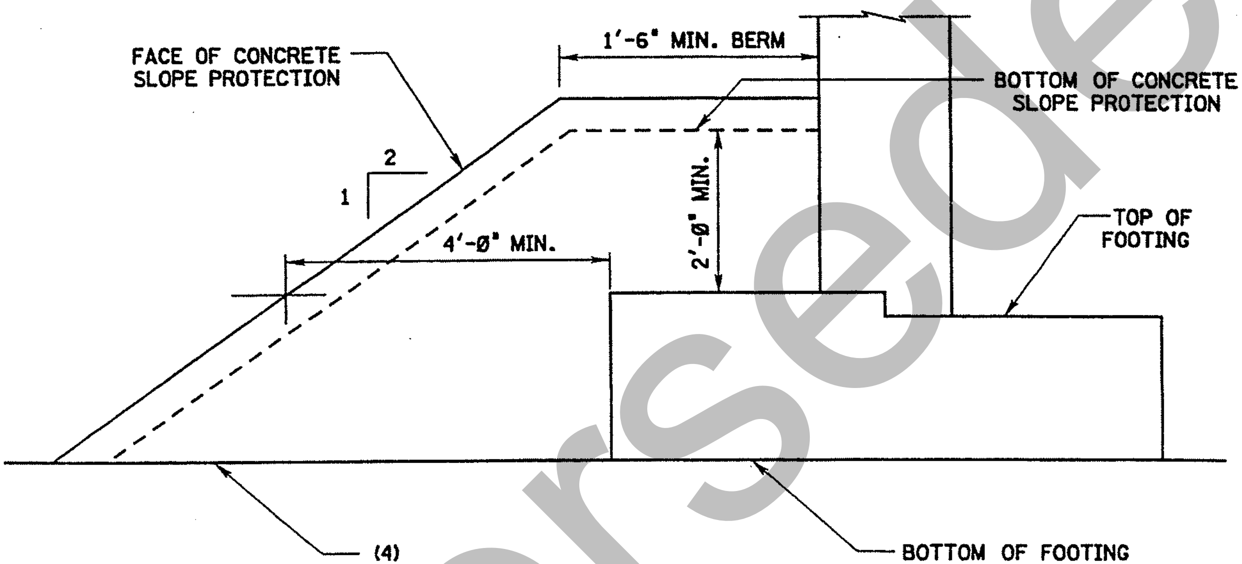
ANGLE BETWEEN ℄ STRINGER AND ℄ BEARING	A* MIN.
$75^\circ < \theta \le 90^\circ$	1'-0"
$45^\circ < \theta \le 75^\circ$	1'-3"

* DESIGNER TO VERIFY THAT EACH BRIDGE MEETS THE REQUIREMENTS OF AASHTO LRFD 5.7.5



1. REINFORCEMENT NOT DESIGNATED SHALL BE AS REQUIRED BY DESIGN.
2. SEE PLATE 3.4-4 FOR ALTERNATE DOWEL DETAIL.
3. EDGE OF BRIDGE SEAT SHALL PROJECT AT LEAST 3" BEYOND THE EDGE OF THE BEARING MASONRY PLATE.
4. CORROSION PROTECTED BARS. SEE NOTE 9.
5. CORROSION PROTECTED DOWELS IN CORROSIVE ENVIRONMENTS. SEE NOTE 9.
6. TRANSVERSE STEEL IN TOP OF FOOTING SHALL BE DEVELOPED IN TENSION.
7. ABUTMENT SEATS SHALL BE SLOPED 5 % AS REQUIRED BY AASHTO 2.5.2.1.2 FOR DRAINAGE BETWEEN THE LEVEL BEARING SEAT AREAS. REFER TO GUIDE PLATE 3.3-4 FOR MORE INFORMATION.
8. HEADER TO BE CONSTRUCTED AFTER THE DECK SLAB IS IN PLACE.
9. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.

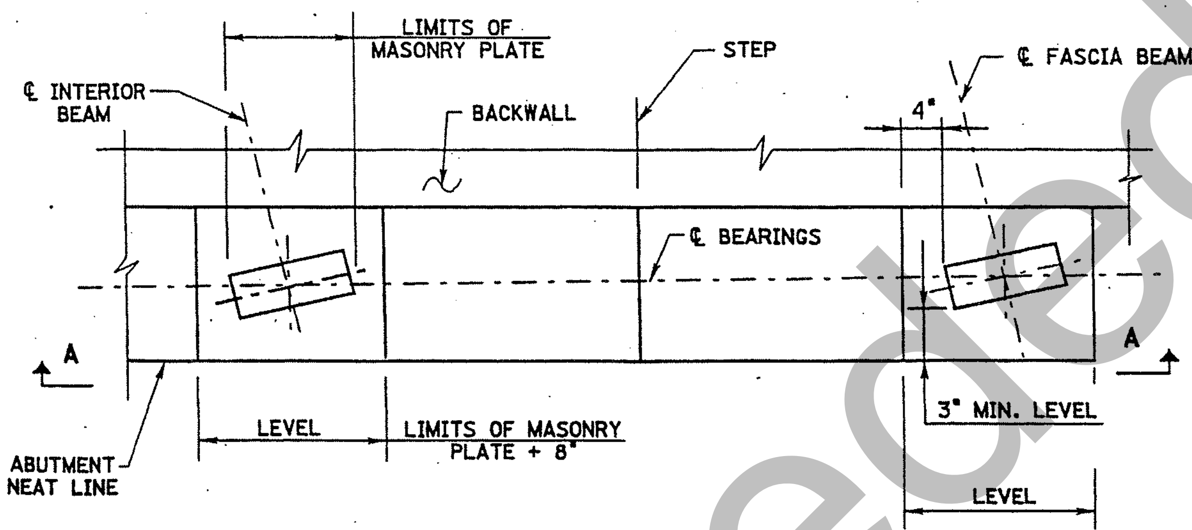
FOOTINGS ON EMBANKMENTS	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.3-3



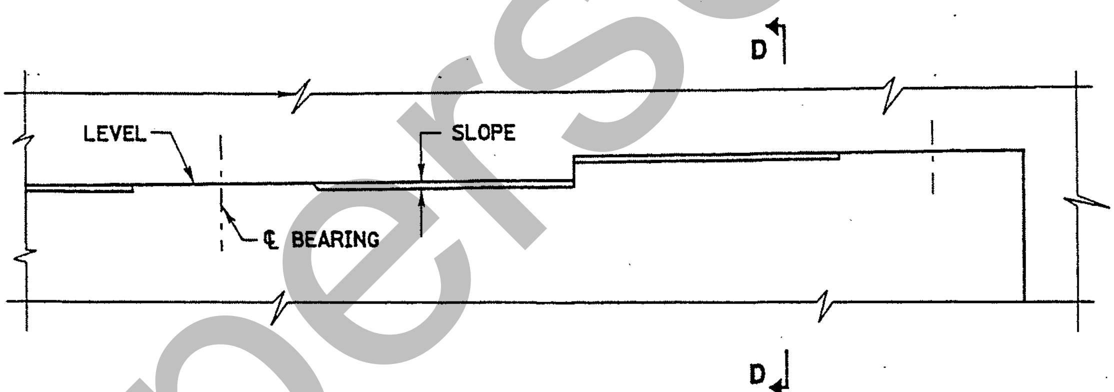
NOTES:

1. SPREAD FOOTINGS ON BORROW EXCAVATION, BRIDGE FOUNDATION TO BE DESIGNED FOR 2.5 TONS/SQ. FT. PRESSURE.
2. FOR FOOTINGS ON PILES, THE EMBANKMENT SHALL CONSIST OF BORROW EXCAVATION ZONE 3 MATERIAL WITH 2" MAXIMUM SIZE AGGREGATE. SCHEDULING OF PRE-BORED HOLES WHEN WARRENTED (THROUGH EMBANKMENT) AS A CONTRACT ITEM TO BE DETERMINED ON A PROJECT TO PROJECT BASIS. SEE SUBSECTION 1.36.3 (a) (2) OF THIS MANUAL.
3. REFERENCE SECTIONS 203 AND 204 OF THE NJDOT STANDARD SPECIFICATIONS.
4. REFERENCE GUIDE PLATE 3.15-3 FOR MORE INFORMATION REGARDING THE LIMITS FOR BORROW EXCAVATION, BRIDGE FOUNDATION.

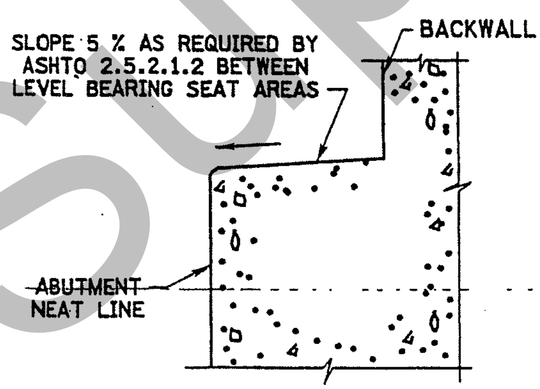
BRIDGE SEAT DETAILS	ISSUED: 2002 REV:	PLATE 3.3-4



PLAN OF BRIDGE SEAT AT ABUTMENTS



VIEW A-A

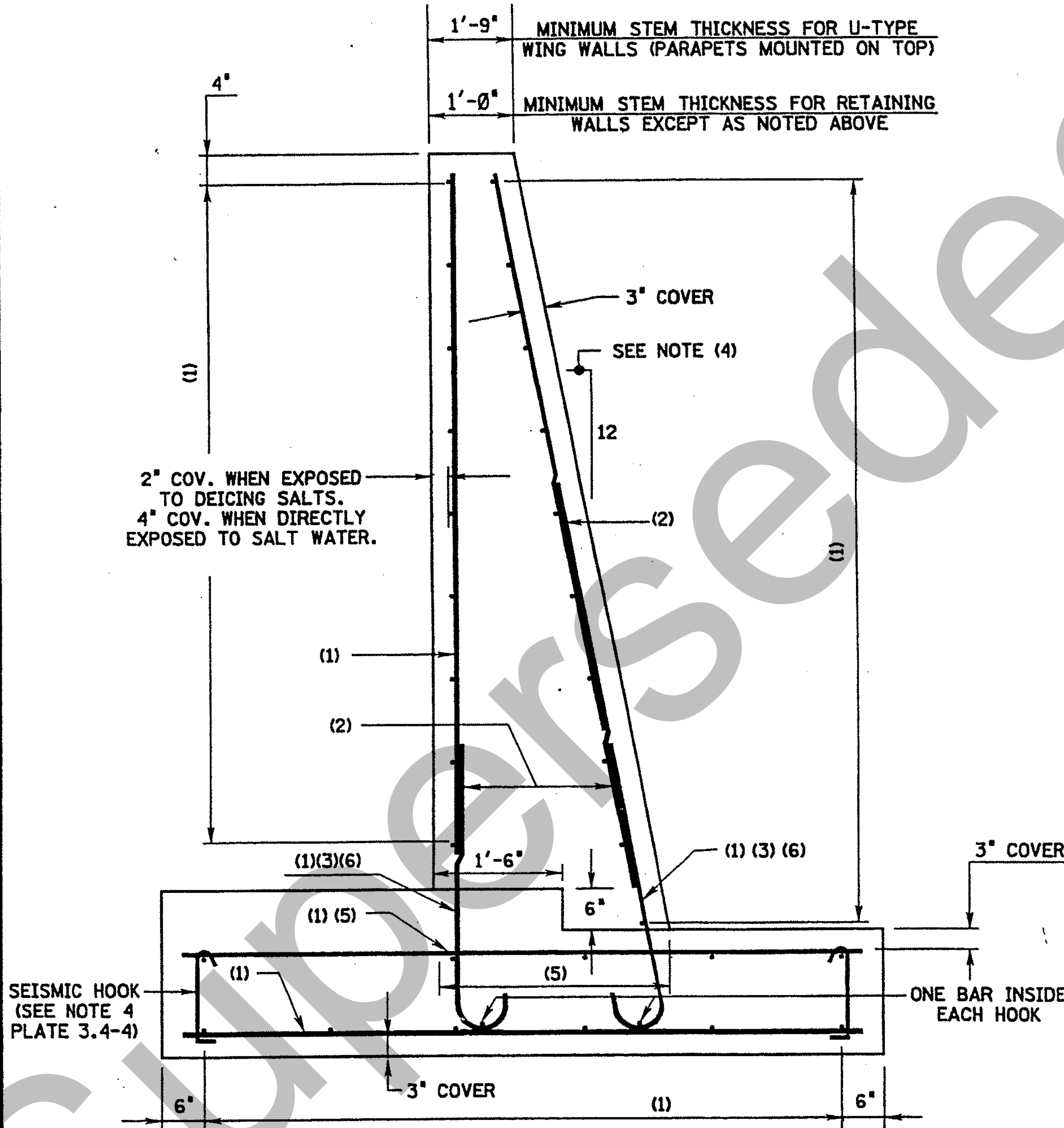


SECTION D - D

NOTES:

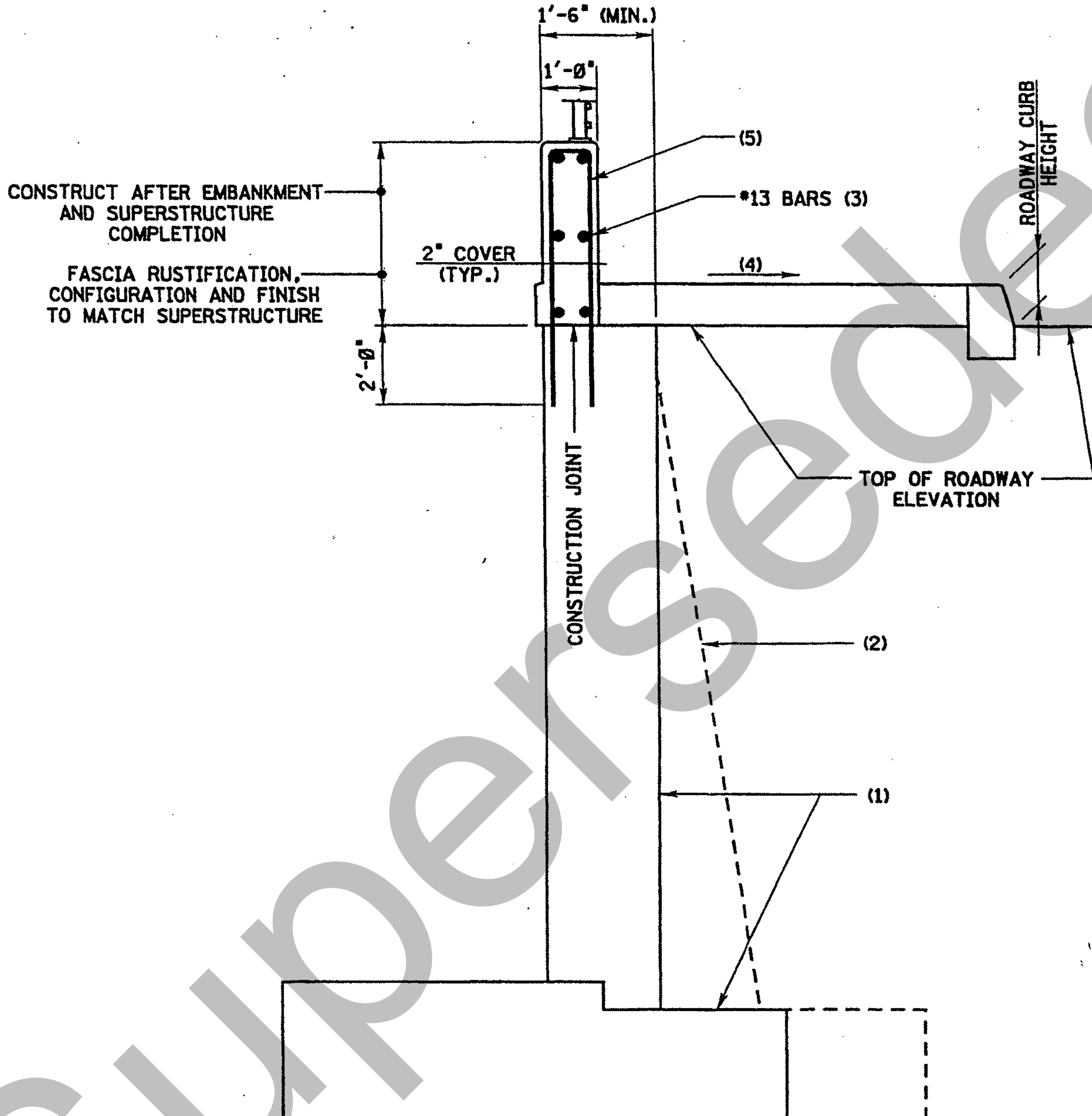
1. SLOPE TOP OF PIERS SIMILAR TO ABUTMENT.
2. SLOPE TO START FROM ℄ OF PIER, TOWARD BOTH FACES OF THE PIER.

RETAINING WALL SECTION	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.4-1



1. REINFORCEMENT NOT DESIGNATED SHALL BE AS REQUIRED BY DESIGN.
2. TENSION LAP SPLICE TO MEET AASHTO LRFD 5.11.5.3.1 CLASS C SPLICE.
3. SEE PLATE 3.4-4 FOR ALTERNATE DOWEL DETAIL.
4. DESIGNER SHALL VERIFY THE NEED FOR BATTER FOR WALLS UNDER 10'-0". WALLS OVER 10'-0" SHALL HAVE A MINIMUM BATTER OF 12:1. THE HEIGHT OF THE WALL SHALL BE MEASURED FROM THE TOP OF THE HEEL OF THE FOOTING.
5. TRANSVERSE STEEL IN TOP OF FOOTING SHALL BE DEVELOPED IN TENSION.
6. CORROSION PROTECTED DOWELS IN CORROSIVE ENVIRONMENTS. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.

U-TYPE WINGWALL WITH SIDEWALK	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.4-2



1. SEE PLATE 3.4-1 FOR TYPICAL REINFORCEMENT.

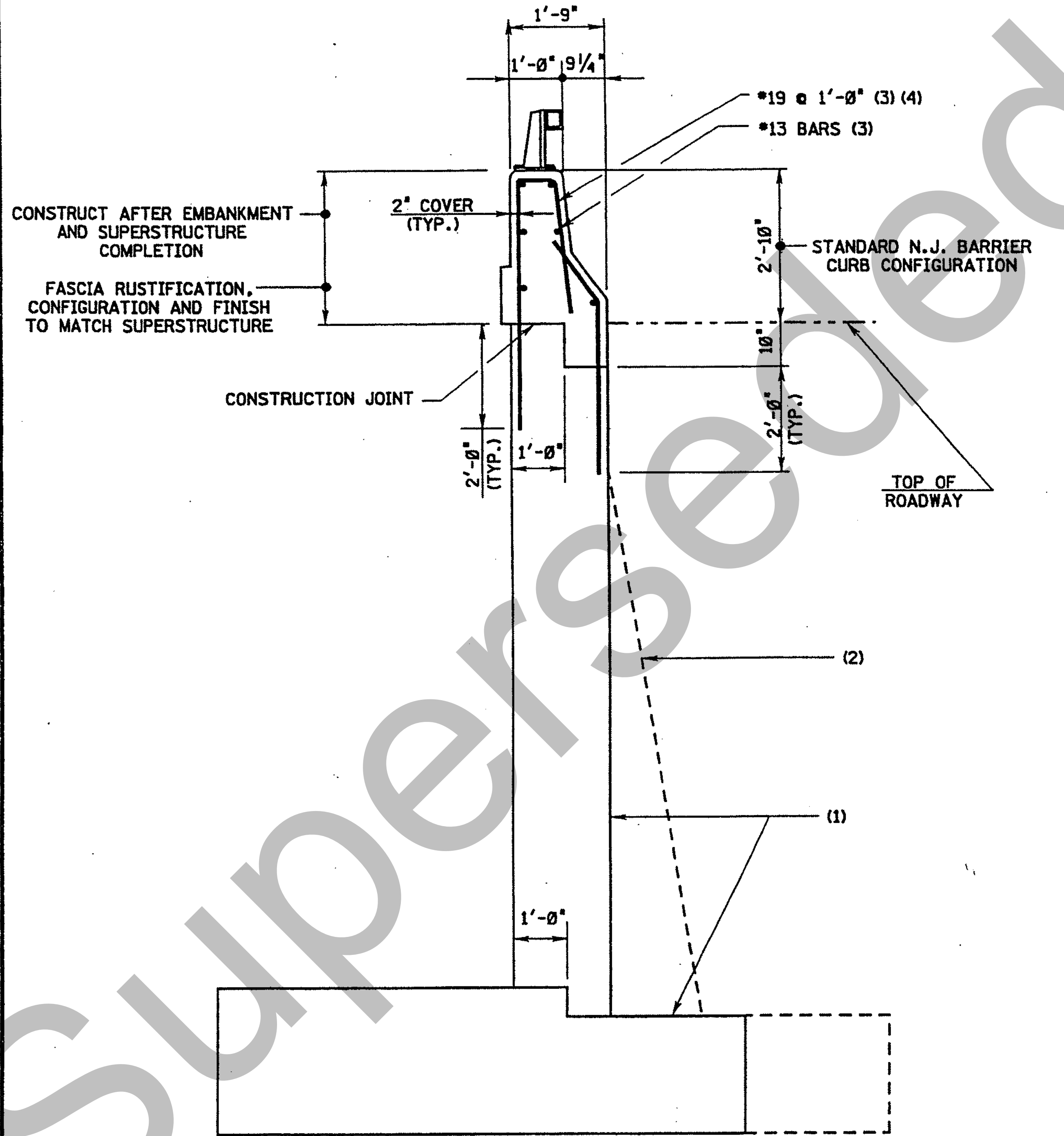
2. DESIGNER SHALL VERIFY THE NEED FOR BATTER FOR WALLS UNDER 10'-0". WALLS OVER 10'-0" SHALL HAVE A MINIMUM BATTER OF 12:1. THE HEIGHT OF THE WALL SHALL BE MEASURED FROM THE TOP OF THE HEEL OF THE FOOTING.

3. CORROSION PROTECTED REINFORCING STEEL. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.

4. SIDEWALK SHALL BE SLOPED 2 % FOR DRAINAGE.

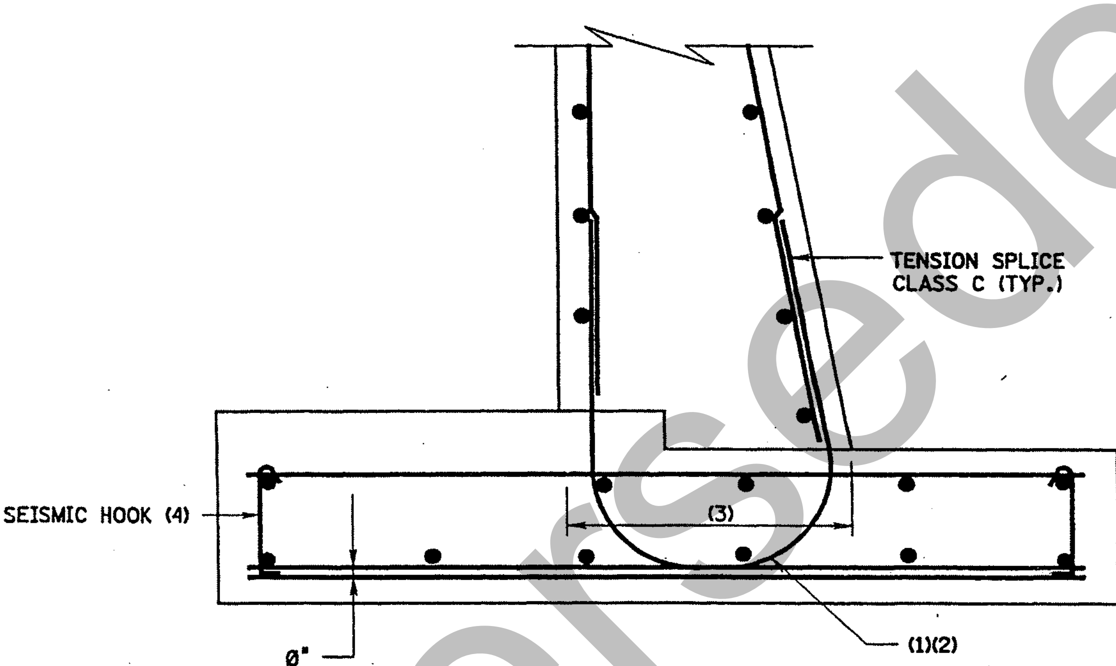
5. REINFORCEMENT SHALL BE AS REQUIRED BY DESIGN.

U-TYPE WINGWALL WITH BARRIER CURB	ISSUED: 2ØØ2 REVISION: BDCØ4MB-Ø1	PLATE 3.4-3



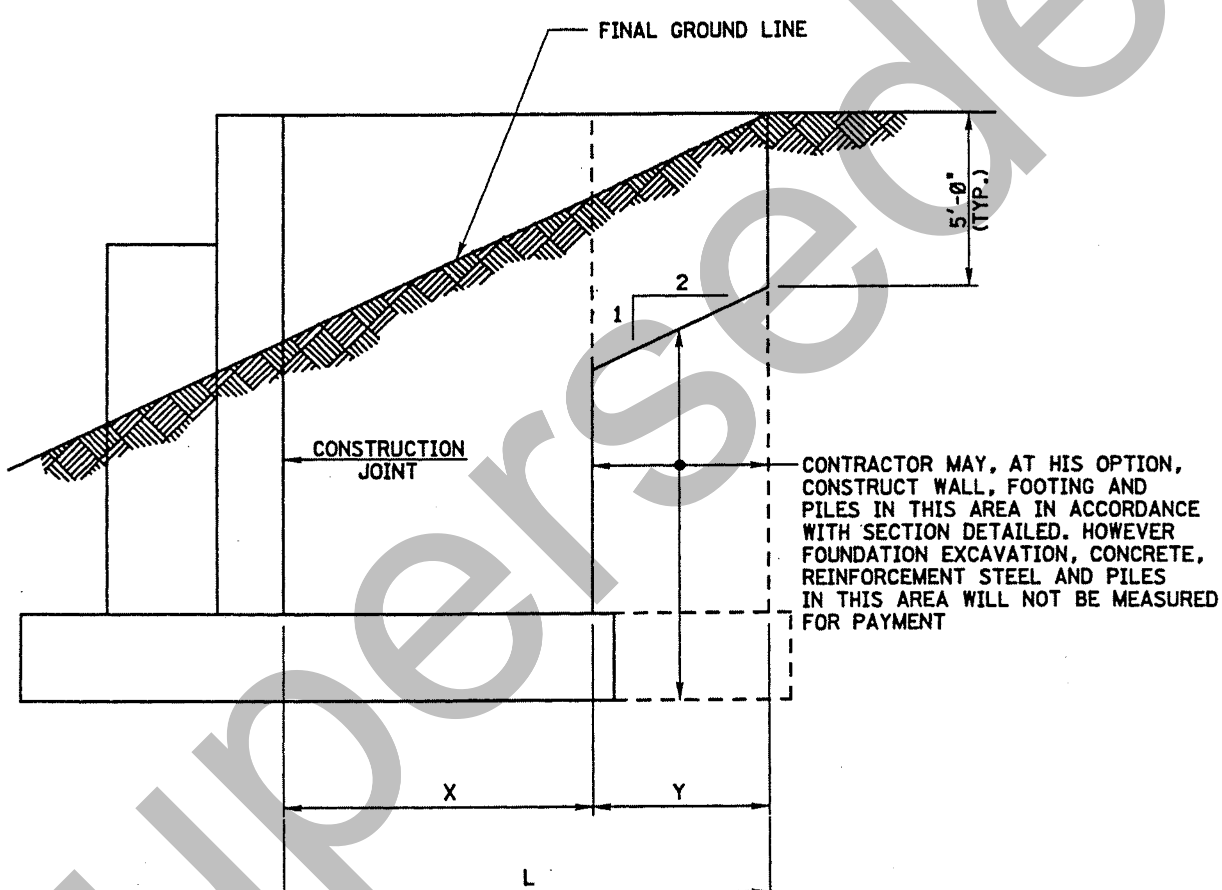
1. SEE PLATE 3.4-1 FOR TYPICAL REINFORCEMENT.
2. DESIGNER SHALL VERIFY THE NEED FOR BATTER FOR WALLS UNDER 1Ø'-Ø". WALLS OVER 1Ø'-Ø" SHALL HAVE A MINIMUM BATTER OF 12:1. THE HEIGHT OF THE WALL SHALL BE MEASURED FROM THE TOP OF THE HEEL OF THE FOOTING.
3. CORROSION PROTECTED REINFORCING STEEL. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.
4. ONE PIECE STIRRUP ARRANGEMENT MAY BE UTILIZED.

ALTERNATE DOWEL DETAIL	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.4-4



1. DOWEL CONFIGURATION SHALL BE THE SAME FOR ALL BRIDGES IN A CONTRACT.
2. CORROSION PROTECTED DOWELS SHALL BE USED IN SALT WATER ENVIRONMENTS. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.
3. TRANSVERSE STEEL IN TOP OF FOOTING SHALL BE DEVELOPED IN TENSION.
4. IN THE EVENT THAT SEISMIC FORCES GOVERN THE DESIGN OF THE FOOTING, #13 SIZE VERTICAL STIRRUPS WITH ALTERNATED 135° HOOKS AT ONE END AND 90° HOOKS AT THE OTHER END SHALL BE USED TO CONNECT THE TOP AND BOTTOM REINFORCEMENT MATS. SPACING SHALL BE A MINIMUM OF 48 INCHES.

WING STEM DETAILS	ISSUED: 2002 REV:	PLATE 3.4-5

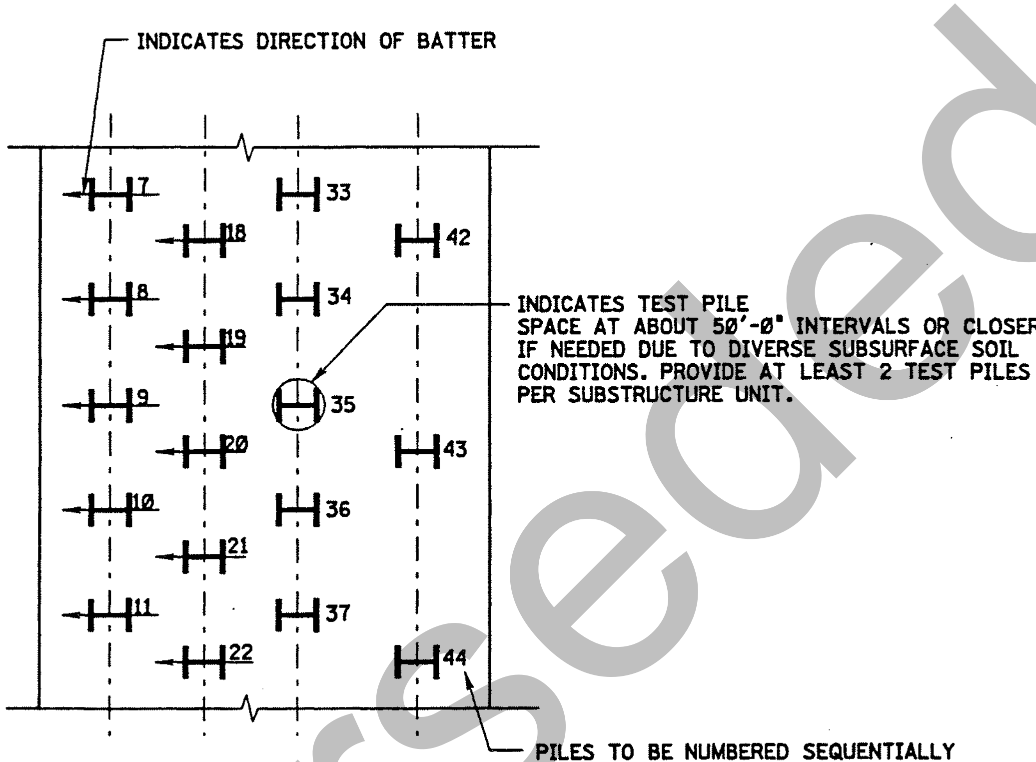


Y= 1/3 L BUT NOT TO EXCEED 10'-0".

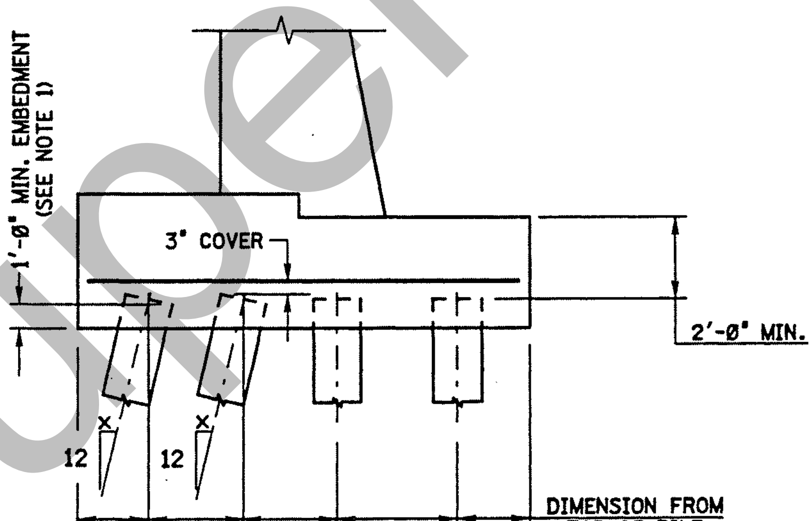
NOTE TO DESIGNERS:

SEE SUBSECTION 1.17.1.8 FOR FURTHER INFORMATION.

FOOTINGS ON PILES	ISSUED: 2002 REV:	PLATE 3.4-6



PLAN

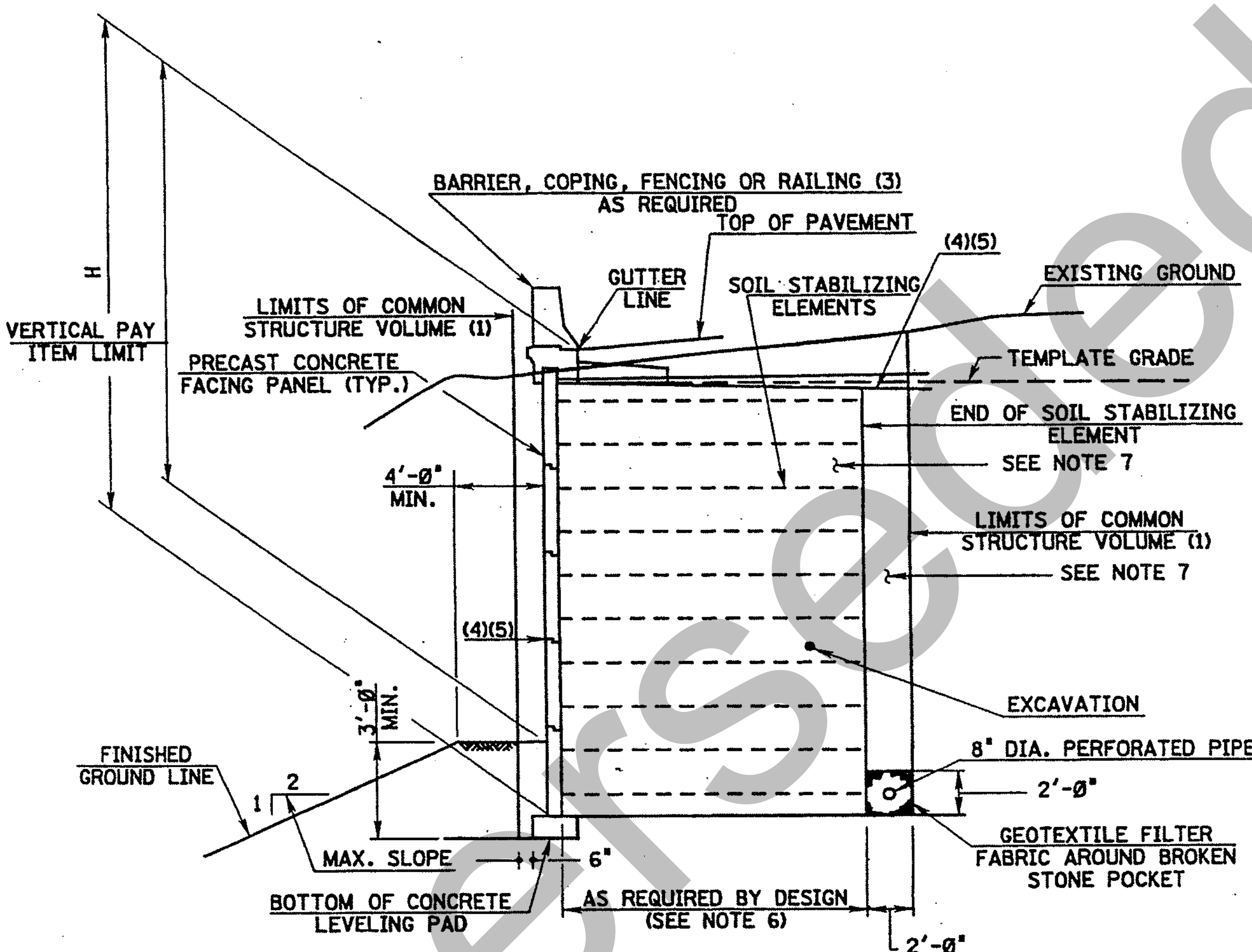


SECTION

NOTES:

1. REFERENCE AASHTO LRFD SUBSECTION 10.7.1.5.
2. REFERENCE SECTION 15 FOR THE ORIENTATION OF PILES IN THE INTEGRAL ABUTMENTS.
3. REFER TO SUBSECTION 5.13.4.6 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS FOR CONCRETE PILE ANCHORAGE SEISMIC CRITERIA.

MECHANICALLY STABILIZED EARTH WALL TYPICAL CUT SECTION	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.4-7



TYPICAL SECTION (CUT)

MECHANICALLY STABILIZED EARTH WALL

(1) THE LIMIT OF COMMON STRUCTURE VOLUME BEHIND THE WALL SHALL BE GOVERNED BY THE NARROWEST LIMIT OF ALTERNATE WALL ALLOWED IN THE CONTRACT AT THAT LOCATION. THE DESIGNER SHALL CONTACT THE WALL MANUFACTURER TO DETERMINE THE WIDTH OF THE NEEDED CUT.

(2) FOR WALLS BUILT IN PARTIAL CUT AND FILL AREAS, THE COMMON STRUCTURE VOLUME LIMITS FOR EACH SITUATION SHALL BE COMBINED INTO ONE TYPICAL SECTION.

3) PAYMENT FOR THIS ITEM IS BASED ON PROJECT TO PROJECT BASIS.

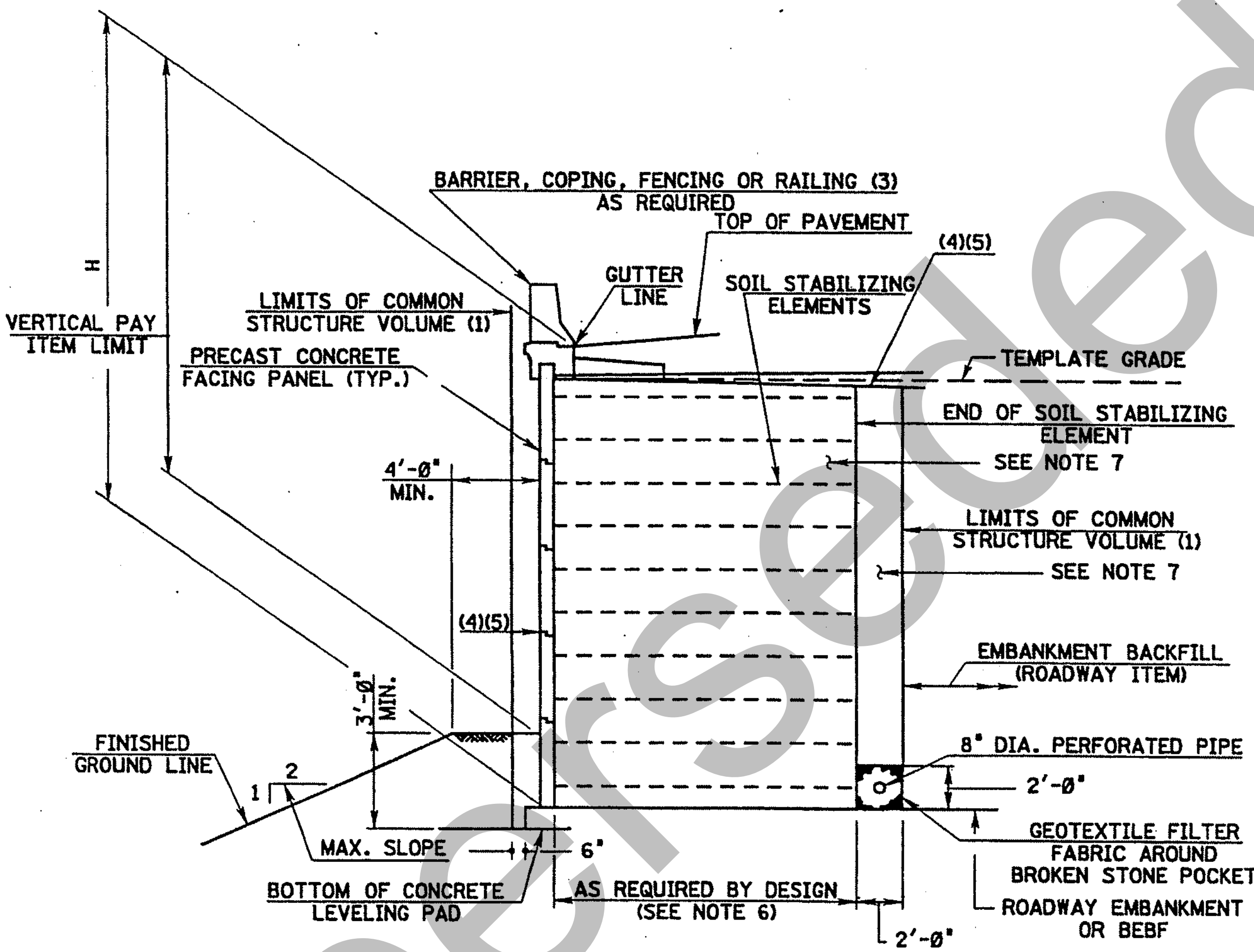
(4) REFERENCE SECTION 17 OF THIS MANUAL FOR PROVISION OF AN IMPERVIOUS MEMBRANE UPON COMPLETION OF THE SPECIFIED BACKFILL PLACEMENT. ALSO, PROVISION OF FILLER MATERIAL OR FILTER FABRIC AT THE LOCATION OF VERTICAL AND HORIZONTAL JOINTS BETWEEN PANELS SHOULD BE VERIFIED WITH THE MANUFACTURER.

(5) THE REQUIREMENTS OF SECTION 17 FOR DRAINAGE SHOULD BE ADHERED TO.

(6) AS REQUIRED BY DESIGN, A MINIMUM OF 0.7H SHALL BE USED TO SATISFY REINFORCEMENT LENGTH REQUIREMENTS. 0.8H PLUS 2'-0" SHALL BE USED TO SATISFY COMMON STRUCTURE VOLUME REQUIREMENTS.

(7) POROUS FILL OR BROKEN STONE MAY BE USED AS BACKFILL MATERIAL. SEE SUBSECTION 520.02 OF THE SPECIFICATIONS.

MECHANICALLY STABILIZED EARTH WALL TYPICAL FILL SECTION	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.4-8



TYPICAL SECTION (FILL)

MECHANICALLY STABILIZED EARTH WALL

(1) THE LIMIT OF COMMON STRUCTURE VOLUME BEHIND THE WALL SHALL BE GOVERNED BY THE WIDEST LIMIT OF ALTERNATE WALL ALLOWED IN THE CONTRACT AT THAT LOCATION. THE DESIGNER SHALL CONTACT THE WALL MANUFACTURER TO DETERMINE THE WIDTH OF THE NEEDED CUT.

(2) FOR WALLS BUILT IN PARTIAL CUT AND FILL AREAS, THE COMMON STRUCTURE VOLUME LIMITS FOR EACH SITUATION SHALL BE COMBINED INTO ONE TYPICAL SECTION.

3) PAYMENT FOR THIS ITEM IS BASED ON PROJECT TO PROJECT BASIS.

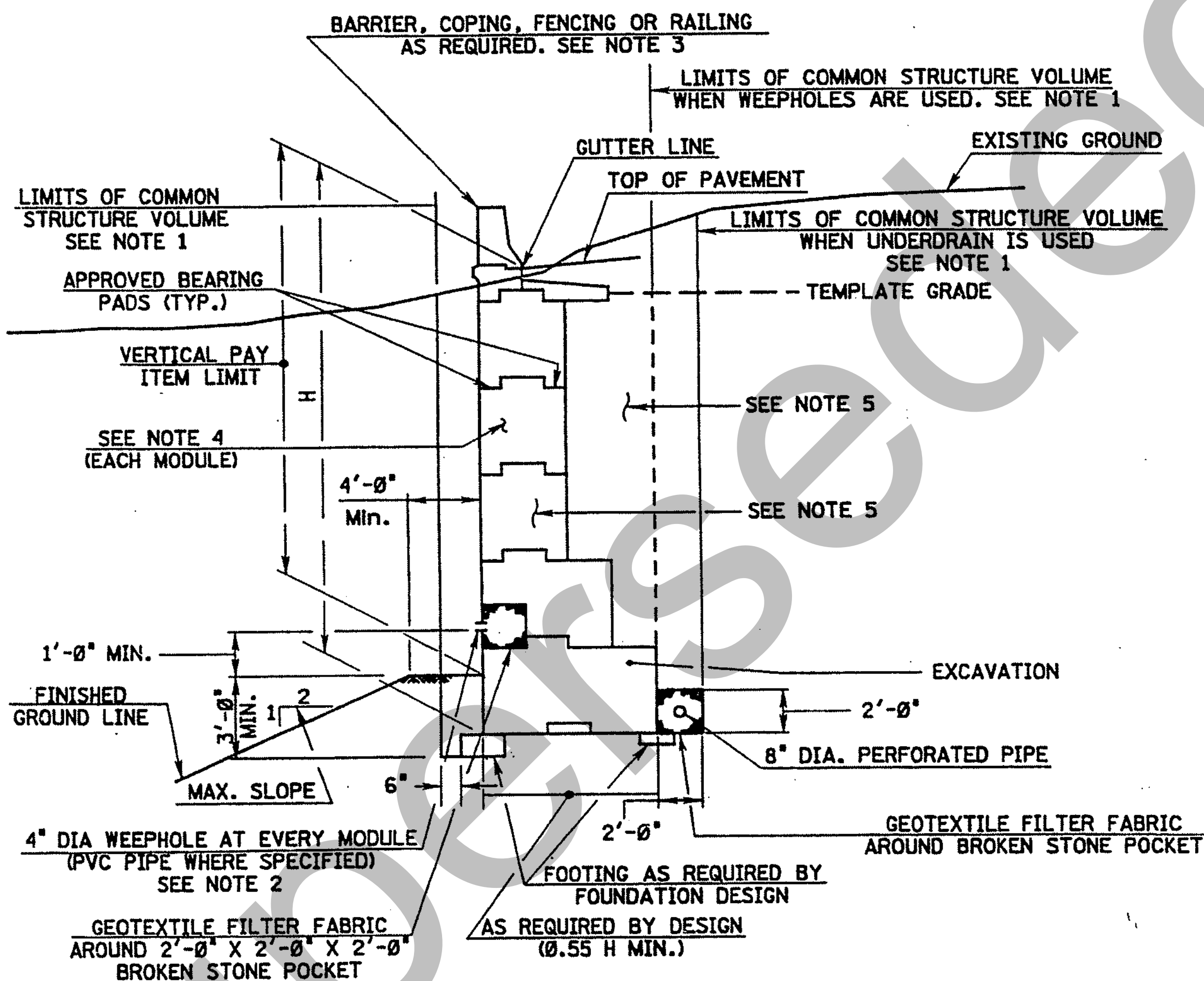
(4) REFERENCE SECTION 17 OF THIS MANUAL FOR PROVISION OF AN IMPERVIOUS MEMBRANE UPON COMPLETION OF THE SPECIFIED BACKFILL PLACEMENT. ALSO, PROVISION OF FILLER MATERIAL OR FILTER FABRIC AT THE LOCATION OF VERTICAL AND HORIZONTAL JOINTS BETWEEN PANELS SHOULD BE VERIFIED WITH THE MANUFACTURER.

(5) THE REQUIREMENTS OF SECTION 17 FOR DRAINAGE SHOULD BE ADHERED TO.

(6) AS REQUIRED BY DESIGN, A MINIMUM OF 0.7H SHALL BE USED TO SATISFY REINFORCEMENT LENGTH REQUIREMENTS. 0.8H PLUS 2'-0" SHALL BE USED TO SATISFY COMMON STRUCTURE VOLUME REQUIREMENTS.

(7) POROUS FILL OR BROKEN STONE MAY BE USED AS BACKFILL MATERIAL. SEE SUBSECTION 520.02 OF THE SPECIFICATIONS.

PREFABRICATED MODULAR WALL (DOUBLEWAL) TYPICAL CUT SECTION	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.4-9



TYPICAL SECTION (CUT)

PREFABRICATED MODULAR WALL

(1) THE LIMIT OF COMMON STRUCTURE VOLUME BEHIND THE WALL SHALL BE GOVERNED BY THE NARROWEST LIMIT OF ALTERNATE WALL ALLOWED IN THE CONTRACT AT THAT LOCATION. THE DESIGNER SHALL CONTACT THE WALL MANUFACTURER TO DETERMINE THE WIDTH OF THE NEEDED CUT.

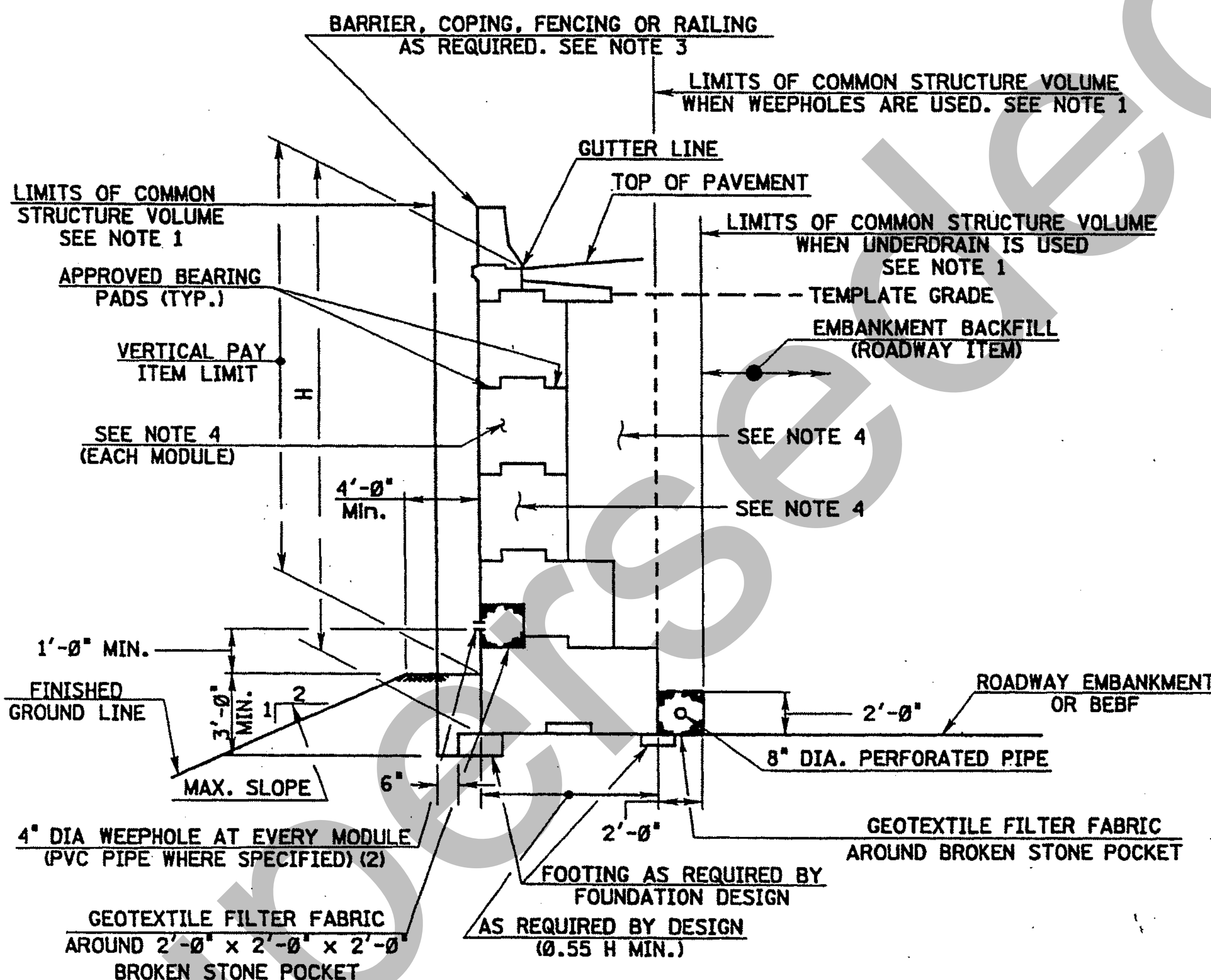
(2) FOR WEEPHOLE GUIDELINES SEE SECTION 17 OF THIS MANUAL.

(3) PAYMENT FOR THIS ITEM IS BASED ON PROJECT TO PROJECT BASIS.

(4) FOR WALLS BUILT IN PARTIAL CUT AND FILL AREAS, THE COMMON STRUCTURE VOLUME LIMITS FOR EACH SITUATION SHALL BE COMBINED INTO ONE TYPICAL SECTION.

(5) SEE SUBSECTION 519.02 OF THE SPECIFICATIONS FOR PERMISSIBLE BACKFILL MATERIAL AND FOR REQUIREMENTS FOR THE PLACEMENT OF GEOTEXTILE FILTER FABRIC MATERIAL.

PREFABRICATED MODULAR WALL (DOUBLEWAL) TYPICAL FILL SECTION	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.4-10



TYPICAL SECTION (FILL)

PREFABRICATED MODULAR WALL

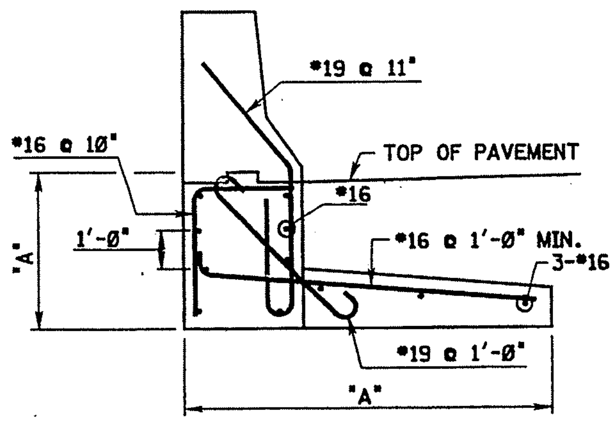
(1) THE LIMIT OF COMMON STRUCTURE VOLUME BEHIND THE WALL SHALL BE GOVERNED BY THE WIDEST LIMIT OF ALTERNATE WALL ALLOWED IN THE CONTRACT AT THAT LOCATION. THE DESIGNER SHALL CONTACT THE WALL MANUFACTURER TO DETERMINE THE WIDTH OF THE NEEDED CUT.

(2) FOR WEEPHOLE GUIDELINES SEE SECTION 17 OF THIS MANUAL.

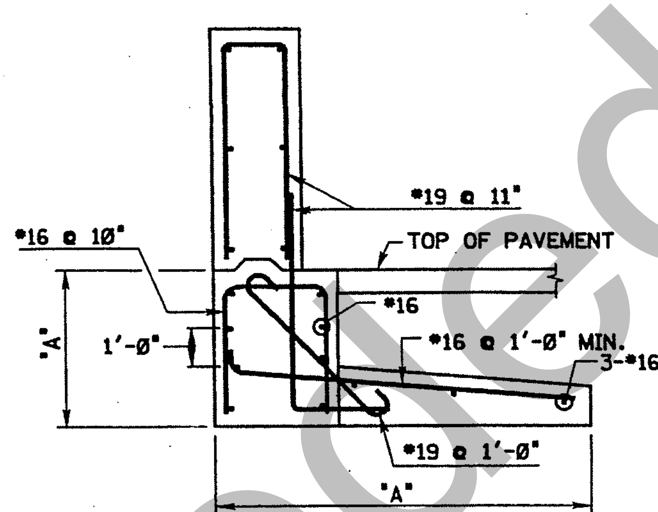
(3) PAYMENT FOR THIS ITEM IS BASED ON PROJECT TO PROJECT BASIS.

(4) SEE SUBSECTION 519.02 OF THE SPECIFICATIONS FOR PERMISSIBLE BACKFILL MATERIAL AND FOR REQUIREMENTS FOR THE PLACEMENT OF GEOTEXTILE FILTER FABRIC MATERIAL.

PROPRIETARY WALLS - COPING DETAILS	ISSUED: 2ØØ2 REVISION: BDCØ4MB-Ø1	PLATE 3.4-11

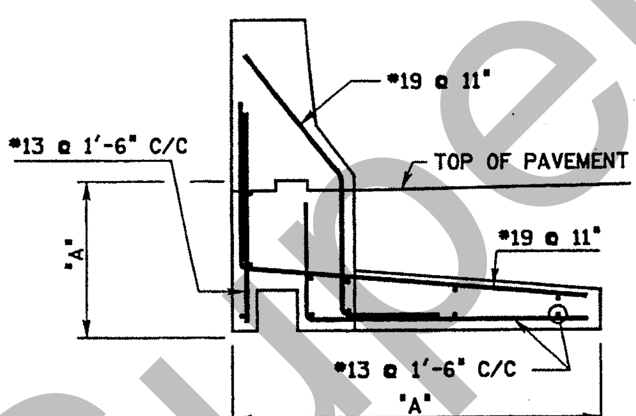


STANDARD NEW JERSEY BARRIER

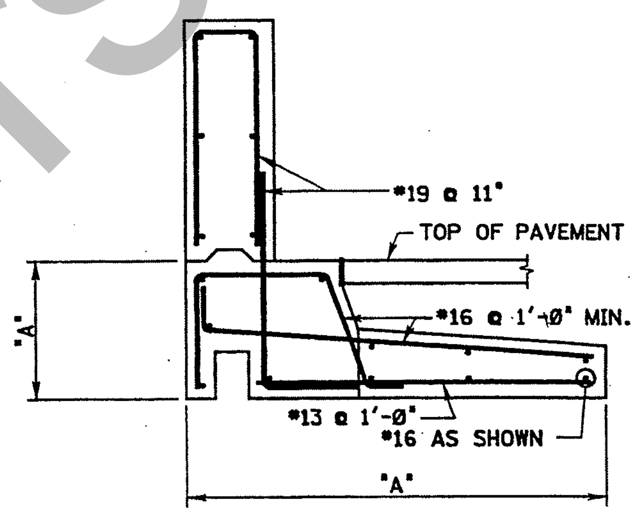


STANDARD 2'-8" PARAPET

PREFABRICATED MODULAR WALL



STANDARD NEW JERSEY BARRIER



STANDARD 2'-8" PARAPET

WHEN DESIGNING MSE WALL SYSTEMS, REFER TO SUBSECTION 5.8.12.2 OF THE AASHTO STANDARD SPECIFICATIONS FOR TREATMENT OF TRAFFIC LOADS AND OF THE BARRIER AND PARAPET LOADS.

MECHANICALLY STABILIZED EARTH WALL

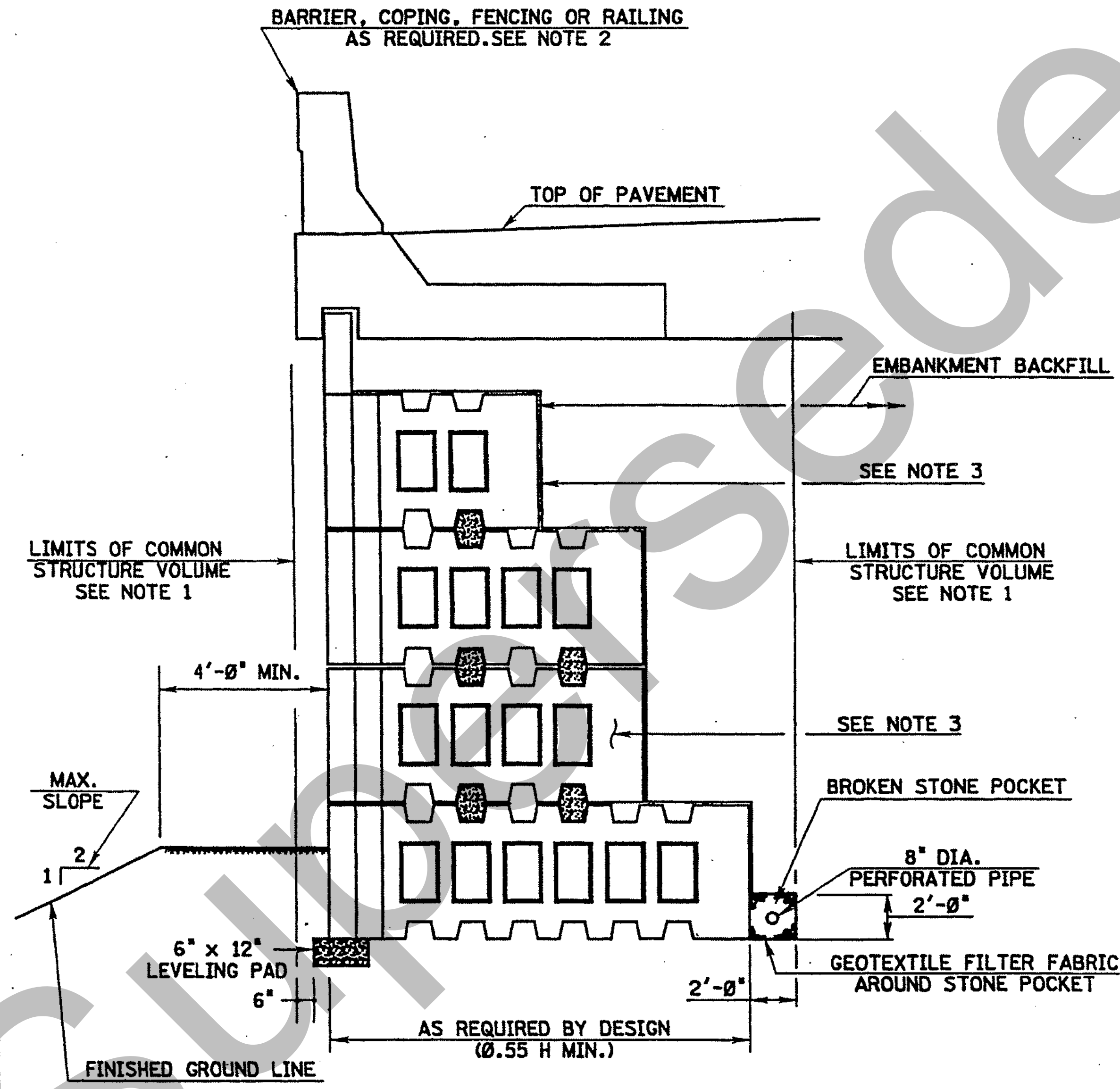
NOTES:

1. ALL DETAILED REINFORCEMENT SHALL BE CORROSION PROTECTED. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.

2. "A" DIMENSIONS SET FOR SPECIFIC SITE BY WALL MANUFACTURER.

3. THE MOMENT SLAB SHALL BE DIMENSIONED TO BE OF SUFFICIENT STRENGTH TO RESIST THE ULTIMATE STRENGTH OF THE RESPECTIVE PARAPET CONFIGURATION.

T- WALL TYPICAL SECTION	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.4-12

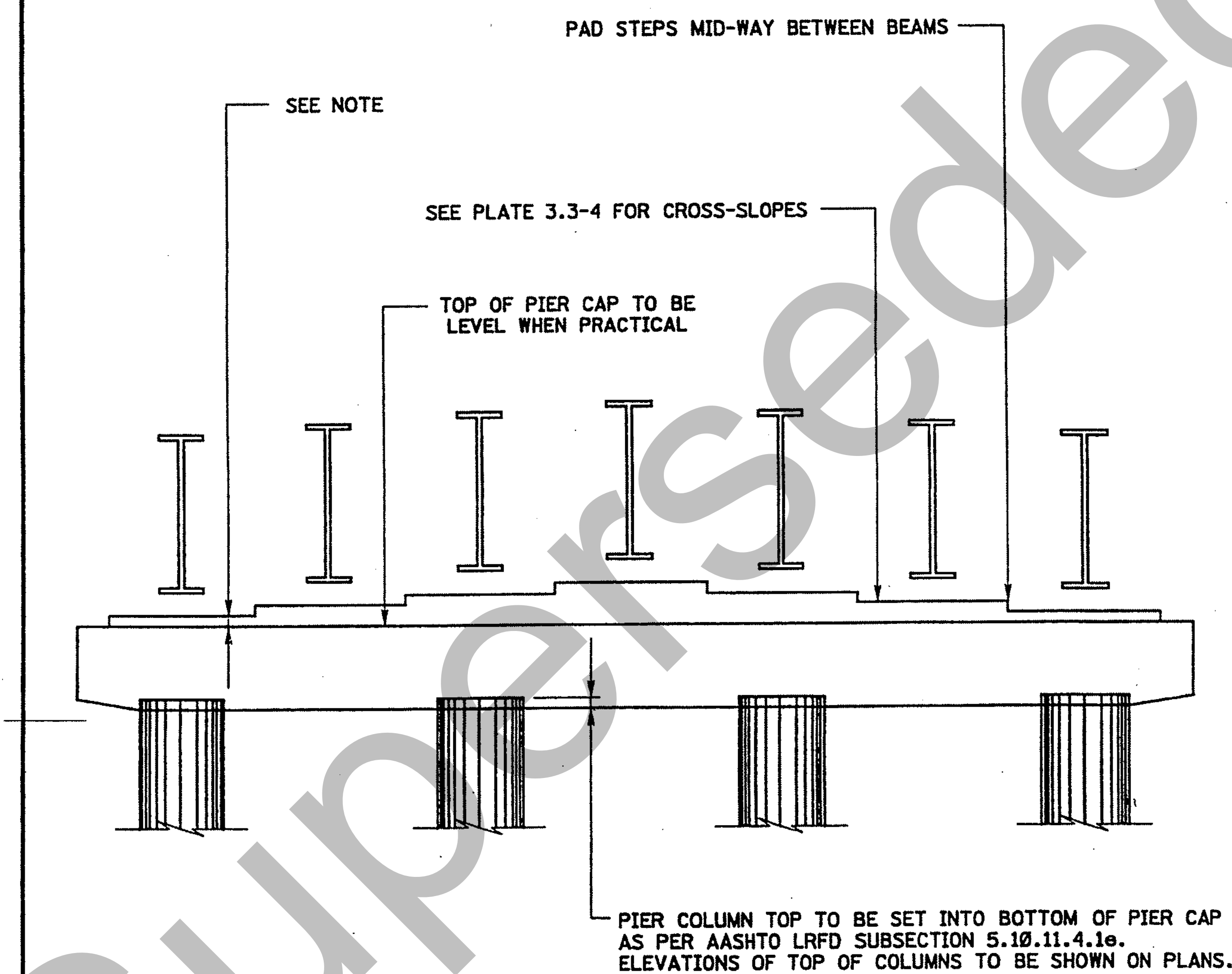


(1) THE LIMIT OF COMMON STRUCTURE VOLUME BEHIND THE WALL SHALL BE GOVERNED BY THE WIDEST LIMIT FOR FILL SECTION AND THE NARROWEST LIMIT FOR CUT SECTION OF ALTERNATE WALL ALLOWED IN THE CONTRACT AT THAT LOCATION. THE DESIGNER SHALL CONTACT THE WALL MANUFACTURER TO DETERMINE THE WIDTH OF THE NEEDED FILL.

(2) PAYMENT FOR THIS ITEM IS BASED ON PROJECT TO PROJECT BASIS.

(3) SEE SUBSECTION 519.02 OF THE SPECIFICATIONS FOR PERMISSIBLE BACKFILL MATERIAL AND FOR REQUIREMENTS FOR THE PLACEMENT OF GEOTEXTILE FILTER FABRIC MATERIAL.

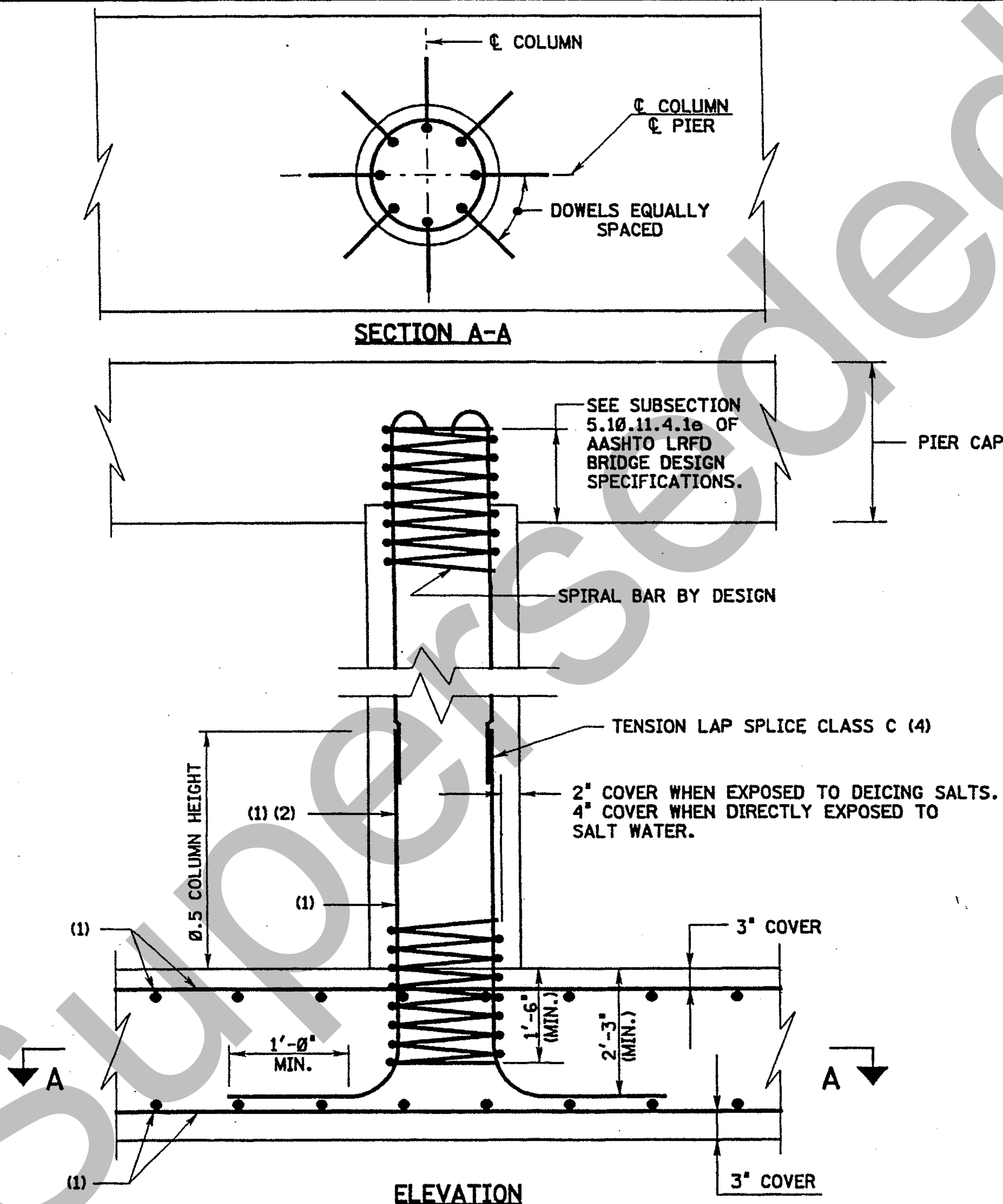
PIER CAP	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.5-1



NOTE:

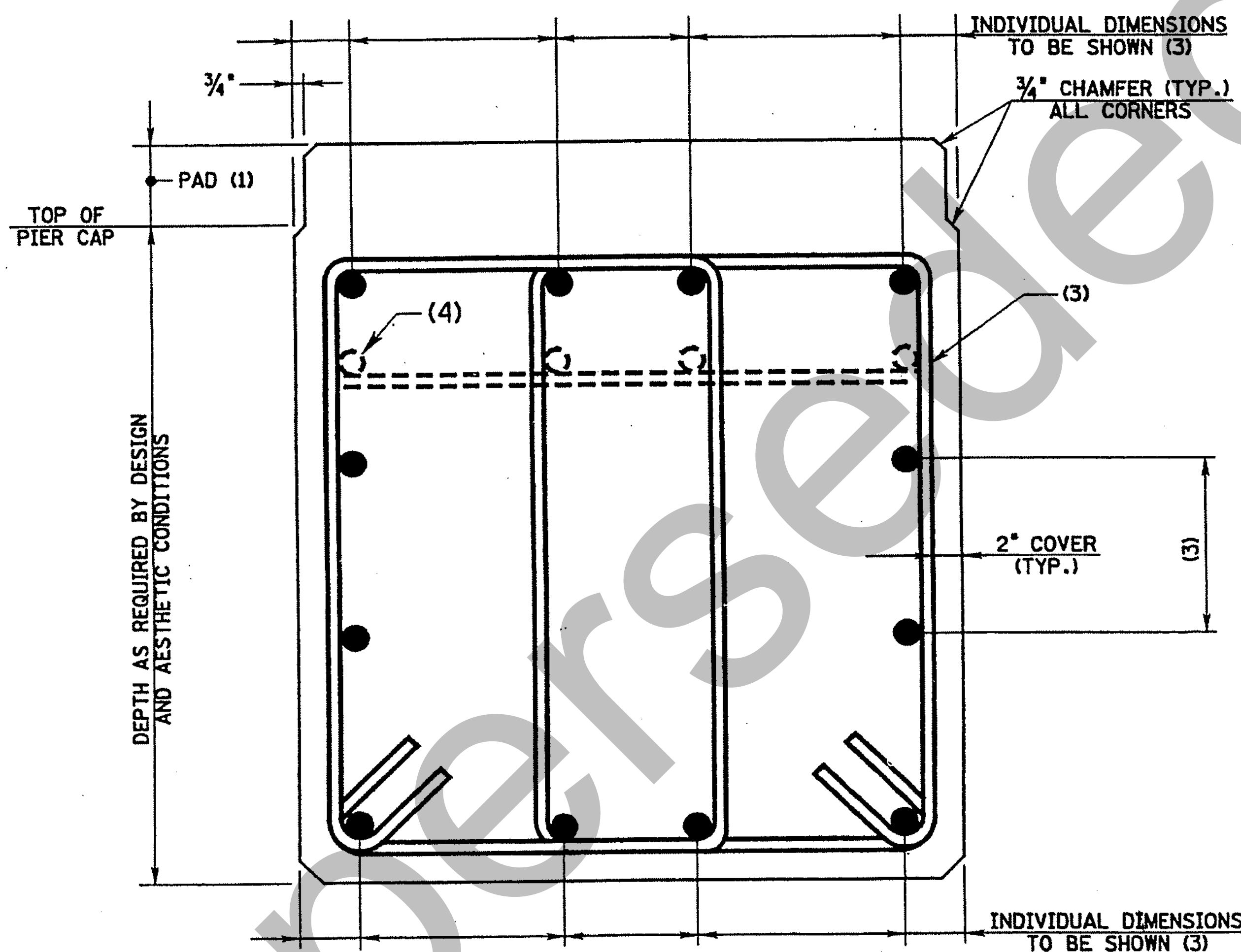
PROVIDE GRILLAGE SIMILAR TO THAT SHOWN ON PLATE 3.3-1 FOR PADS OVER 3" HIGH. GRILLAGE BARS UNDER DECK JOINTS SHALL BE CORROSION PROTECTED. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.

ROUND COLUMN REINFORCEMENT	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.5-2



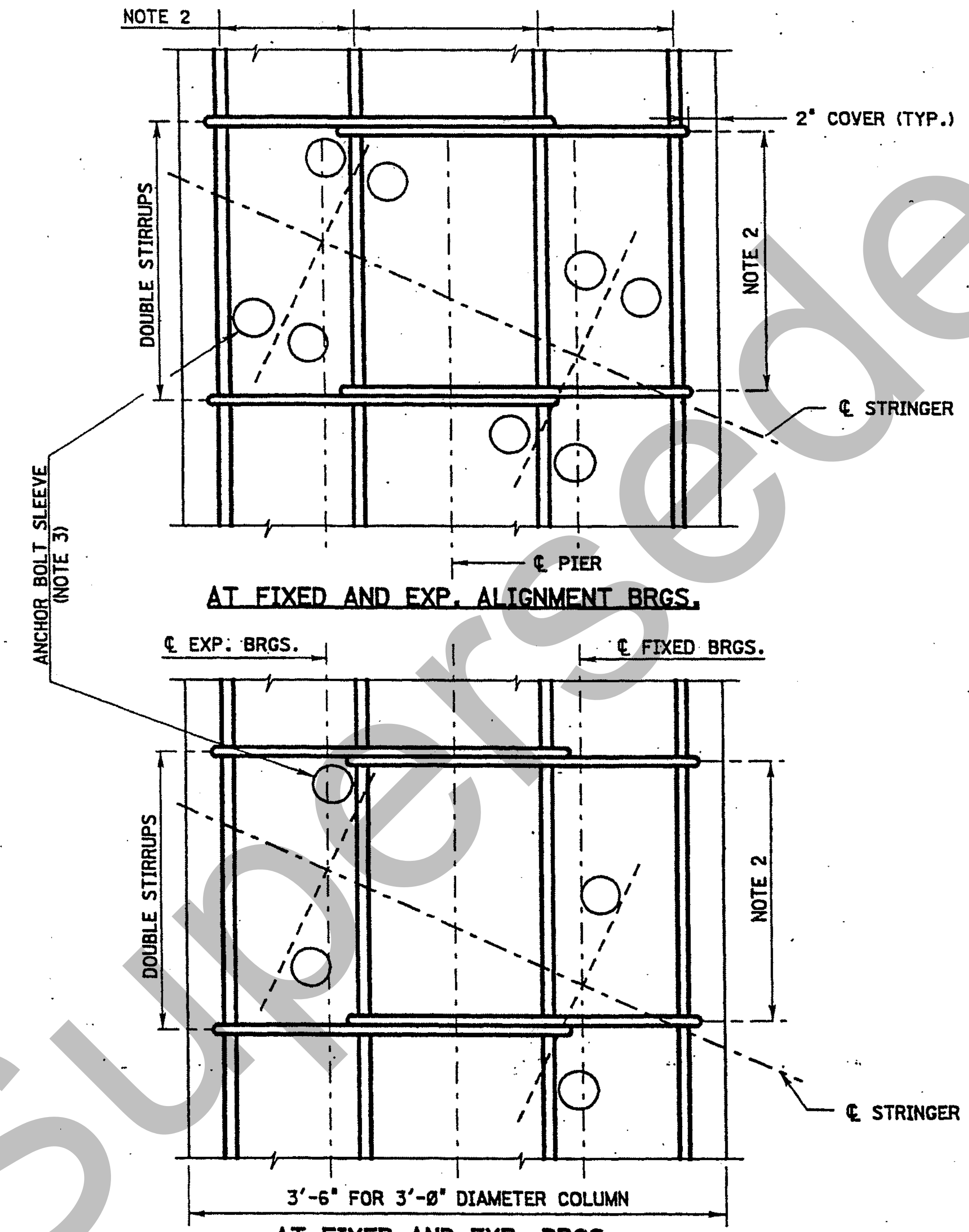
1. REINFORCEMENT STEEL AS REQUIRED BY DESIGN.
2. CORROSION PROTECTED DOWEL BARS IN CORROSIVE ENVIRONMENTS. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.
3. COLUMN DESIGN SHALL CONFORM TO THE AASHTO LRFD SPECIFICATIONS SUBSECTION 5.10.11.3.
4. STEEL REINFORCEMENT SPLICES SHALL BE IN ACCORDANCE WITH THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SUBSECTION 5.10.11.4.1f.

PIER CAP SECTION	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.5-3



1. PROVIDE GRILLAGE SIMILAR TO THAT SHOWN ON PLATE 3.3-1 FOR PADS OVER 3" HIGH. GRILLAGE BARS UNDER DECK JOINTS SHALL BE CORROSION PROTECTED. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.
2. SEE SUBSECTION 1.19.4. (INDIVIDUAL PIER CAP SECTIONS SHALL BE SHOWN FOR EACH CHANGE IN SIZE AND/OR SPACING OF BARS).
3. REINFORCEMENT STEEL SIZE AND SPACING AS REQUIRED BY DESIGN.
4. USE 2 OR MORE ROWS IF REQUIRED BY DESIGN OR AS REQUIRED TO FACILITATE PLACING OF CONCRETE AND/OR ANCHOR BOLT SLEEVES.
5. PIER CAPS UNDER DECK JOINTS SHALL BE TREATED WITH EPOXY WATERPROOFING SEAL COAT, CONFORMING TO SUBSECTION 912.12 OF THE SPECIFICATIONS. THE LIMITS SHALL BE SHOWN AS SHOWN ON STANDARD PLATE 2.6.1. SEAL COAT LIMITS FOR CONTINUOUS SPANS SHALL BE LOCATED FROM THE END OF EACH PIER CAP TO 2'-0" INSIDE THE CENTERLINE OF EACH FASCIA STRINGER.

ANCHOR BOLT LAYOUT	ISSUED: 2002 REV:	PLATE 3.5-4



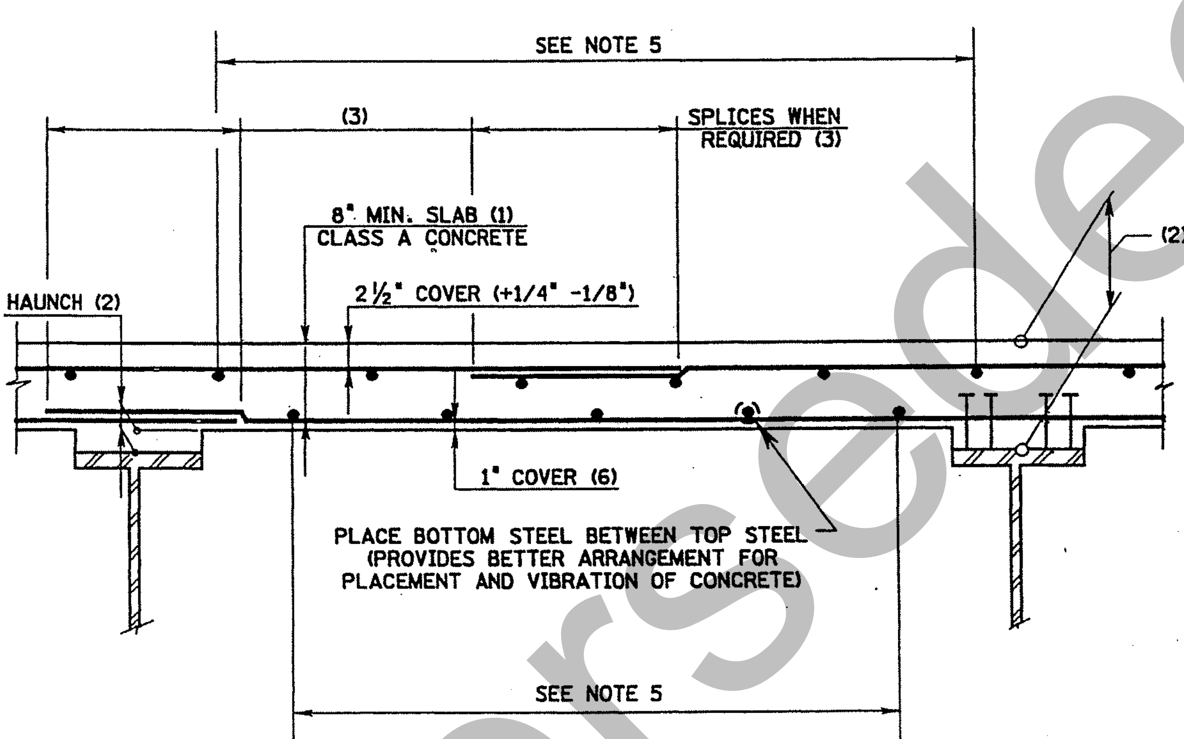
AT FIXED AND EXP. BRGS.

PLAN - PIER CAP REINFORCEMENT LAYOUT

NOTES:

1. THE ABOVE ILLUSTRATES LAYOUT REQUIRED ON CONTRACT PLANS PER SUBSECTION 1.19.4.
2. REINFORCEMENT STEEL SIZE AND SPACING AS REQUIRED BY DESIGN.
3. LOCATION AND NUMBER BY DESIGN.

DECK SLAB: ONE COURSE CONSTRUCTION REINFORCEMENT DETAILS	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.6-1

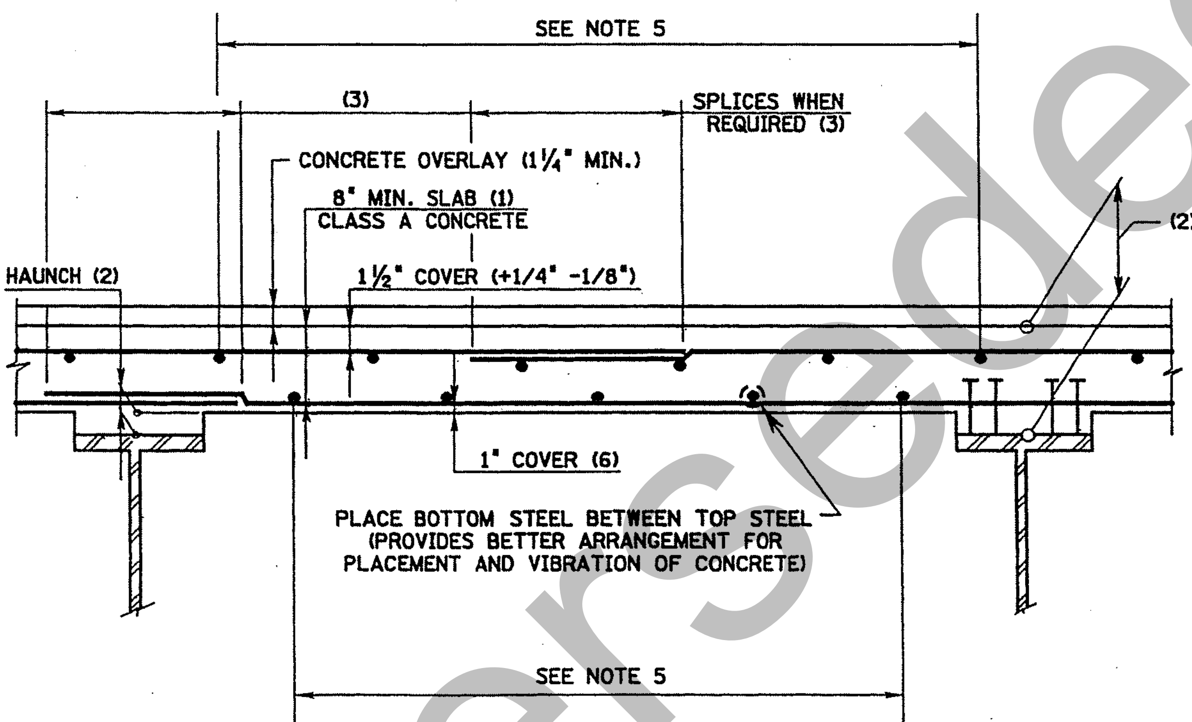


TYPICAL SLAB SECTION

NOTES:

1. SEE SUBSECTION 1.20.6 OF THIS MANUAL.
2. SEE SUBSECTION 1.20.8 OF THIS MANUAL.
3. THE SPLICES IN BOTTOM TRANSVERSE BARS SHALL BE ALTERNATED OVER ADJACENT BEAMS AT THE CENTER PORTION OF THE ROADWAY. THE SPLICES IN TOP TRANSVERSE BARS SHALL ALTERNATE OVER THE CENTERS OF ADJACENT BEAMS AT THE CENTER PORTIONS OF THE ROADWAY.
4. ALL REINFORCING STEEL SHALL BE CORROSION PROTECTED. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.
5. THE TOP AND BOTTOM LONGITUDINAL REINFORCEMENT SHALL BE PROVIDED AS PER TABLE-1 OF SUBSECTION 1.20.6 OF THIS MANUAL FOR THE DECK SLABS THAT MEET THE DESIGN CRITERIA OF AASHTO LRFD APPENDIX A4. OTHERWISE, THE REINFORCEMENT SHALL BE DESIGNED ACCORDING TO AASSHTO LRFD SUBSECTION 5.10.3.2.
6. PROVIDE 1½" BOTTOM COVER IN BRIDGE STRUCTURES THAT ARE LOCATED IN MARINE ENVIRONMENT.

DECK SLAB: TWO COURSE CONSTRUCTION REINFORCEMENT DETAILS	ISSUED: 2ØØ2 REVISION: BDCØ4MB-Ø1	PLATE 3.6-2

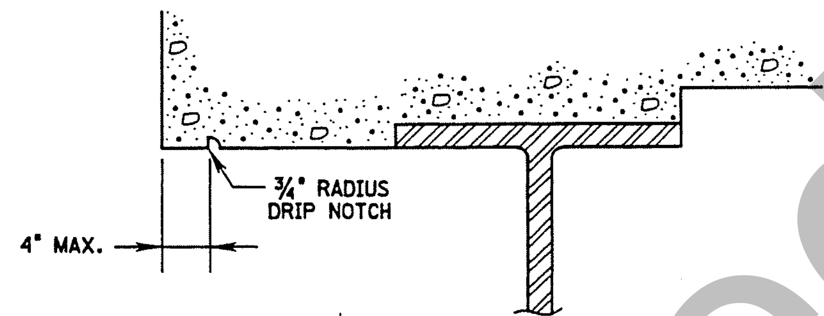


TYPICAL SLAB SECTION

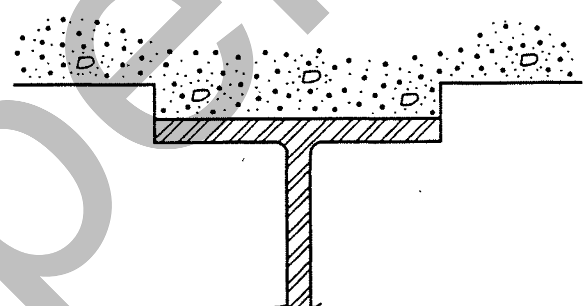
NOTES:

1. SEE SUBSECTION 1.2Ø.6 OF THIS MANUAL.
2. SEE SUBSECTION 1.2Ø.8 OF THIS MANUAL.
3. THE SPLICES IN BOTTOM TRANSVERSE BARS SHALL BE ALTERNATED OVER ADJACENT BEAMS AT THE CENTER PORTION OF THE ROADWAY. THE SPLICES IN TOP TRANSVERSE BARS SHALL ALTERNATE OVER THE CENTERS OF ADJACENT BEAMS AT THE CENTER PORTIONS OF THE ROADWAY.
4. ALL REINFORCING STEL SHALL BE CORROSION PROTECTED. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.
5. THE TOP AND BOTTOM LONGITUDINAL REINFORCEMENT SHALL BE PROVIDED AS PER TABLE-1 OF SUBSECTION 1.2Ø.6 OF THIS MANUAL FOR THE DECK SLABS THAT MEET THE DESIGN CRITERIA OF AASHTO LRFD APPENDIX A4. OTHERWISE, THE REINFORCEMENT SHALL BE DESIGNED ACCORDING TO AASSHTO LRFD SUBSECTION 5.1Ø.3.2.
6. PROVIDE 1½" BOTTOM COVER IN BRIDGE STRUCTURES THAT ARE LOCATED IN MARINE ENVIRONMENT.

HAUNCH FOR DECK SLAB	ISSUED: 2002 REV:	PLATE 3.6-3



HAUNCH - FASCIA BEAMS

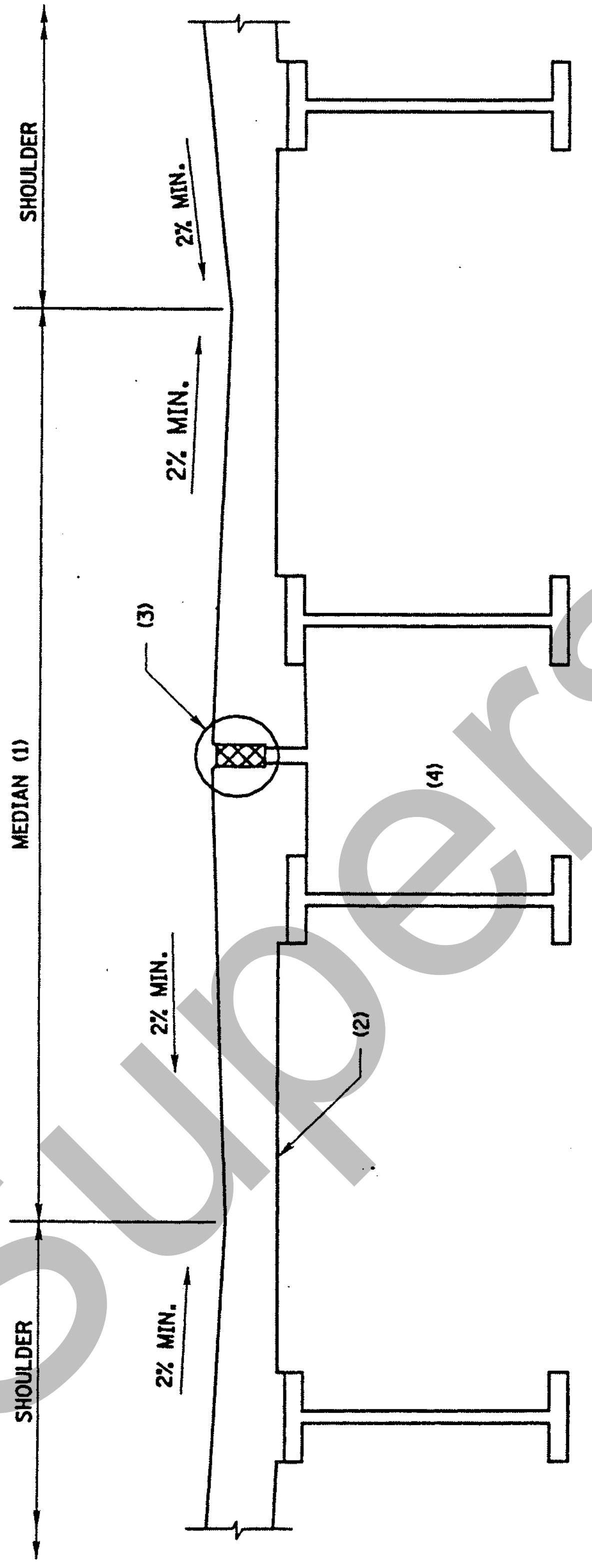


HAUNCH - INTERIOR BEAMS

NOTE TO DESIGNER:

SEE SUBSECTION 1.20.8 FOR FURTHER INFORMATION.

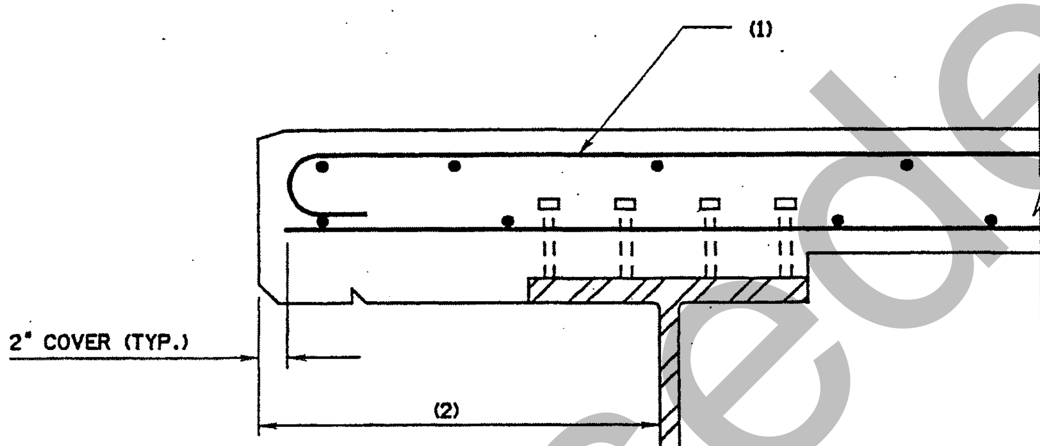
DECKED OVER MEDIAN	ISSUED: 2002 REV:	PLATE 3.6-4



NOTES:

1. SEE SUBSECTION 1.20.2 AND 1.20.12.
2. SEE PLATE 3.6-1 AND 3.6-2 FOR REINFORCEMENT STEEL.
3. SEE PLATE 3.8-1 AND 3.8-2 DETAIL NO. 2.
4. SEE SECTION 22 FOR DECK DRAINAGE CRITERIA.

DECK SLAB REINFORCEMENT, DETAILS AT FASCIA	ISSUED: 2002 REV:	PLATE 3.6-5

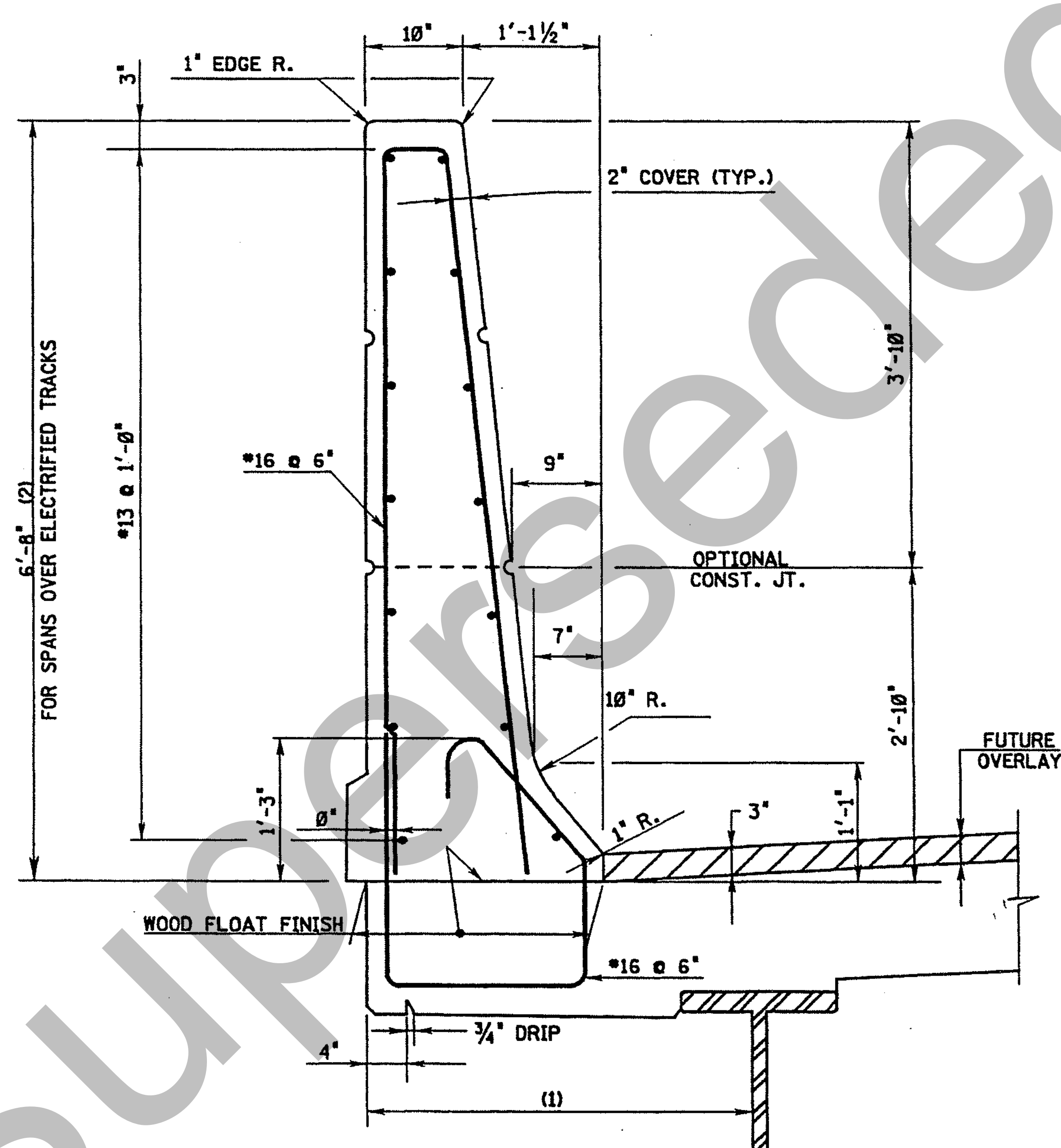


NOTES:

1. THE OVERHANG PORTION OF THE DECK SHALL BE DESIGNED ACCORDING TO LRFD BRIDGE DESIGN SPECIFICATIONS SUBSECTION 9.7.1-5. REFER TO SUBSECTION 1.20.6 OF THIS MANUAL.

2. OVERHANG LENGTH SHALL NOT EXCEED 4'-6". REFER TO NJDOT STIPULATIONS TO AASHTO LRFD SUBSECTION 9.7.1.5 IN CHAPTER 3 OF THIS MANUAL. PERMANENT METAL STAY-IN-PLACE FORMS NOT PERMITTED IN THIS AREA.

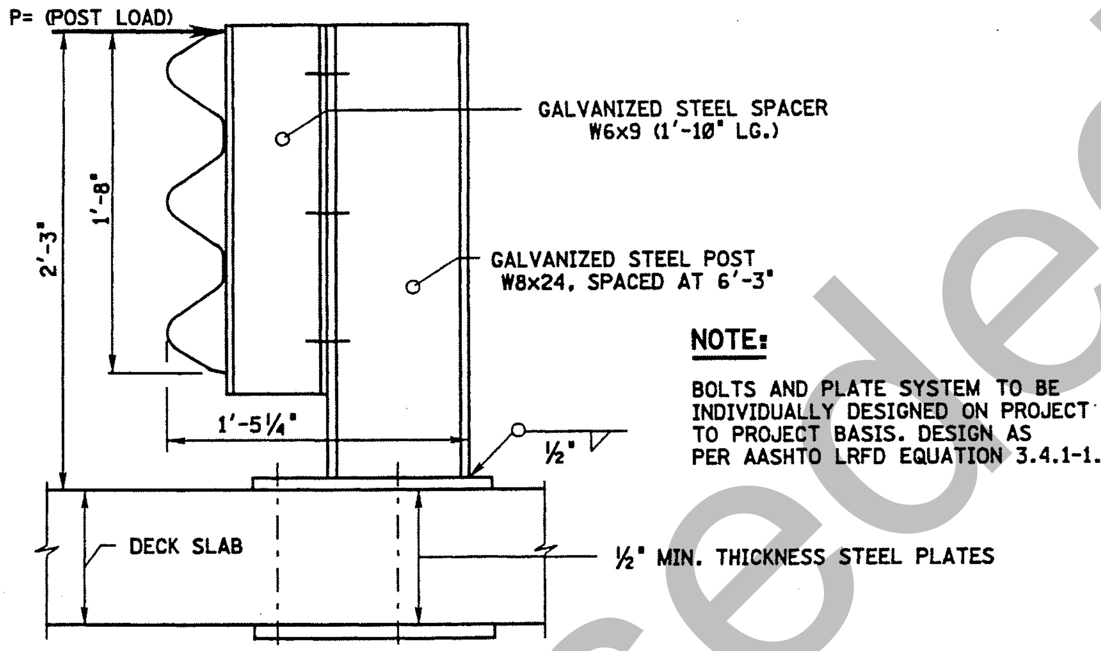
6′-8" HIGH PARAPET WITH BARRIER CURB	ISSUED: 2002 ~~REVISION:~~ BDC04MB-01	PLATE 3.7-1



NOTES:

1. PREFERRED MAXIMUM OVERHANG IS 2′-6".
2. FACIA RUSTICATION AND/OR CONFIGURATION SUBJECT TO STUDY AND DEVELOPMENT ON AN INDIVIDUAL BRIDGE BASIS.
3. SEE SUBSECTION 1.20.13 FOR LOCATION OF CONTRACTION AND OPEN JOINTS IN PARAPET AND BARRIER CURB.
4. ALL REINFORCING STEEL SHALL BE CORROSION PROTECTED. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.
5. PROVIDE ADDITIONAL REINFORCEMENT IN THE VICINITY OF PARAPET JOINTS TO PREVENT CRACKING IN THE DECK OVERHANG. REFER TO STANDARD BRIDGE CONSTRUCTION DETAIL BCD-3.

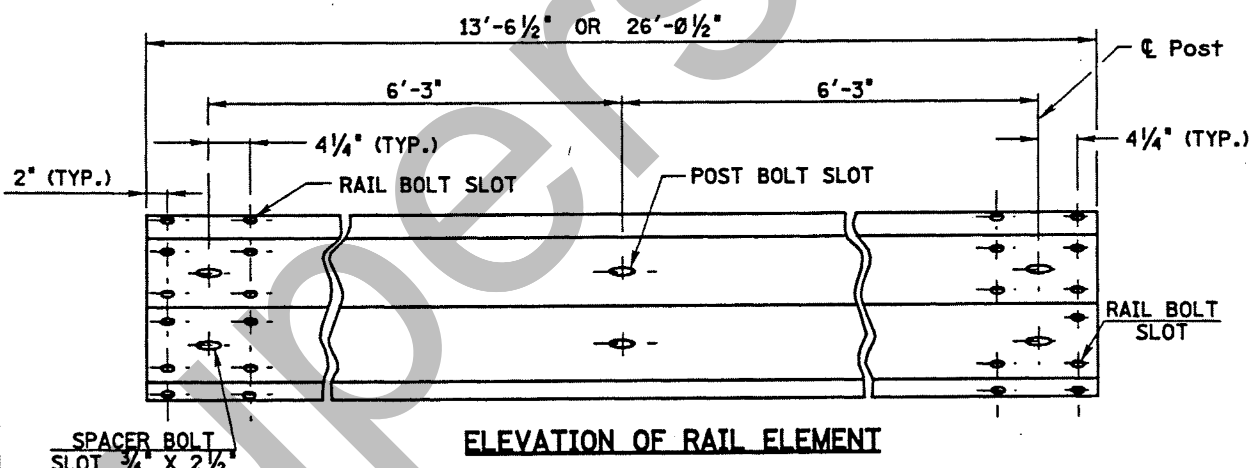
TEMPORARY BARRIER, BRIDGE	ISSUED: 2002 REV:	PLATE 3.7-2



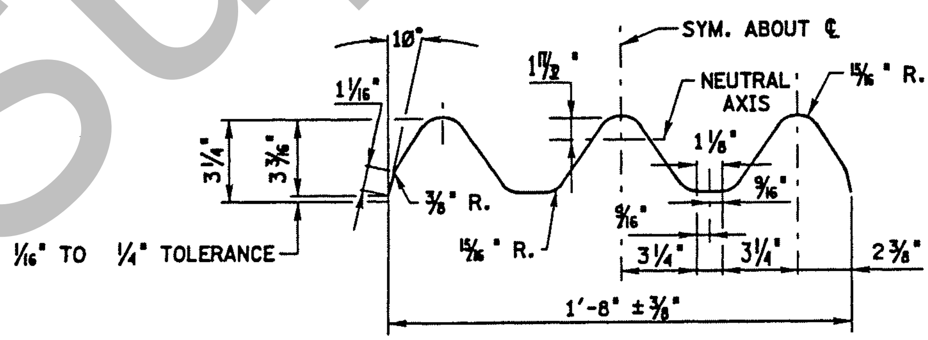
NOTE:

BOLTS AND PLATE SYSTEM TO BE INDIVIDUALLY DESIGNED ON PROJECT TO PROJECT BASIS. DESIGN AS PER AASHTO LRFD EQUATION 3.4.1-1.

ELEVATION OF POST

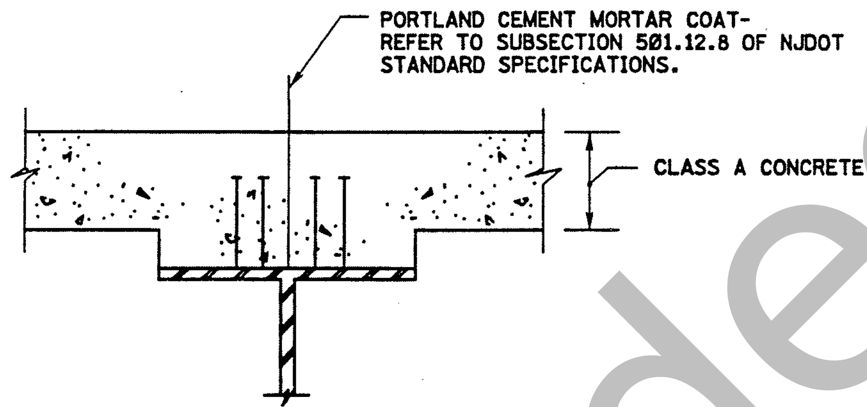


ELEVATION OF RAIL ELEMENT

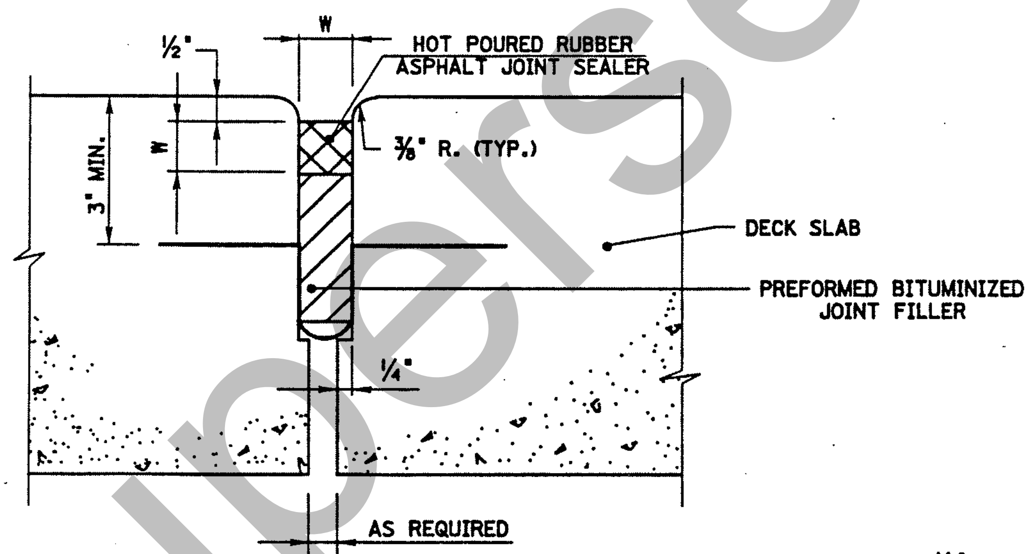


SECTION THROUGH 10 GA. RAIL ELEMENT, GALVANIZED

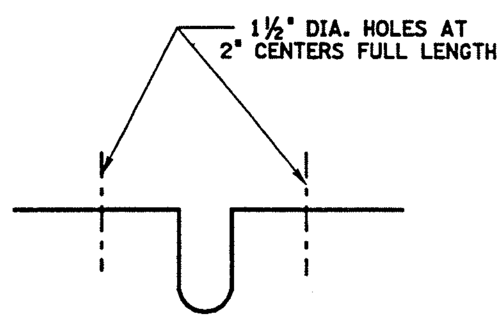
LONGITUDINAL JOINTS IN DECK SLAB (ONE-COURSE CONSTRUCTION)	ISSUED: 2002 REV:	PLATE 3.8-1



DETAIL No. 1
LONGITUDINAL CONSTRUCTION JOINT IN DECK SLAB



DETAIL No. 2
LONGITUDINAL EXPANSION JOINT IN DECK SLAB

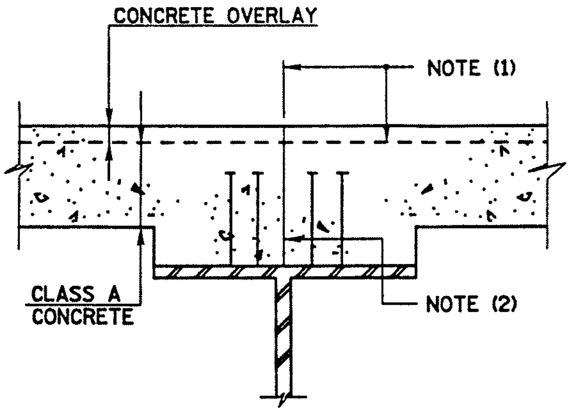


DETAIL " Y "

NOTE TO DESIGNER:

SEE SUBSECTION 1.21.2 FOR FURTHER INFORMATION.

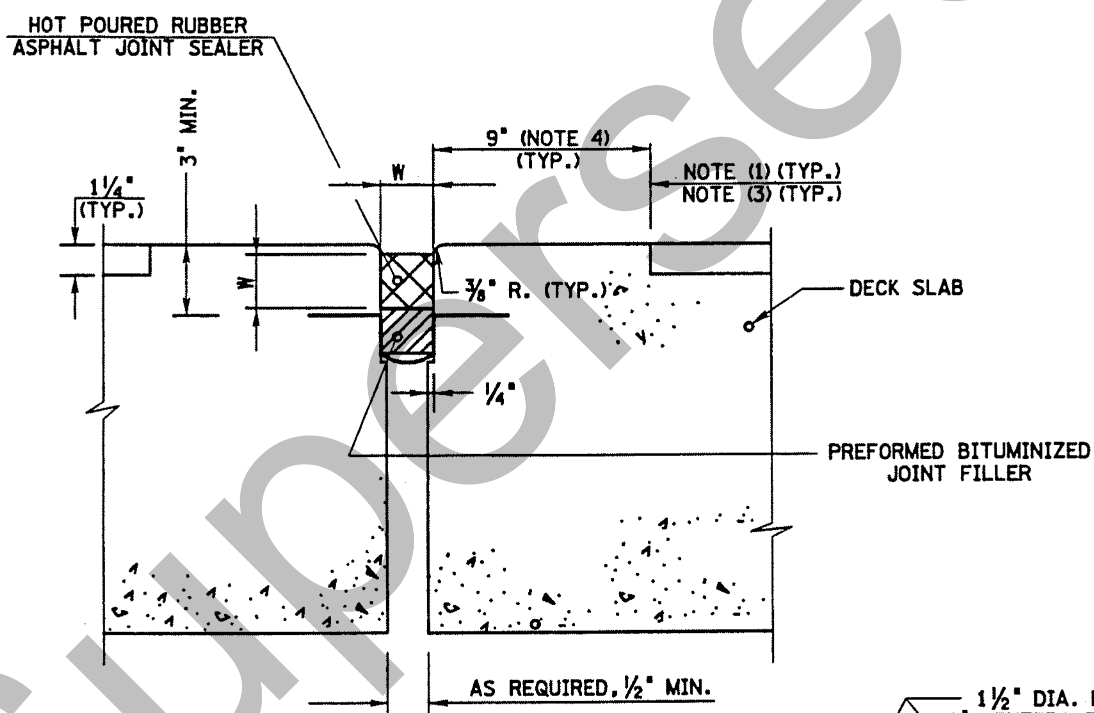
LONGITUDINAL JOINTS IN DECK SLAB (TWO-COURSE CONSTRUCTION)	ISSUED: 2002 REV:	PLATE 3.8-2



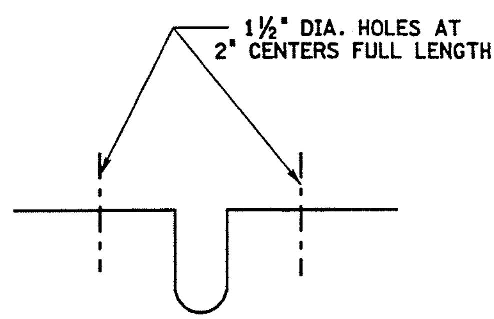
DETAIL No. 1
LONGITUDINAL CONSTRUCTION JOINT IN DECK SLAB

NOTES:

1. SEE STANDARD AND SUPPLEMENTAL SPECIFICATIONS FOR CLEANING CONTACT SURFACES AND PLACING CONCRETE OVERLAY.
2. PORTLAND CEMENT MORTAR COAT REQUIRED FOR JOINT IN FIRST-COURSE SLAB. EXCESS OVERFLOW AT TOP SHALL BE REMOVED. REFER TO SECTION 501.12.8 OF NJDOT STANDARD SPECIFICATIONS.
3. CONTRACTOR SHALL USE PLASTIC COATED FORMS AT THESE LOCATIONS.
4. FLOAT FINISH AND APPLY GRIT BEFORE CONCRETE SETS TO CREATE A NON-SKID SURFACES.



DETAIL No. 2
LONGITUDINAL EXPANSION JOINT IN DECK SLAB

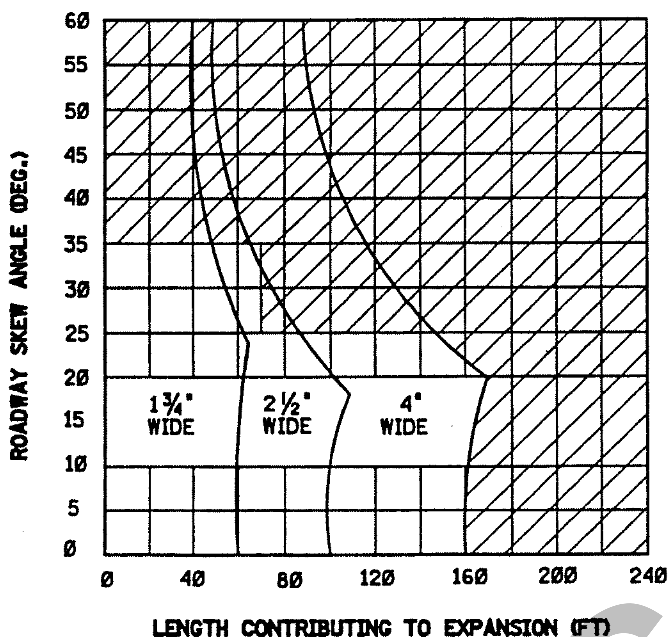


DETAIL " Y "

NOTE TO DESIGNER:

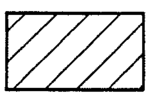
SEE SUBSECTION 1.21.2 FOR FURTHER INFORMATION.

ELASTOMERIC COMPRESSION AND STRIP SEAL EXPANSION JOINT SELECTION CHART	ISSUED: 2002 REV:	PLATE 3.8-3



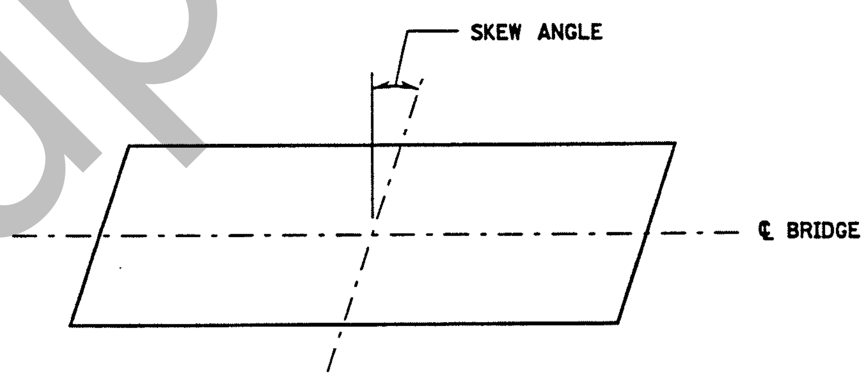
NOMINAL SIZE OF PREFORMED ELASTOMERIC COMPRESSION JOINT SEALS SHOWN.

JOINT TYPES FOR SPAN LENGTHS OVER 250' SHALL BE SUBJECT TO APPROVAL AT THE PRELIMINARY SUBMISSION



STRIP SEAL EXPANSION DAMS MAY BE USED IN THIS RANGE. OTHER LOCATIONS SHALL BE UPON APPROVAL BY THE ENGINEER ON A PROJECT TO PROJECT BASIS.

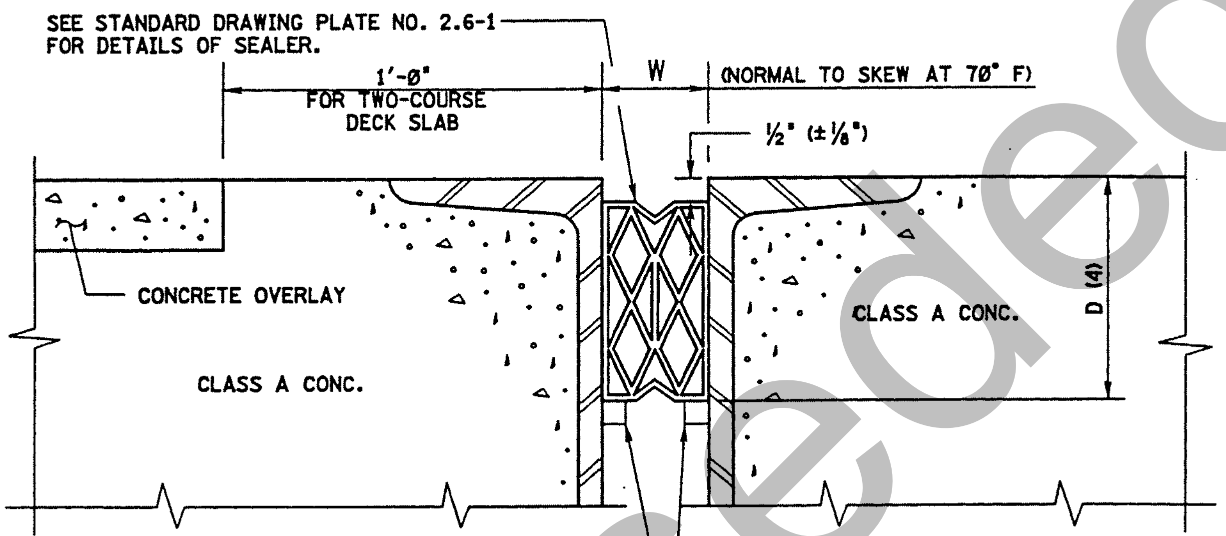
WIDTH OF SEAL NEEDED TO KEEP ANGULAR DEFLECTION OF SEAL MATERIAL BELOW 10° FOR A JOINT THAT MAY VARY FROM 90 PERCENT OF SEAL WIDTH TO 35 PERCENT AS TEMPERATURE CHANGES FROM COLD TO HOT. THIS IS BASED ON INSTALLING THE SEAL TO 65 PERCENT OF NOMINAL SIZE AT THE DESIGN TEMPERATURE.



NOTE:

THIS SHEET IS TO BE USED AS A GUIDE ONLY. CHECK WITH THE MANUFACTURER TO VERIFY MOVEMENT CAPABILITIES FOR VARIOUS CONDITIONS.

JOINT SEALER SEAT DEPTH DETAILS (Sheet 1)	ISSUED: 2002 REV:	PLATE 3.8-4

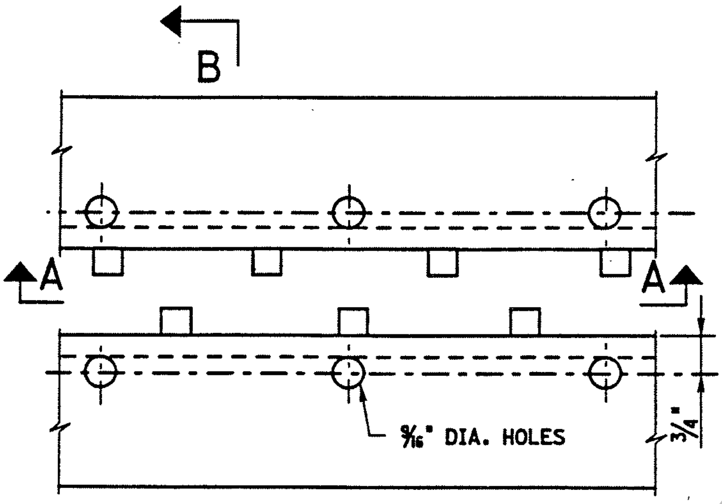


NOMINAL SEALER SIZE (2) (3)		W	D
WIDTH	HEIGHT (1)		
1¾"	1¾"	1"	(4)
2½"	2½"	1⅝"	(4)
4"	4"	2⅝"	(4)

NOTES:

1. THE NOMINAL HEIGHT OF COMPRESSION SEALS MAY VARY BASED UPON MANUFACTURER'S SPECIFICATIONS.
2. THE COMPRESSION SEAL HEIGHT TO WIDTH RATIO SHALL NOT BE LESS THAN 90 %.
3. THE WIDTH OF SEALER SHALL NOT BE LESS THAN NOMINAL SIZE. THE HEIGHT MAY EXCEED THE NOMINAL MANUFACTURER'S SEALER HEIGHT BY NOT MORE THAN ¼". REFERENCE SECTION 908.03 OF THE NJDOT STANDARD SPECIFICATIONS FOR MORE INFORMATION ON MATERIAL REQUIREMENTS.
4. "D" DIMENSION IS EQUAL TO COMPRESSED SEAL HEIGHT PER MANUFACTURER'S SPECIFICATIONS PLUS ½" (±⅛"). DIMENSION "D" SHALL BE SET IN THE SHOP BY THE FABRICATOR.

JOINT SEALER SEAT DEPTH DETAILS (SHEET 2)	ISSUED: 2002 REV:	PLATE 3.8-5

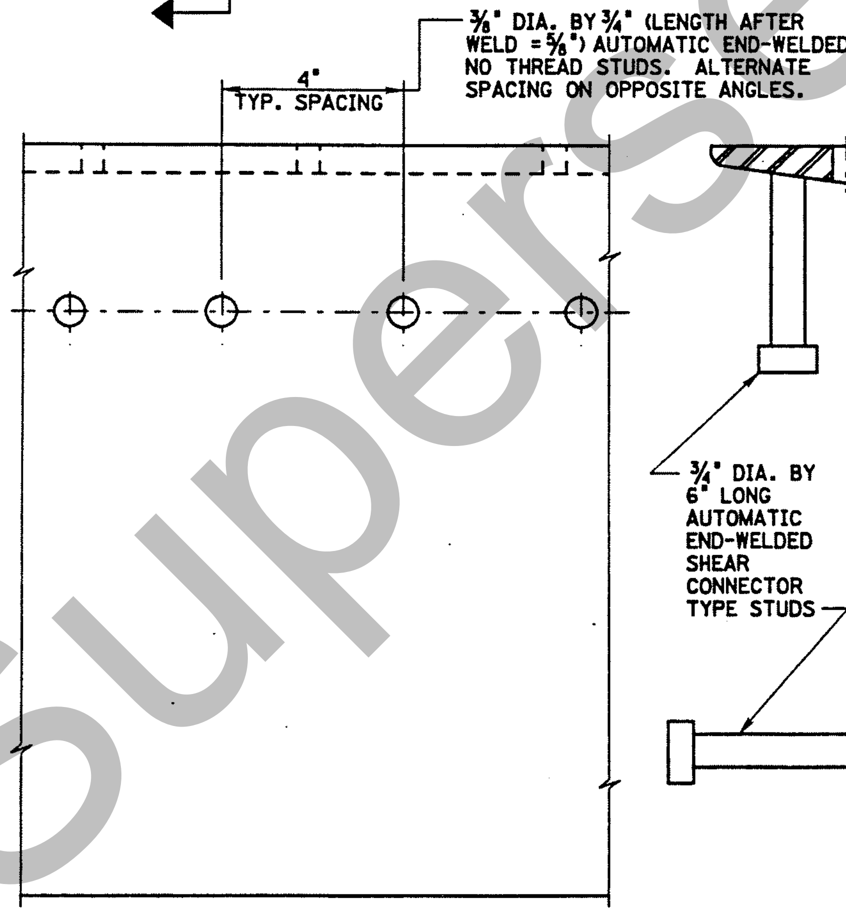


PLAN

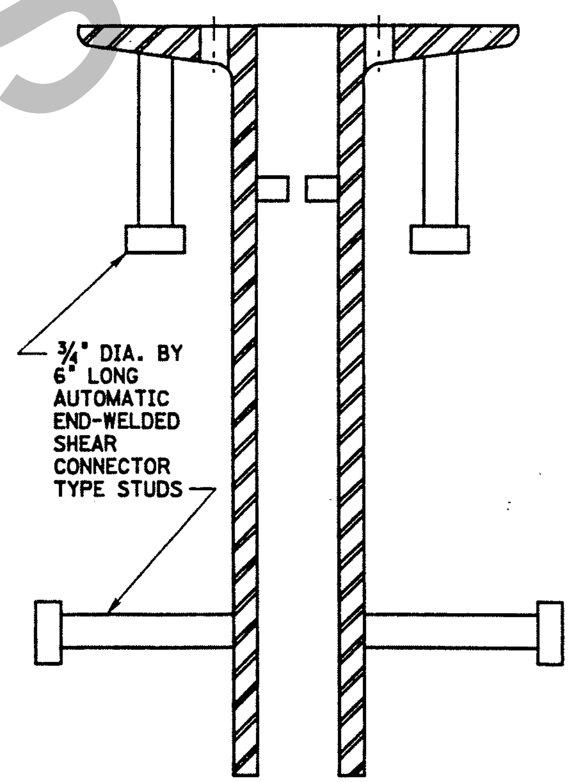
NOTES:

1. SEE GUIDE SHEET PLATES 3.8-6 TO 3.8-15 FOR ADDITIONAL DETAILS.

2. AUTOMATIC END-WELDED STUDS SHALL BE INSTALLED PRIOR TO ZINC-COATING OF ASSEMBLY. AREAS OF STEEL ON WHICH STUDS ARE TO BE WELDED, SHALL BE CLEANED OF RUST AND SCALE BY GRINDING.

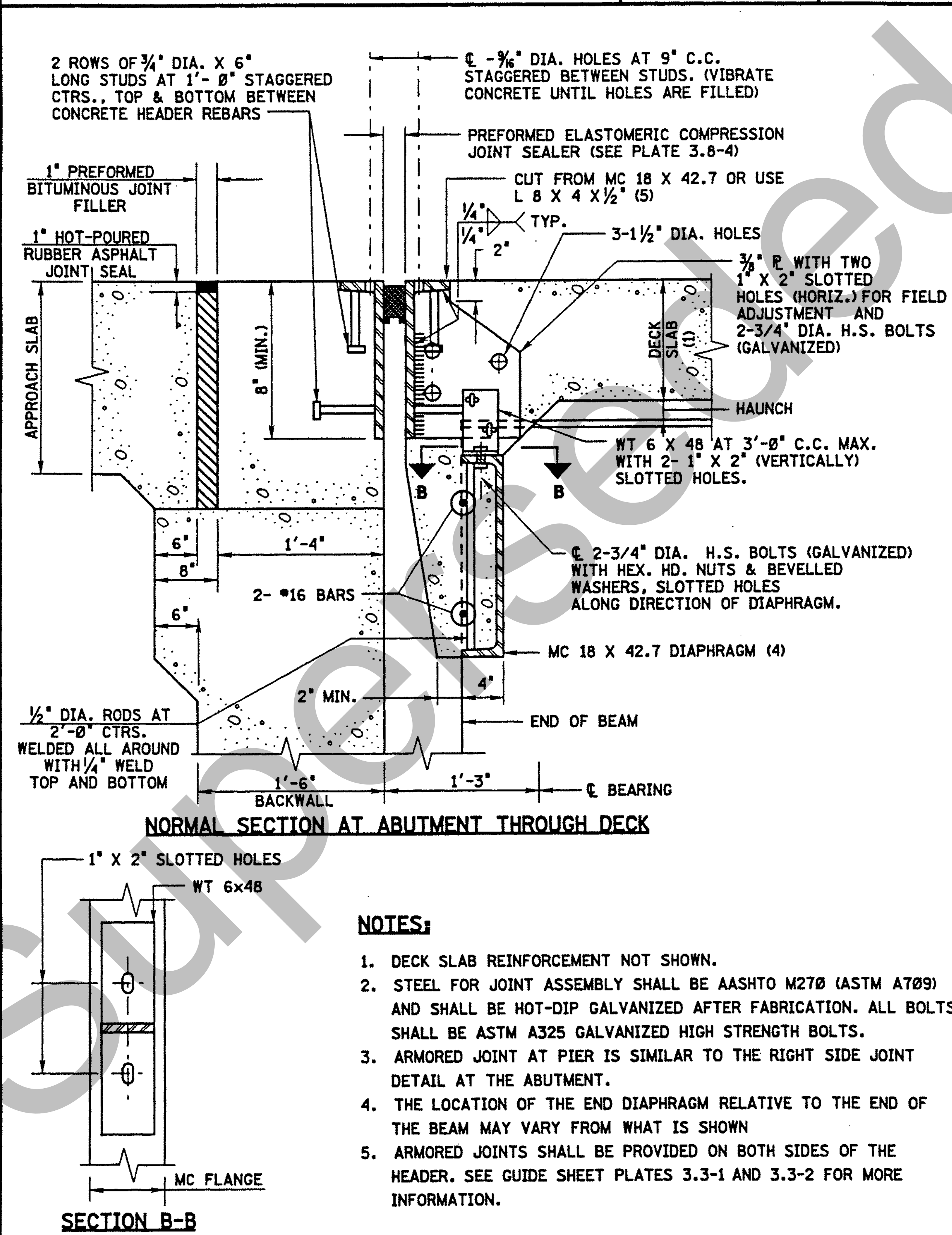


SECTION A - A



SECTION B - B

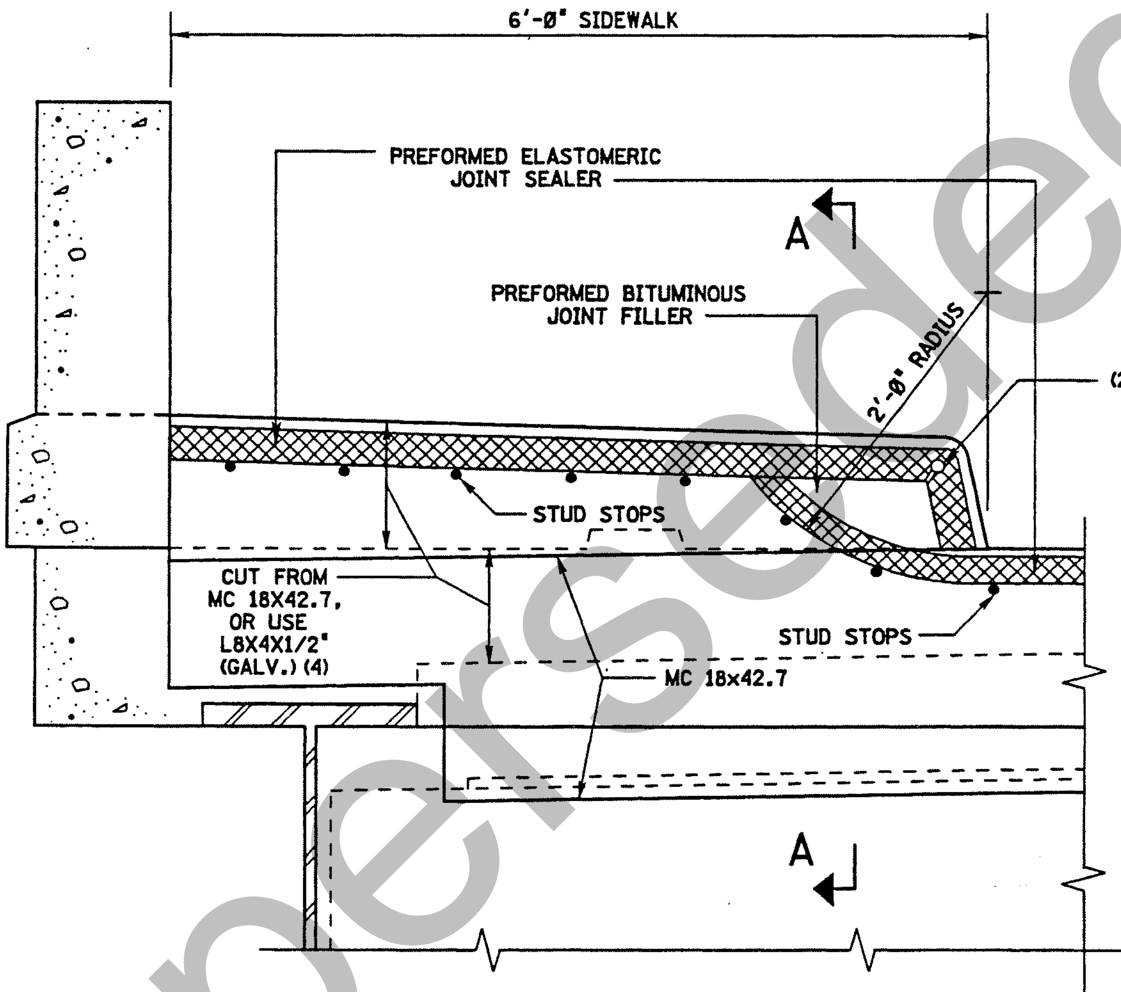
ARMORED JOINT DETAIL WITH COMPRESSION SEAL (SHEET 1)	ISSUED: 2002 REV:	PLATE 3.8-6



NOTES:

1. DECK SLAB REINFORCEMENT NOT SHOWN.
2. STEEL FOR JOINT ASSEMBLY SHALL BE AASHTO M270 (ASTM A709) AND SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION. ALL BOLTS SHALL BE ASTM A325 GALVANIZED HIGH STRENGTH BOLTS.
3. ARMORED JOINT AT PIER IS SIMILAR TO THE RIGHT SIDE JOINT DETAIL AT THE ABUTMENT.
4. THE LOCATION OF THE END DIAPHRAGM RELATIVE TO THE END OF THE BEAM MAY VARY FROM WHAT IS SHOWN
5. ARMORED JOINTS SHALL BE PROVIDED ON BOTH SIDES OF THE HEADER. SEE GUIDE SHEET PLATES 3.3-1 AND 3.3-2 FOR MORE INFORMATION.

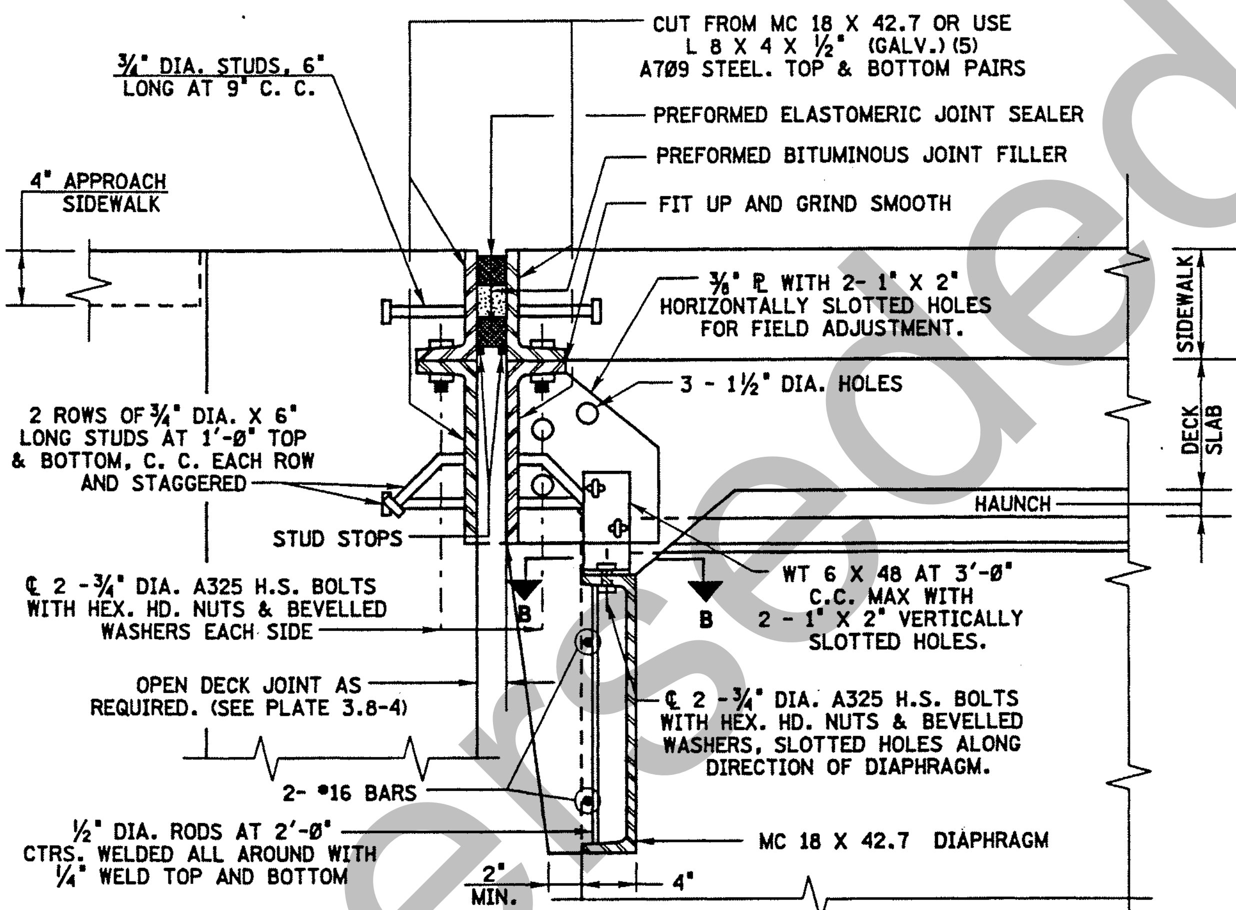
ARMORED JOINT DETAIL WITH COMPRESSION SEAL (SHEET 2)	ISSUED: 2002 REV:	PLATE 3.8-7



LONGITUDINAL SECTION THRU JOINT AT SIDEWALK

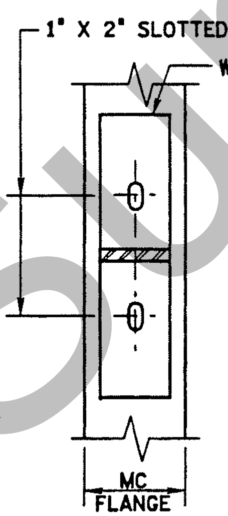
1. FOR SECTION A-A, SEE PLATE 3.8-8.
2. DRILL ½" DIA. HOLE, CUT AND REMOVE SMALL WEDGE FOR DOWN TURN IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATION.
3. THE DESIGNER SHALL CHECK TO SEE IF THE JOINT MATERIAL SHOULD BE EXTENDED INTO THIS AREA WHEN BRIDGE PARAPETS DO NOT EXTEND BEYOND BRIDGE ABUTMENTS.
4. DEPTH VARIES DEPENDING ON SIDEWALK, DECK SLAB AND HAUNCH THICKNESS.

ARMORED JOINT DETAIL WITH COMPRESSION SEAL (SHEET 3)	ISSUED: 2002 REV:	PLATE 3.8-8



SECTION A-A

FOR LOCATION, SEE PLATE 3.8-7

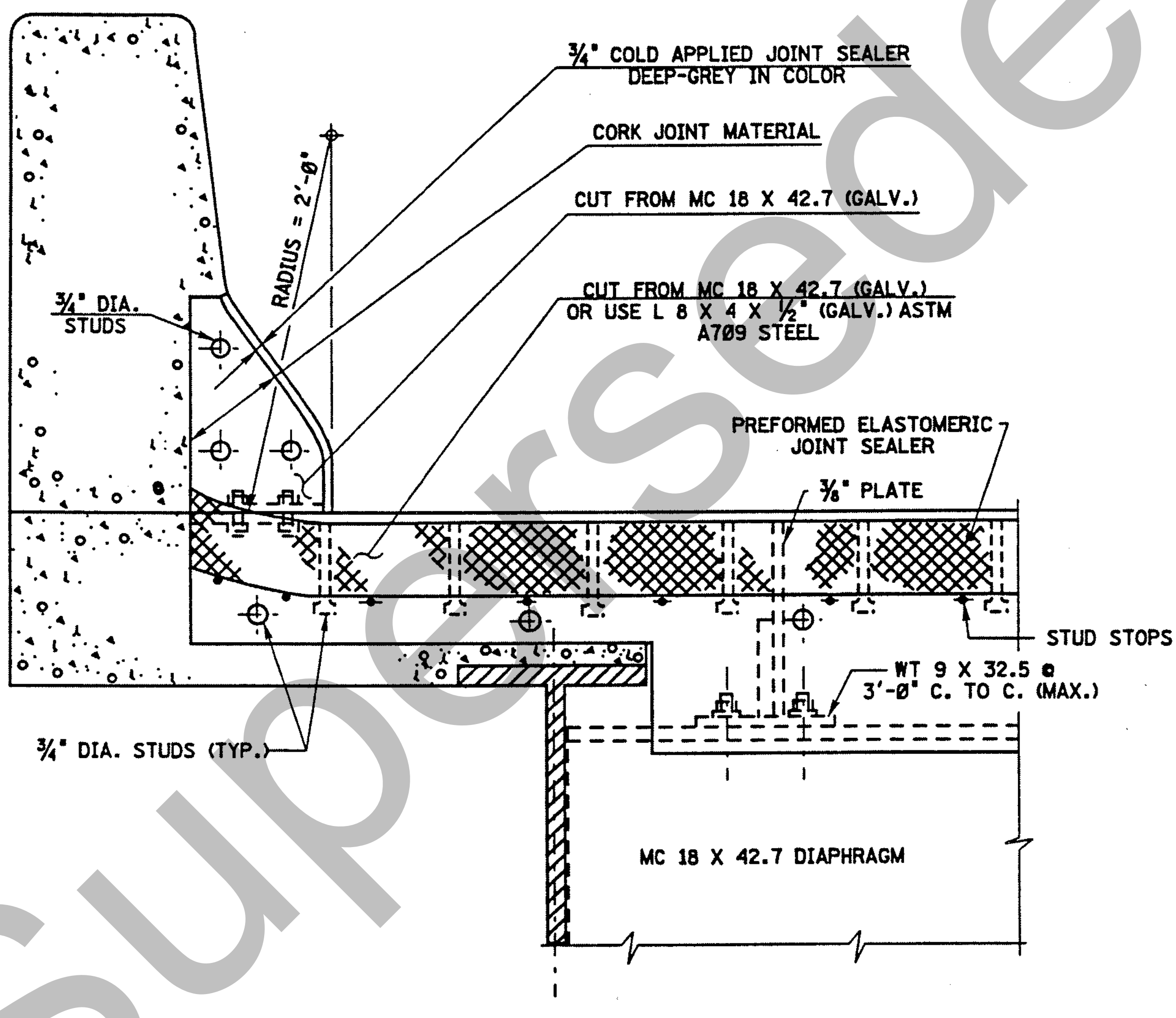


SECTION B-B

NOTES:

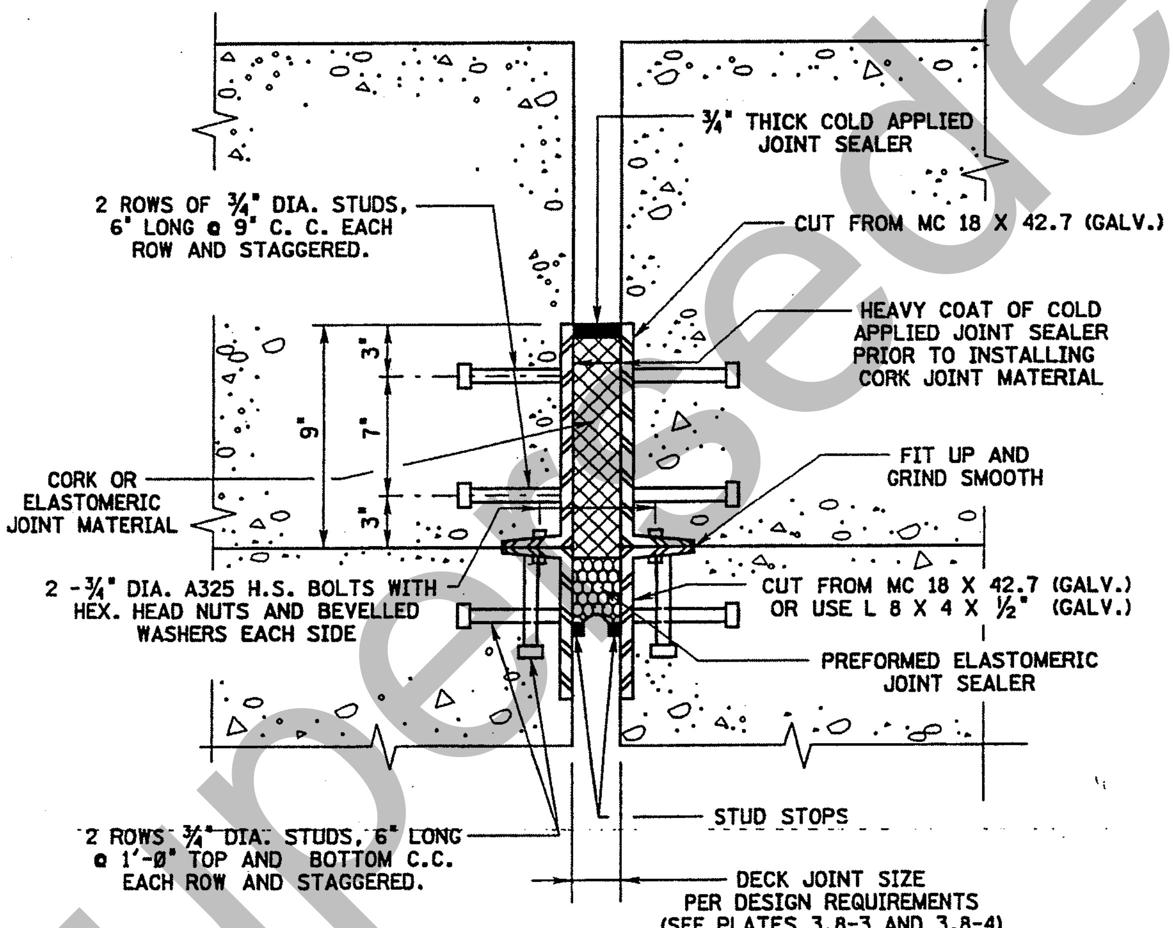
1. DECK SLAB REINFORCEMENT NOT SHOWN.
2. STEEL FOR JOINT ASSEMBLY SHALL BE AASHTO M270 (ASTM A709 AND SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION.
3. ARMORED JOINT AT PIER IS SIMILAR TO THE RIGHT SIDE JOINT DETAIL AT THE ABUTMENT.
4. ALL BOLTS SHALL BE ASTM A325 GALVANIZED HIGH STRENGTH BOLTS.
5. DEPTH VARIES DEPENDING ON SIDEWALK, DECK SLAB AND HAUNCH THICKNESSES.

ARMORED JOINT DETAIL WITH COMPRESSION SEAL (SHEET 4)	ISSUED: 2002 REV:	PLATE 3.8-9



LONGITUDINAL SECTON THROUGH JOINT AT ABUTMENT AND PIER SHOWING STEEL ARMOR PLATE AT JOINT FOR BARRIER AT MEDIAN AND PARAPET

ARMORED JOINT DETAIL WITH COMPRESSION SEAL (SHEET 5)	ISSUED: 2002 REV:	PLATE 3.8-10

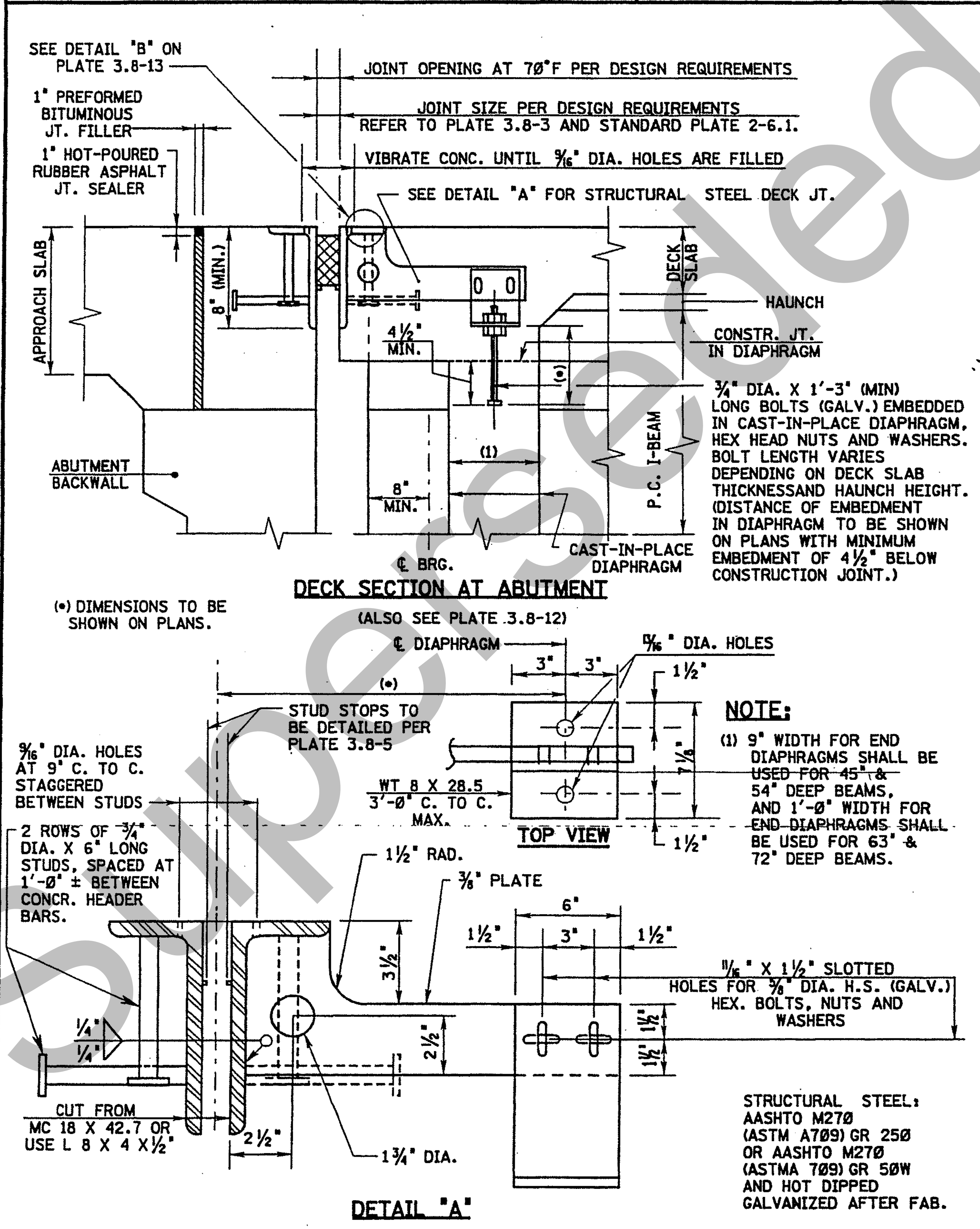


SECTION THROUGH BARRIER AT ABUTMENT AND PIER

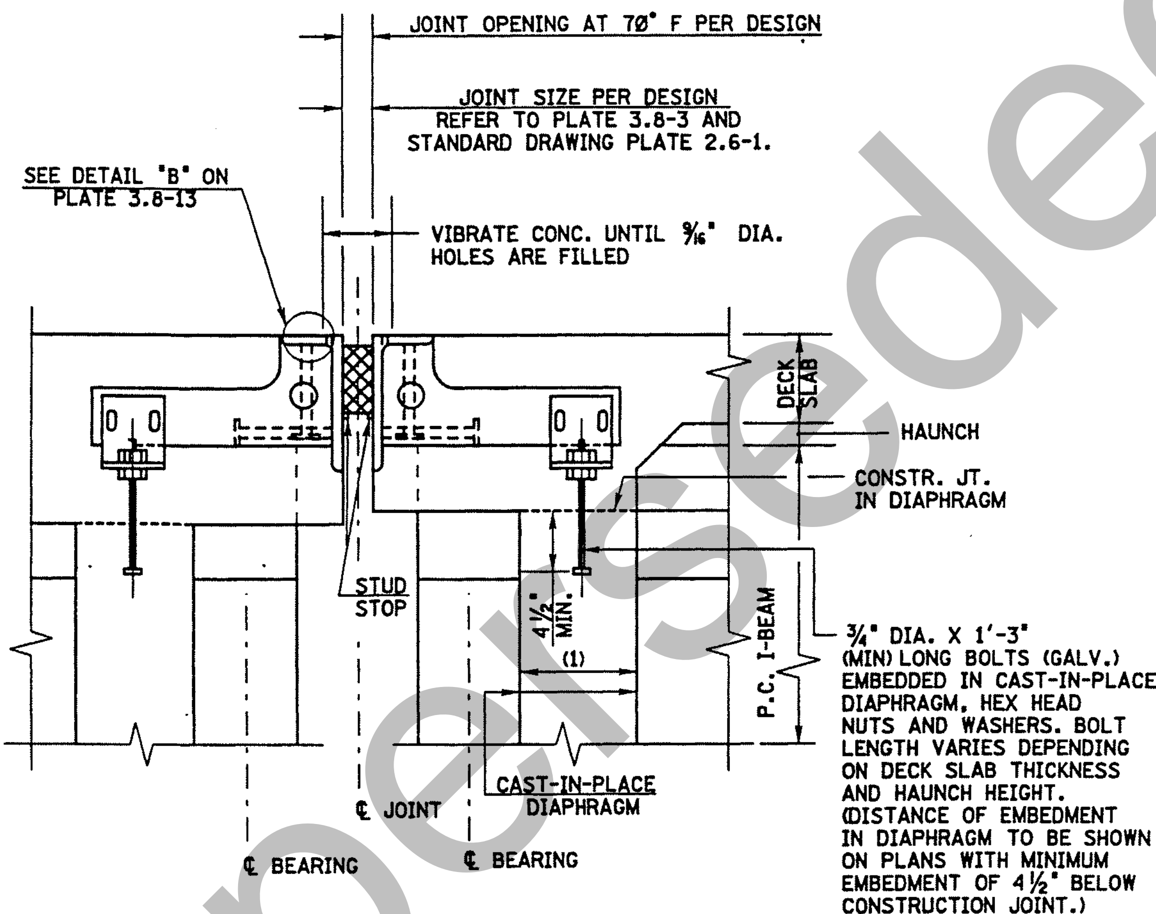
NOTES:

1. ALL BOLTS SHALL BE ASTM A325 GALVANIZED HIGH STRENGTH BOLTS.
2. MATERIAL FOR STEEL ARMORING SHALL CONFORM TO AASHTO M270 (ASTM A709) AND SHALL BE HOT DIPPED GALVANIZED AFTER FABRICATION.

ARMORED JOINT DETAIL AT ABUTMENT, PC I-BEAMS, COMPRESSION SEALS	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.8-11



ARMORED JOINT DETAIL AT PIER, PC I-BEAMS, COMPRESSION SEALS	ISSUED: 2002 REV:	PLATE 3.8-12



DECK SECTION AT PIERS

(SEE PLATES 3.8-11 AND 3.8-13 FOR FURTHER DETAILS)

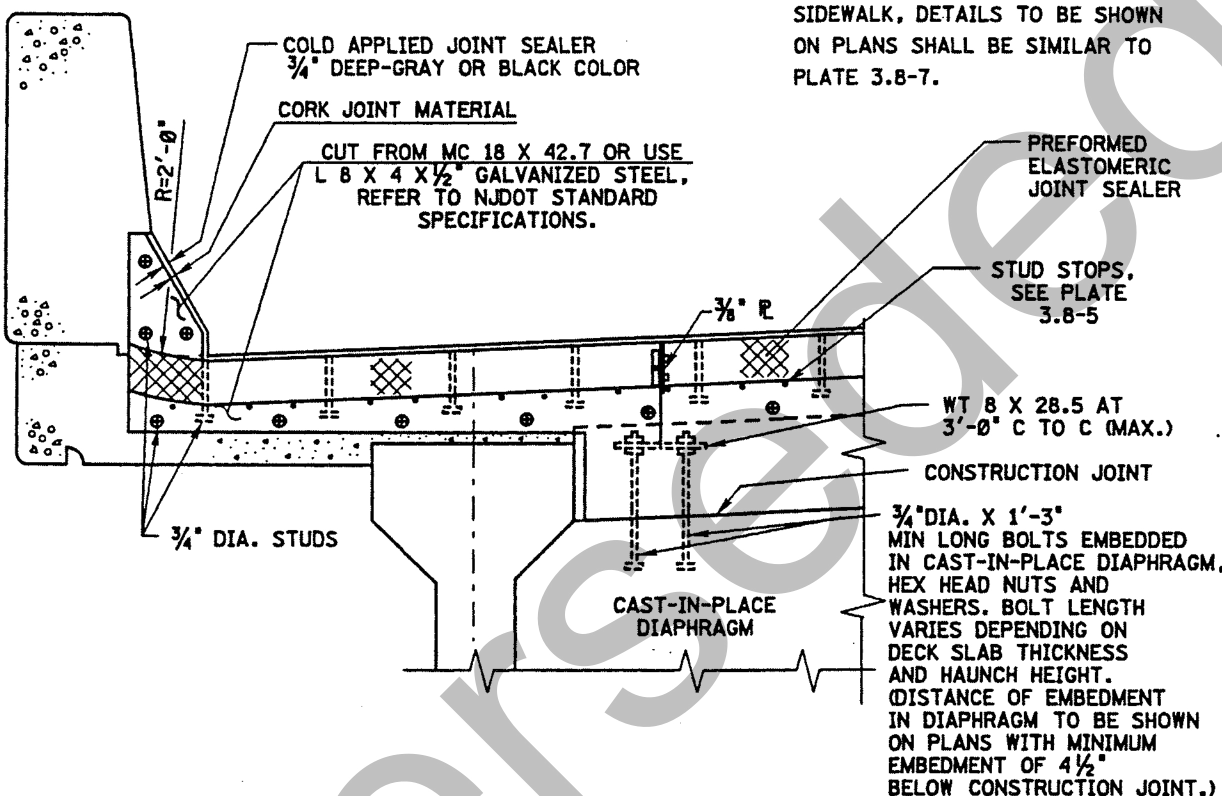
NOTE:

(1) 9" WIDTH FOR END DIAPHRAGMS SHALL BE USED FOR 45" & 54" DEEP BEAMS, AND 1'-0" WIDTH FOR END DIAPHRAGMS SHALL BE USED FOR 63" & 72" DEEP BEAMS.

ARMORED JOINT DETAIL AT BARRIER PARAPET PC I-BEAMS, COMPRESSION SEALS	ISSUED: 2002 REV:	PLATE 3.8-13

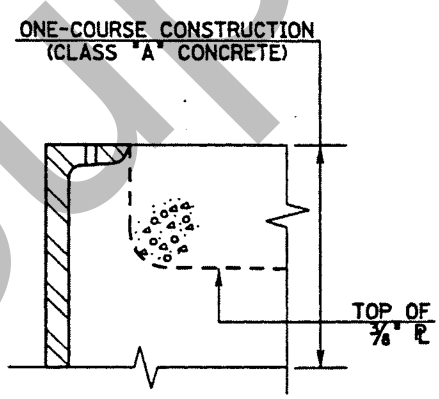
NOTE:

FOR BRIDGES WITH A PEDESTRIAN SIDEWALK, DETAILS TO BE SHOWN ON PLANS SHALL BE SIMILAR TO PLATE 3.8-7.

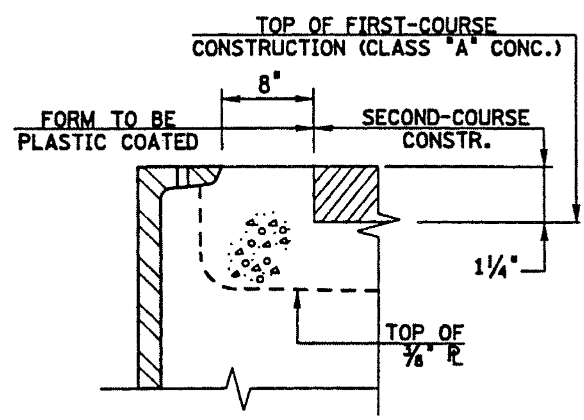


LONGITUDINAL SECTION AT JOINT NEAR PARAPET BARRIER
(SIMILAR AT MEDIAN BARRIER)

(ALSO SEE PLATE 3.8-11 & 3.8-12)



ONE-COURSE DECK CONSTRUCTION

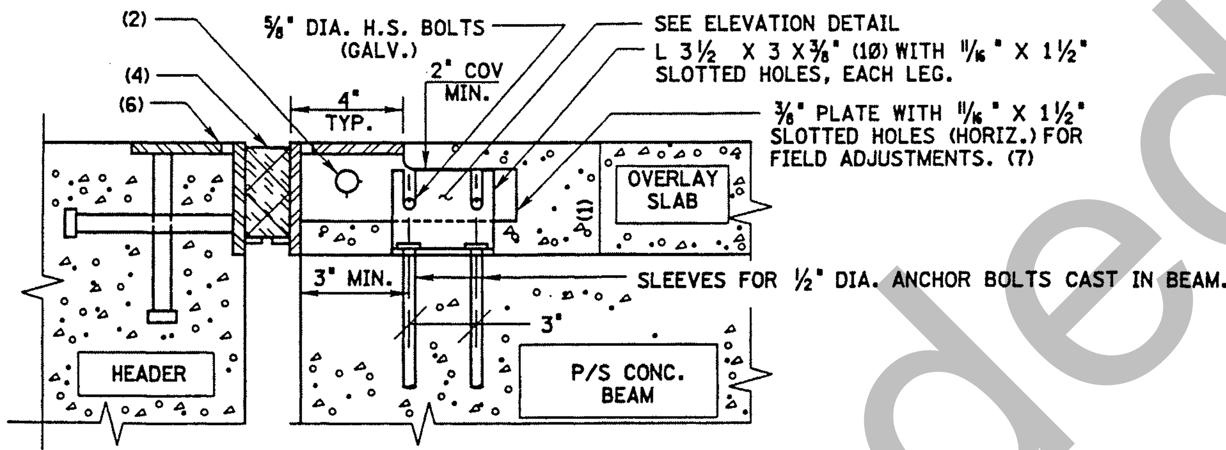


TWO-COURSE DECK CONSTRUCTION

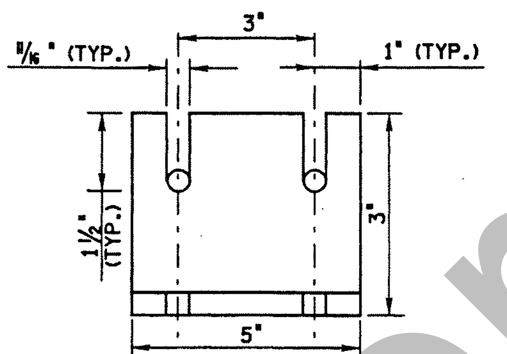
DETAIL "B" (ALSO SEE GUIDE SHEET PLATE 3.8-11)

ARMORED JOINT DETAIL, PC SLAB AND BOX BEAMS (SHEET 1)	ISSUED: 2002 REV:	PLATE 3.8-14

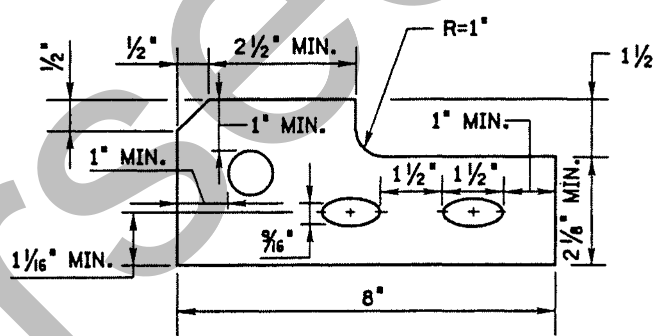
NOTE: ARMORING NOT REQUIRED FOR SPANS LESS THAN 55'-0".



CONNECTION ASSEMBLY FOR ADJACENT BOX BEAMS



ELEVATION OF 3½X 3 X 3/8" ANGLE



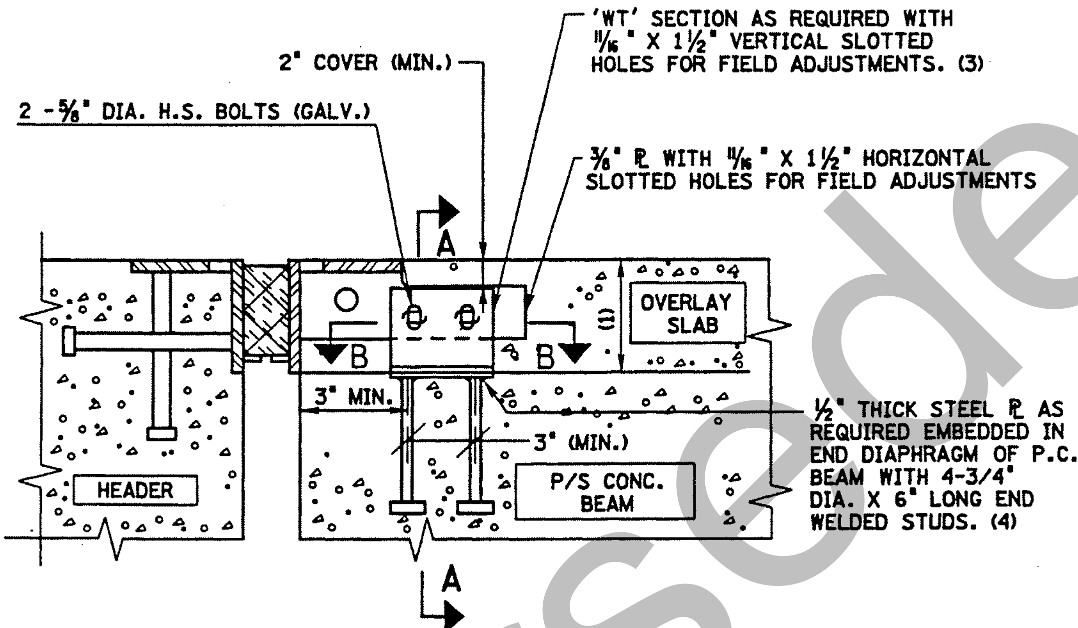
CONNECTION PLATE DETAIL

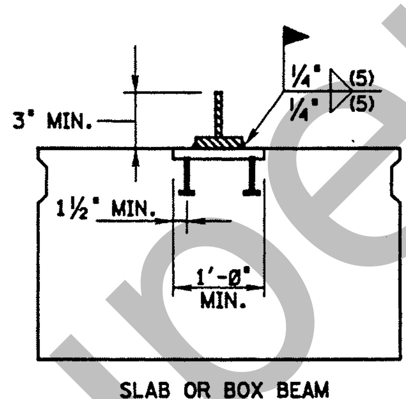
NOTES:

1. 5" MINIMUM OVERLAY SLAB THICKNESS.
2. 1" DIA. HOLE FOR REBAR, AS NECESSARY.
3. PLATES AND ANGLES SHALL BE AS PER NJDOT STANDARD SPECIFICATIONS.
4. COMPRESSION SEAL OR STRIP SEAL AS REQUIRED (SEE PLATES 3.8-3 THROUGH 3.8-5, PLATE 3.8-15, BCD-2 AND STANDARD DRAWING PLATE 2.6-1.)
5. FOR ADDITIONAL DETAILS NOT SHOWN, SEE PLATES 3.8-6 THROUGH 3.8-13.
6. L 6 X 4 X½" UNEQUAL LEG ANGLE (MINIMUM). LEG SIZE WILL VARY BASED UPON OVERLAY SLAB THICKNESS, SEALER SIZE AND ANGLE AVAILABILITY.
7. MAXIMUM CONNECTION PLATE ASSEMBLY SPACING SHALL BE 4'-0".
8. ARMORED JOINT AT PIER IS SIMILAR TO THE RIGHT SIDE JOINT DETAIL AT ABUTMENT.
9. THESE DETAILS ARE ONLY A GUIDE, DESIGNER SHALL VERIFY ITS USE ON A PROJECT TO PROJECT BASIS. MODIFICATIONS TO THIS DETAIL OR A DIFFERENT DESIGN MAY BE NECESSARY TO AVOID INTERFERENCE WITH MILD STEEL REINFORCEMENT OR FOR ATTACHMENT TO A THICKER OVERLAY SLAB.
10. MINIMUM VERTICAL ANGLE HEIGHT OF LEG SHALL BE 3". ANGLE LEG HEIGHT VARIES WITH CONNECTION PLATE SIZE AND OVERLAY SLAB THICKNESS. REFERENCE PLATE 3.8-15 FOR ALTERNATE WT DETAIL.

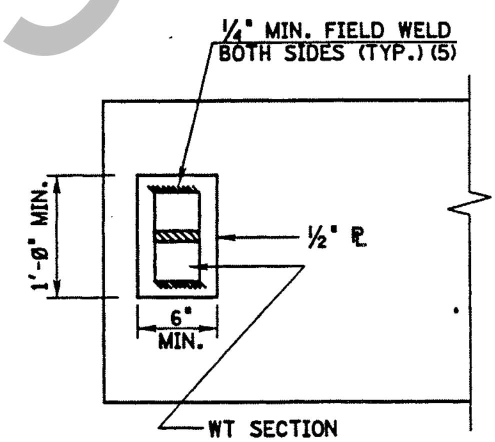
ARMORED JOINT DETAIL, PC SLAB AND BOX BEAMS (SHEET 2)	ISSUED: 2002 REV:	PLATE 3.8-15

NOTE: ARMORING NOT REQUIRED FOR SPANS LESS THAN 55'-0".





SECTION A-A



SECTION B-B

NOTES:

1. 5" MINIMUM OVERLAY SLAB THICKNESS.
2. REFERENCE GUIDE SHEET PLATE 3.8-14 FOR ADDITIONAL INFORMATION.
3. TEE SIZE VARIES BASED UPON OVERLAY SLAB THICKNESS. 3" MINIMUM DEPTH (HEIGHT) AND 3/8" MINIMUM THICKNESS MAY BE UTILIZED.
4. ½" THICK STEEL PLATE SHALL NOT INTERFERE WITH THE ANCHOR DOWEL HOLES.
5. ALL WELDING SHALL CONFORM TO THE CURRENT ANSI/AASHTO/AWS D1.5 BRIDGE WELDING CODE.

STRUCTURAL STEEL GENERAL NOTES	ISSUED: 2002 REV:	PLATE 3.9-1

NOTES TO DESIGNERS

A. PROVIDE MATERIALS AND WORKMANSHIP CONFORMING TO THE AASHTO LRFD BRIDGE CONSTRUCTION SPECIFICATIONS, AND AASHTO/AWS D1.5 WELDING CODE.

B. SEE THE FOLLOWING SUBSECTIONS IN THE MANUAL FOR ADDITIONAL NOTES TO BE SHOWN ON CONTRACT PLANS:

1.24.2(d) (e) - TYPE OF STRUCTURAL STEEL AND DESIGNATION OF (T) ON MAIN LOAD CARRYING MEMBER COMPONENTS SUBJECT TO TENSILE STRESS.

1.24.5 (d) - FRACTURE CRITICAL MEMBERS.

1.24.18 (g) - CLEANING AND PAINTING SYSTEMS.

C. FILLET WELD SIZES AS REQUIRED BY DESIGN TO BE SHOWN ON PLANS.

D. DO NOT CHANGE WIDTH OF TOP FLANGE PLATE IN SIMPLE SPAN GIRDERS.

E. MINIMUM CHANGE OF THICKNESS OF FLANGE PLATES SHALL BE ½".

F. THE FOLLOWING TABLE PROVIDES GUIDELINES IN THE SELECTION OF FLANGE PLATES:

T2 (IN)	T1a (IN)	T1b (IN)	T1c (IN)	T1d (IN)	T1e (IN)
2¾*	2¼	2	1¾	1⅝	-
2½	1¾	1⅝	1½	1⅜	-
2¼	1⅝	1½	1⅜	1¼	1⅛
2	1½	1⅜	1¼	1⅛	-
1¾	1¼	1¼	1⅛	1	-
1⅝	1⅛	1	⅞	¾	-
1½	1	⅞	¾	-	-
1⅜	⅞	¾	-	-	-
1¼	¾	-	-	-	-

* NOT RECOMMENDED FOR TENSION FLANGES.

(1) SELECT FLANGE PLATE THICKNESS T2 FOR MAXIMUM MOMENT.

(2) SELECT T1 FROM AVAILABLE CHOICES T1a THRU T1e.

(3) USE T1 TO ENTER T2 COLUMN FOR RANGE OF POSSIBILITIES FOR NEXT SPLICE. CONTINUE UNTIL T1 MINIMUM IS OBTAINED.

(NOTE: SEE GUIDE PLATE 3.9-4 FOR THICKNESS DESIGNATIONS)

G. MINIMUM LENGTH OF FLANGE PLATES SHOULD BE ABOUT 15 FEET. PLATE LENGTHS SHOULD BE PROPORTIONED TO MINIMIZE, AS MUCH AS PRACTICAL, NUMBER OF BUTT JOINTS IN THE TOTAL SPAN LENGTH.

H. FLANGE PLATE THICKNESS OF THE COMPONENT PLATES SHOULD BE STANDARDIZED AS MUCH AS PRACTICAL IN EACH CONTRACT TO MINIMIZE EXCESSIVE VARIABILITY IN THE ORDER MATERIAL AND TO MAXIMIZE USE OF THE ORDER MATERIAL.

I. CHANGES IN FLANGE AREAS MAY BE ACCOMPLISHED BY VARYING THE THICKNESS AND WIDTH (EXCEPT SEE NOTE D) OF ADJACENT FLANGE PLATES. HOWEVER, A DESIGN MAINTAINING THE SAME WIDTH OF FLANGE AND CHANGING ONLY THE THICKNESS IS PREFERRED IN ORDER TO IMPROVE THE "STRESS FLOW" CHARACTERISTICS OF THE JOINT.

J. SEE SUBSECTION 1.24.4 FOR OF THIS MANUAL ABOUT "ECONOMICS OF STRINGER DESIGN".

K. LOCATE ALL INTERMEDIATE STIFFENERS ON OPPOSITE SIDE OF WEB FROM LONGITUDINAL STIFFENERS WHEN POSSIBLE.

L. WHEN A BEARING STIFFENER IS USED AS A CONNECTION PLATE, WELD TO TOP AND BOTTOM FLANGE.

M. MEMBERS, WELD AND PLATE SIZES SHOWN IN PLATES 3.9-2 THRU 3.9-25 ARE FOR STRAIGHT GIRDERS WITH MAXIMUM GIRDER SPACING OF 10'-0" AND FOR SKEW ANGLES UPTO 20°.

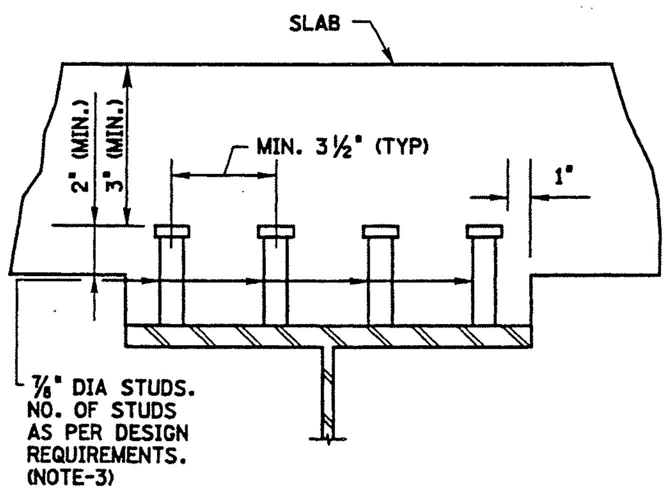
N. THE DETAILS SHOWN IN PLATES 3.9-2 THRU 3.9-25 ARE VALID FOR SKEW ANGLES 0° TO 20°. PROVIDE SPECIAL DETAILS FOR SKEW ANGLES GREATER THAN 20°.

O PROVIDE INTERMEDIATE DIAPHRAGMS NORMAL TO THE MAIN MEMBERS FOR SKEWS > 20°.

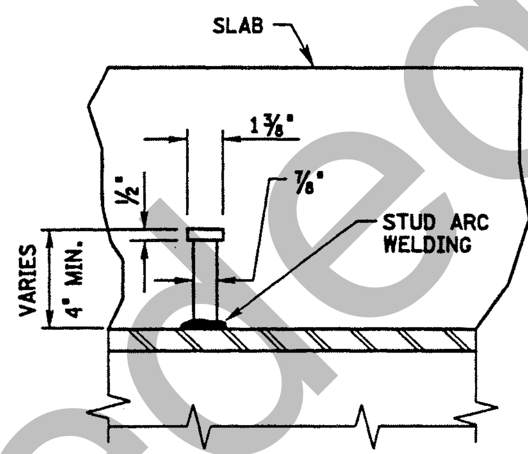
P THE DIAPHRAGMS SHOWN IN PLATES 3.9-2 THRU 3.9-25 ARE FOR STRAIGHT GIRDERS ONLY AND DO NOT INCLUDE WIND LOAD TRANSFERRED THROUGH CONNECTIONS.

Q. SEE GUIDE PLATE 3.9-26 FOR "NOTES TO BE SHOWN ON CONTRACT PLANS".

STUD SHEAR CONNECTORS	ISSUED: 2002 REV:	PLATE 3.9-2



SECTION



ELEVATION

NOTES:

1. LONGITUDINAL SPACING BY DESIGN TO A MAXIMUM OF 2'-0". PER AASHTO LRFD SUBSECTION 6.10.7.4.1b MINIMUM SPACING OF ADJACENT STUD SHEAR CONNECTORS SHALL NOT BE CLOSER THAN 6 DIAMETERS CENTER TO CENTER.

2. HEIGHT OF STUD DEPENDS ON CONCRETE DECK THICKNESS AND THE HAUNCH DIMENSION. THE USE OF THE SAME HEIGHT STUD ON ANY ONE BRIDGE IS PREFERRED. REFERENCE SUBSECTION 1.24.6 (b) OF THIS MANUAL FOR MORE INFORMATION.

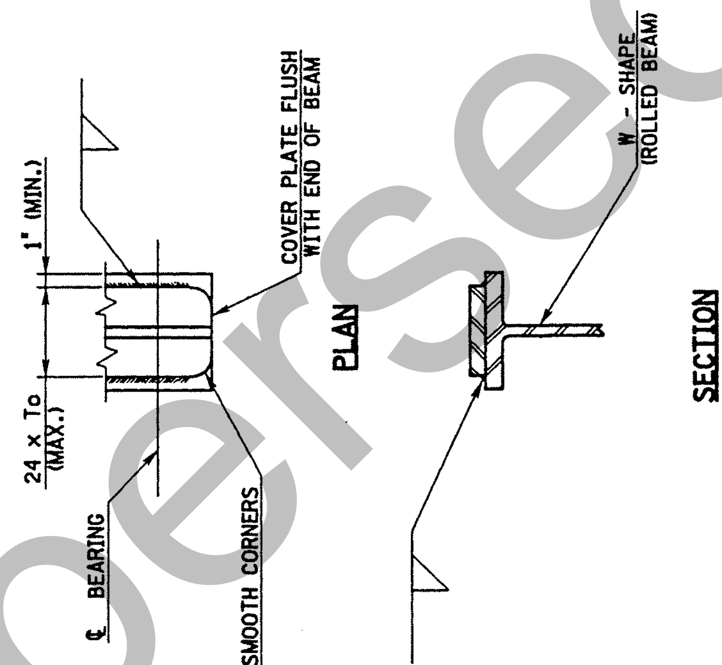
3. THE DESIGNER SHALL CHECK FOR SHEAR STUD AVAILABILITY.

DESIGN CRITERIA:

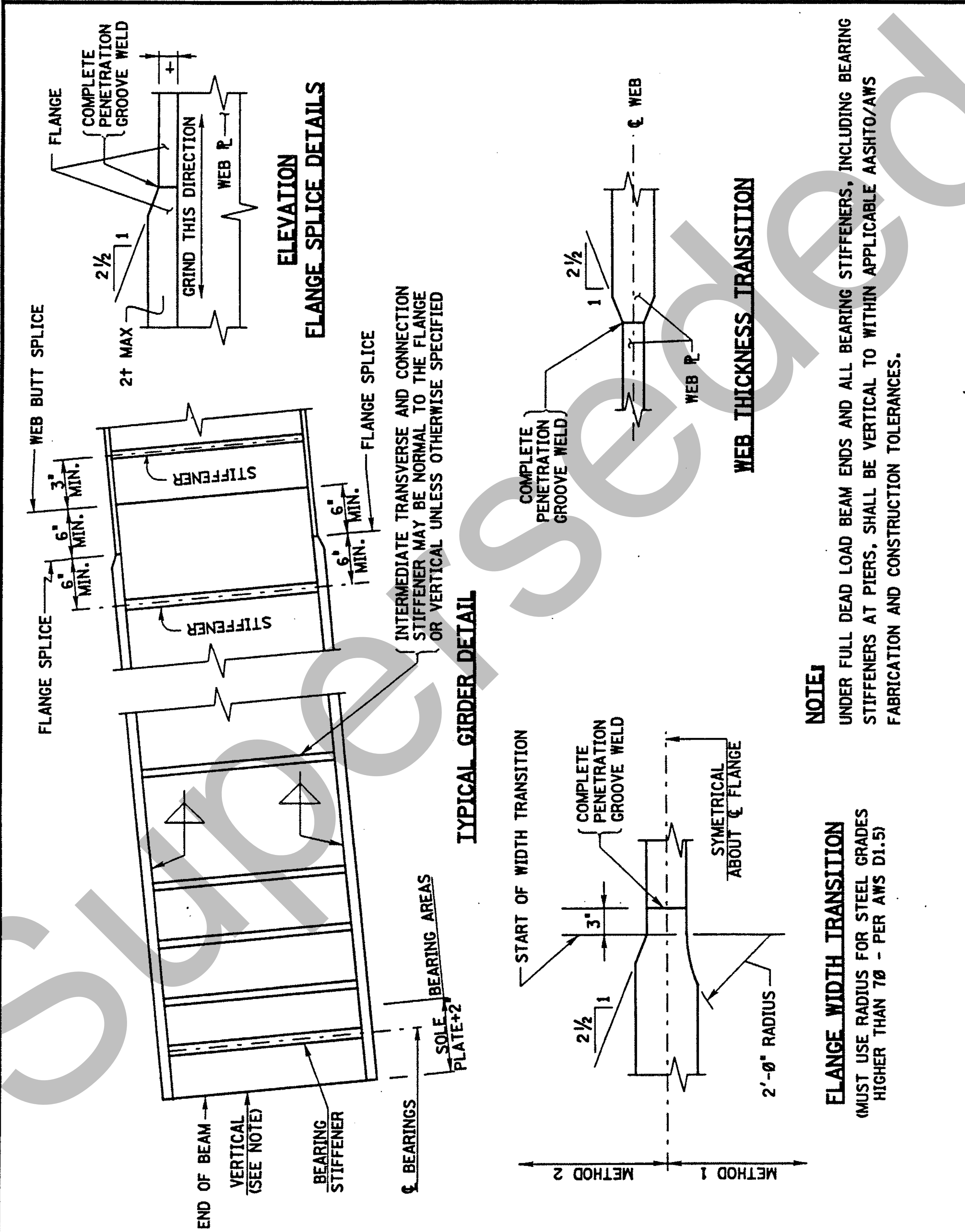
1. REFERENCE AASHTO LRFD SUBSECTION 6.10.7.4 FOR DESIGNING SHEAR CONNECTORS.

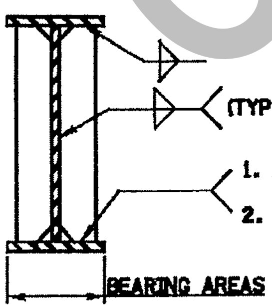
2. REFERENCE AASHTO LRFD SUBSECTION 6.6.1.2.5 FOR THE DETERMINATION OF THE FATIGUE RESISTANCE.

COVER PLATE DETAILS	ISSUED: 2002 REV:	PLATE 3.9-3

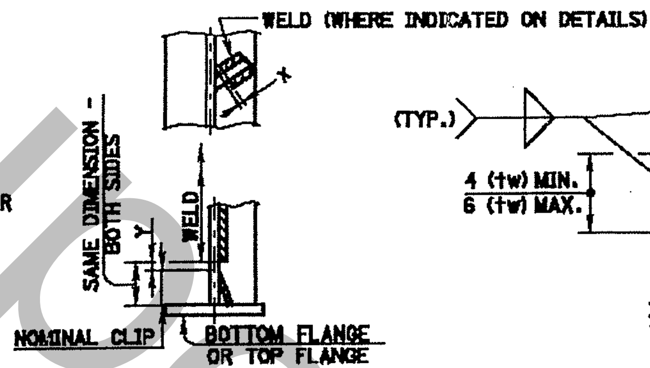


GIRDER WELDED SPLICE DETAILS	ISSUED: 2002 REV:	PLATE 3.9-4



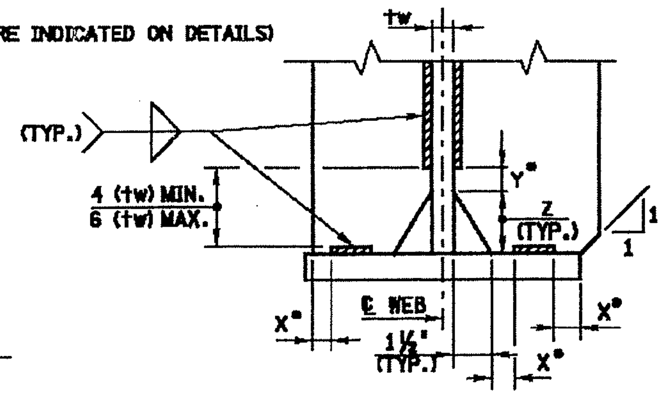


BEARING STIFFENER



STIFFENER WELDING DETAIL

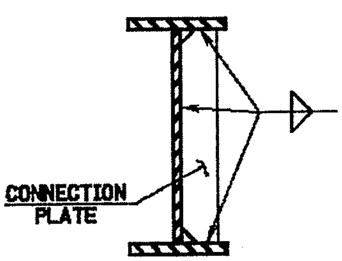
(FOR SKEWED STIFFENERS)



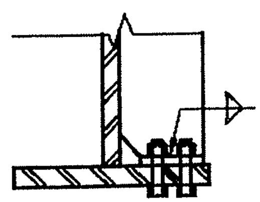
DETAIL @ END OF STIFFENER OR CONNECTION PLATE

• SHOW STIFFENER PLATE AND FILLET WELD SIZES ON THE PLAN

X = 7/8" ± 1/8"
Y = 5/8" ± 3/16"
Z = 2½" FOR ½" WEB
3" FOR 5/8" WEB
4" FOR ¾" WEB
• 0" FOR GROOVE WELD.



CONNECTION PLATE

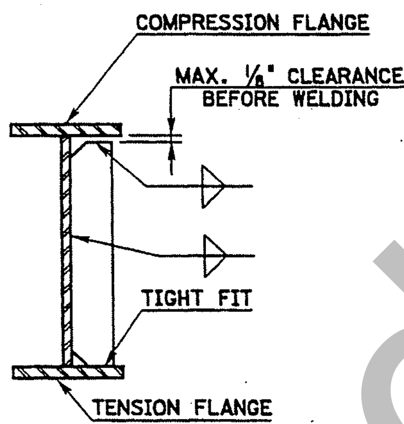


ALTERNATE DETAIL @TENSION FLANGE WHERE STRESS RANGE EXCEEDS CATEGORY C

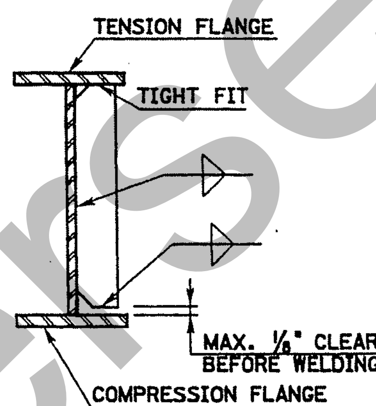
NOTES:

A. STIFFENER SIZE MUST BE SHOWN ON PLANS.
B. FILLET WELD SIZE SHALL BE SHOWN ON PLANS UNLESS MINIMUM WELD SIZE AS PER AASHTO/AWS D1.5 IS TO BE USED.
C. IF A BEARING STIFFENER IS USED AS A CONNECTION PLATE FOR CROSS FRAMES FILLET WELDS ARE REQUIRED.
D. WHEN LONGITUDINAL STIFFENERS ARE REQUIRED, PLACE ALL TRANSVERSE STIFFENERS ON ONE SIDE OF WEB AND PLACE THE LONGITUDINAL STIFFENER ON OPPOSITE SIDE.

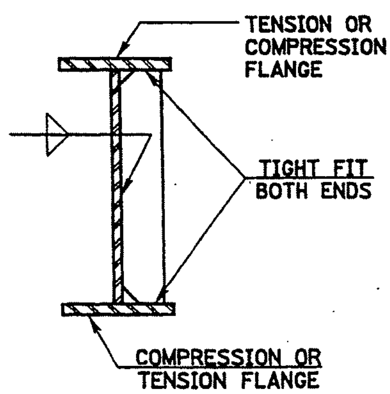
INTERMEDIATE AND BEARING STIFFENER DETAILS (2 OF 2)	ISSUED: 2002 REV:	PLATE 3.9-6



TYPE I



TYPE II

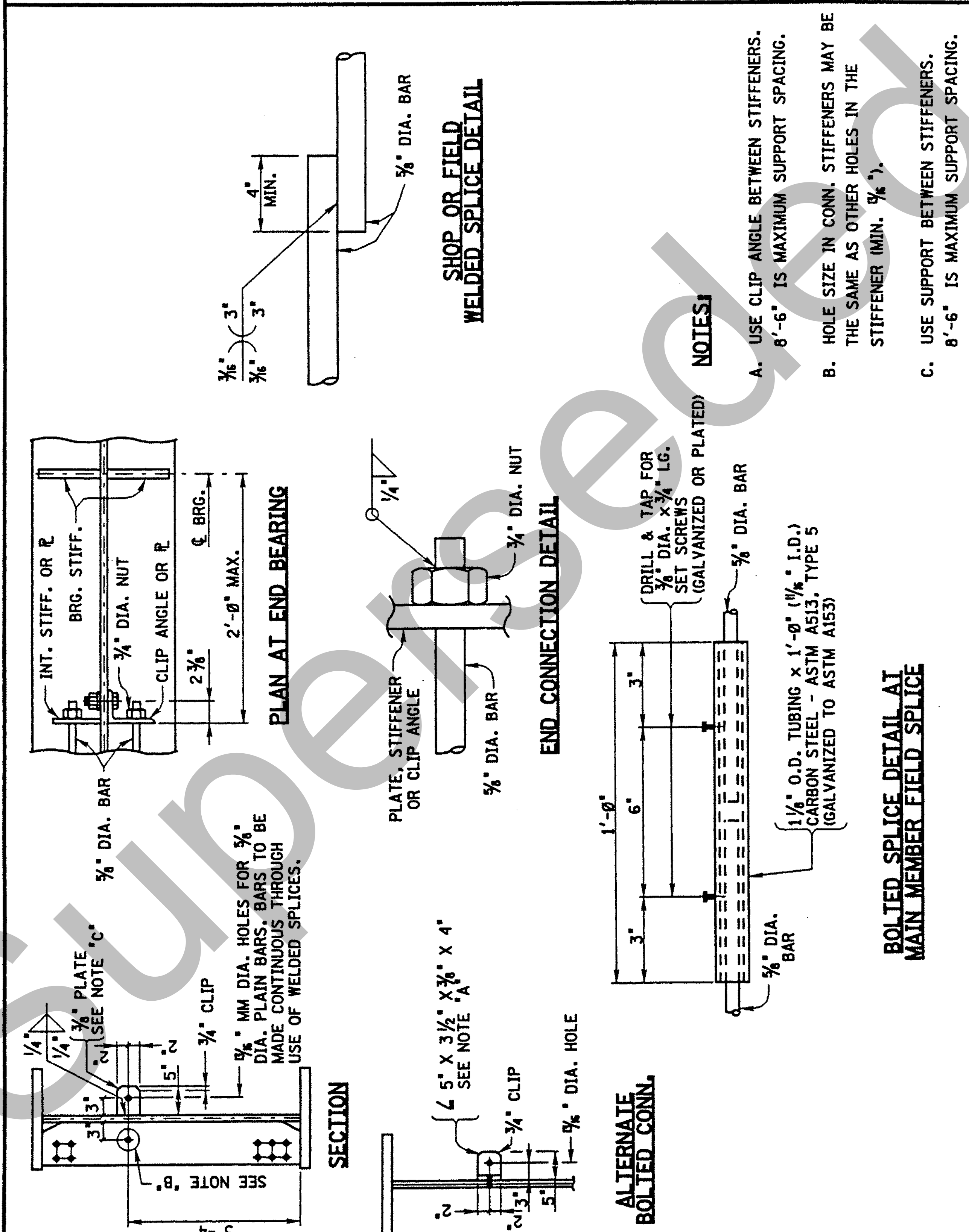


TYPE III

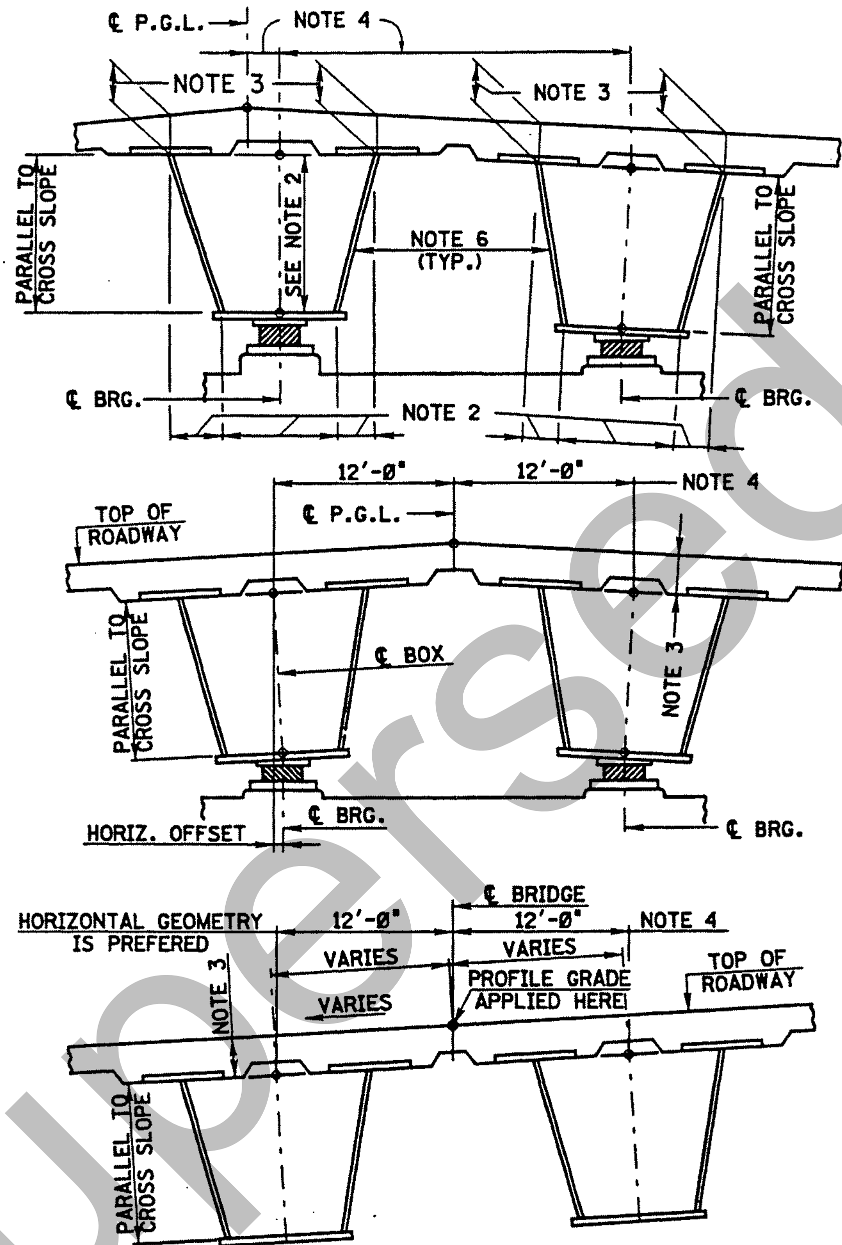
(IN STRESS REVERSAL ZONE)

INTERMEDIATE STIFFENERS

SHOP INSTALLED SAFETY HANDRAIL DETAILS	ISSUED: 2002 REV:	PLATE 3.9-7



TUB GIRDER (OPEN BOX) DETAILS (SHEET 1 OF 3) CROSS SECTIONAL GEOMETRY	ISSUED: 2002 REV:	PLATE 3.9-8

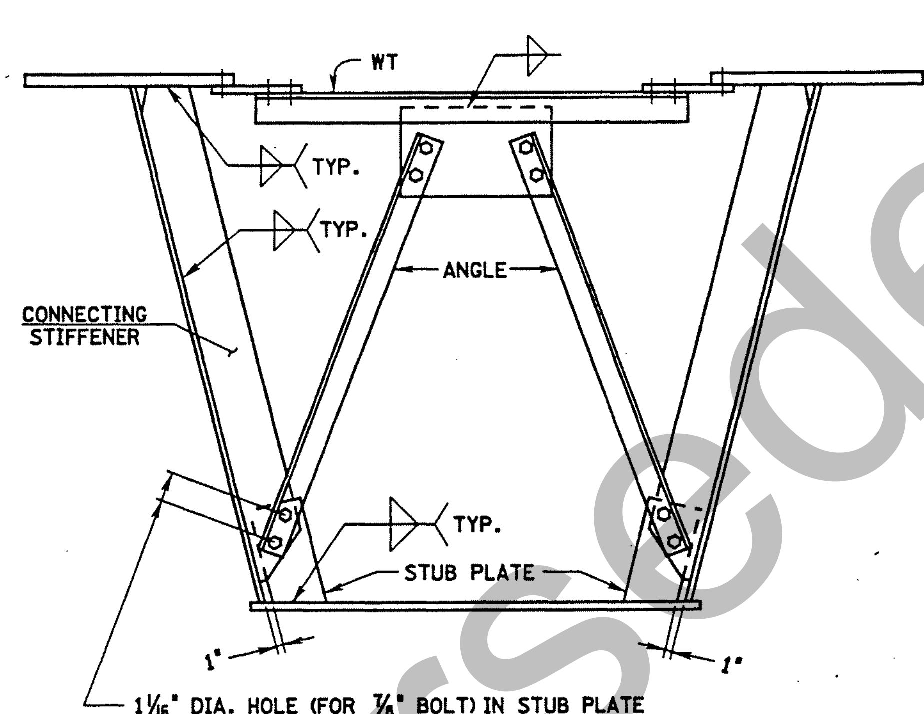


OPEN BOX CROSS SECTIONAL GEOMETRY

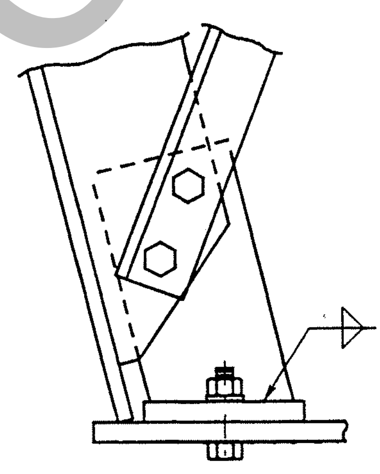
NOTES:

1. ROTATE BOX WITH CROSS SLOPE.
2. MAINTAIN CONSTANT TRAPEZOIDAL SHAPE. (DEPTH MAY VARY WITH HAUNCH).
3. MAINTAIN CONSTANT CONCRETE HAUNCH.
4. HORIZONTAL STATION OFFSETS PREFERRED.
5. FOLLOW CENTERLINE ALIGNMENT EVEN THROUGH A SPIRAL CURVE.
6. THE WEB INCLINATION SHALL NOT EXCEED 1 TO 4.

TUB GIRDER (OPEN BOX) DETAILS (SHEET 2 OF 3) INTERIOR CROSSFRAME	ISSUED: 2002 REV:	PLATE 3.9-9

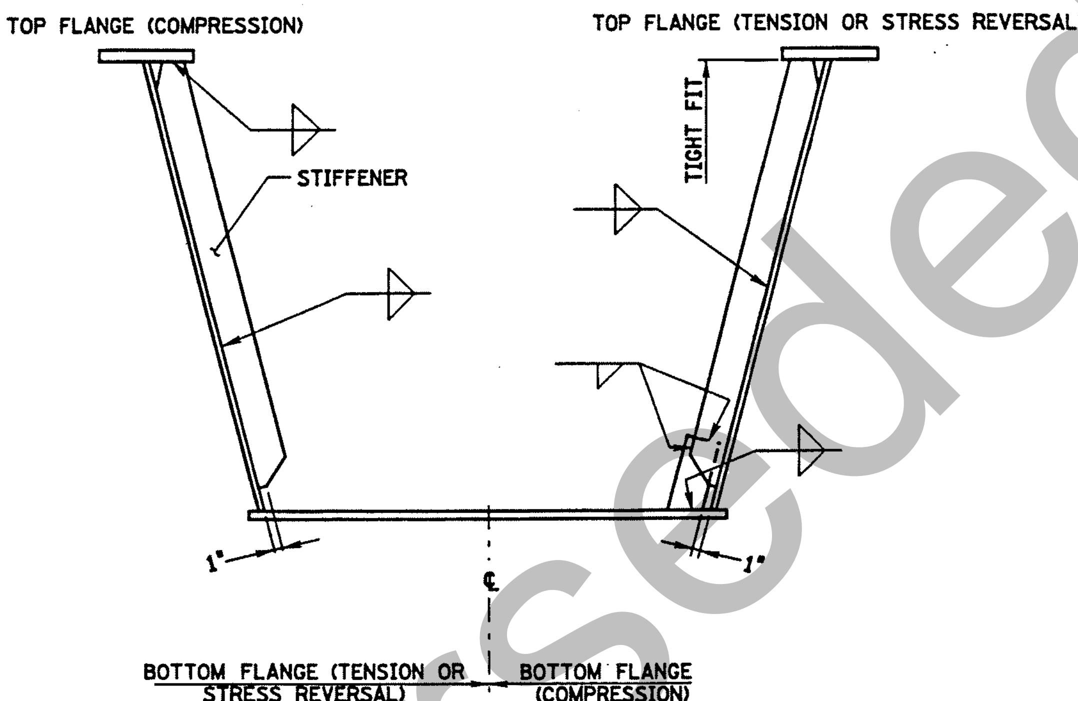


BOTTOM FLANGE (COMPRESSION OR TENSION)
INTERIOR CROSSFRAME

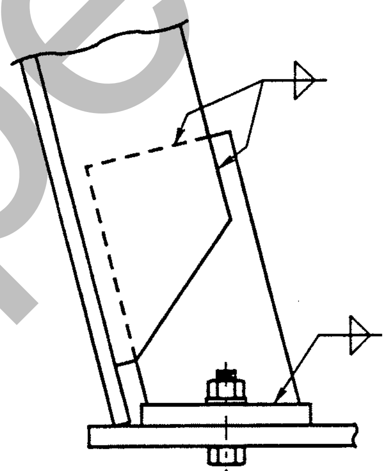


ALTERNATE DETAIL AT TENSION FLANGES

TUB GIRDER (OPEN BOX) DETAILS (SHEET 3 OF 3) TRANSVERSE STIFFENER	ISSUED: 2002 REV:	PLATE 3.9-10

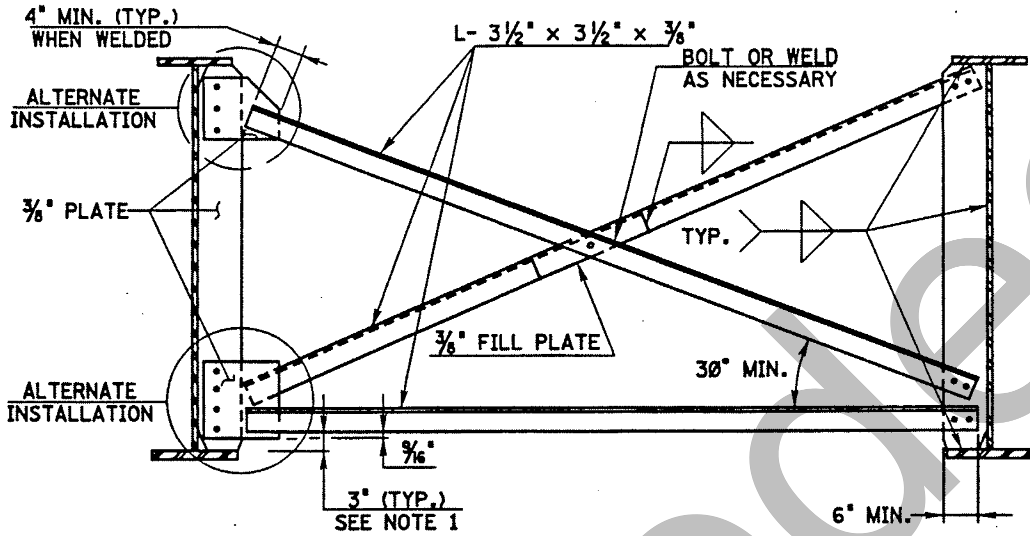


TUB GIRDER TRANSVERSE STIFFENER DETAILS

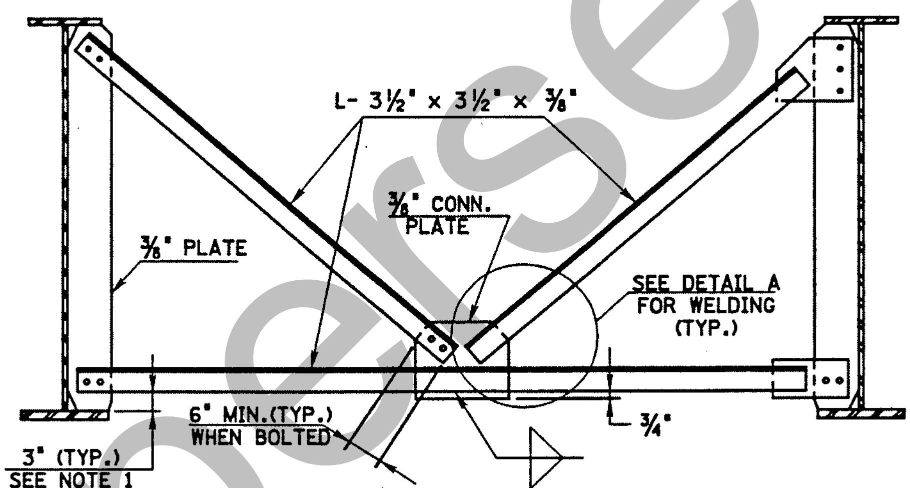


ALTERNATE DETAIL AT TENSION FLANGES

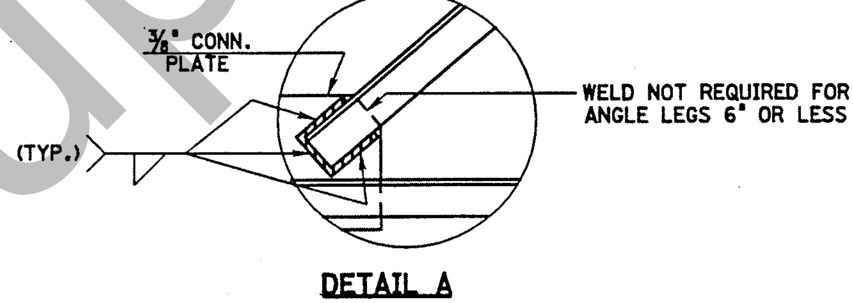
CROSSFRAME DETAILS (SHEET 1 OF 3) INTERMEDIATE DIAPHRAGM	ISSUED: 2002 REV:	PLATE 3.9-11



INTERMEDIATE DIAPHRAGM DETAIL



ALTERNATE INTERMEDIATE DIAPHRAGM DETAIL



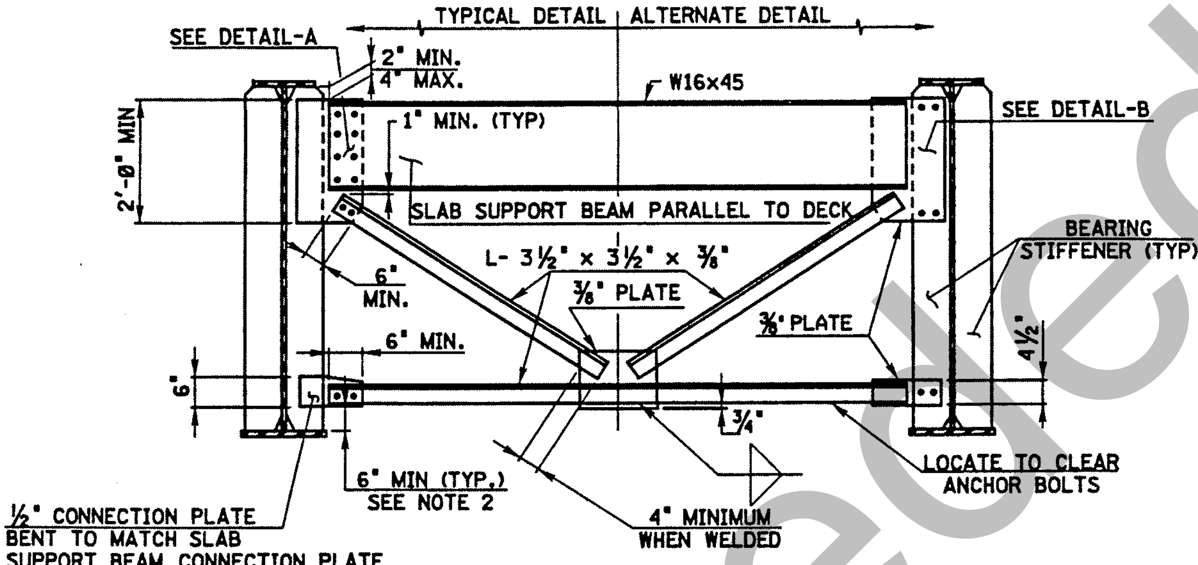
DETAIL A

(TYPICAL FOR ALL WELDED CONNECTIONS)

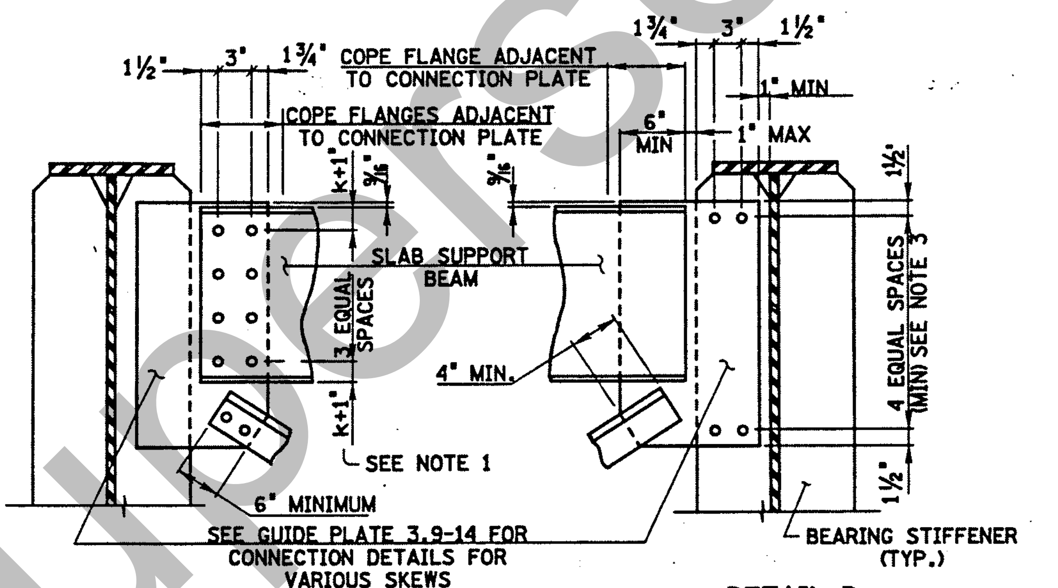
NOTE:

1. MODIFY THE DISTANCE BETWEEN THE BOTTOM GIRDER FLANGE AND THE LOWER DIAPHRAGM COMPONENT WHEN LOWER LATERAL BRACING IS USED.

CROSSFRAME DETAILS (SHEET 2 OF 3) END DIAPHRAGM	ISSUED: 2002 REV:	PLATE 3.9-12



END DIAPHRAGM DETAIL



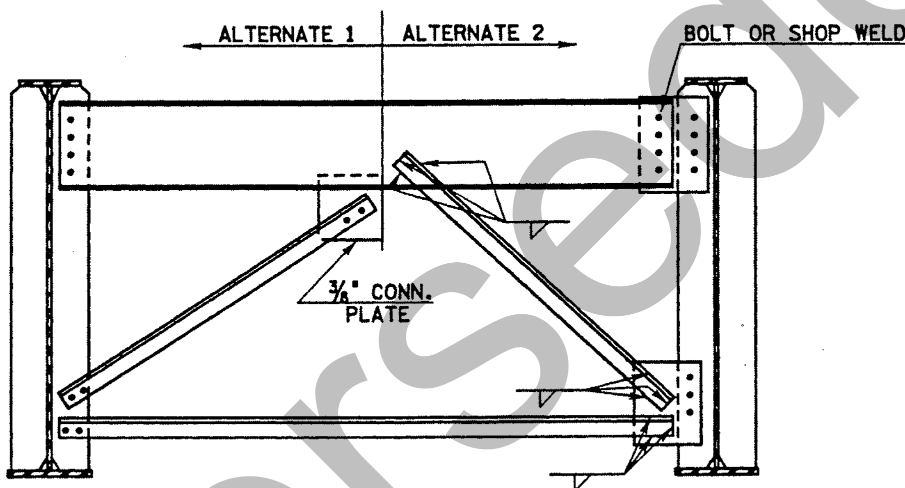
DETAIL-A

DETAIL-B

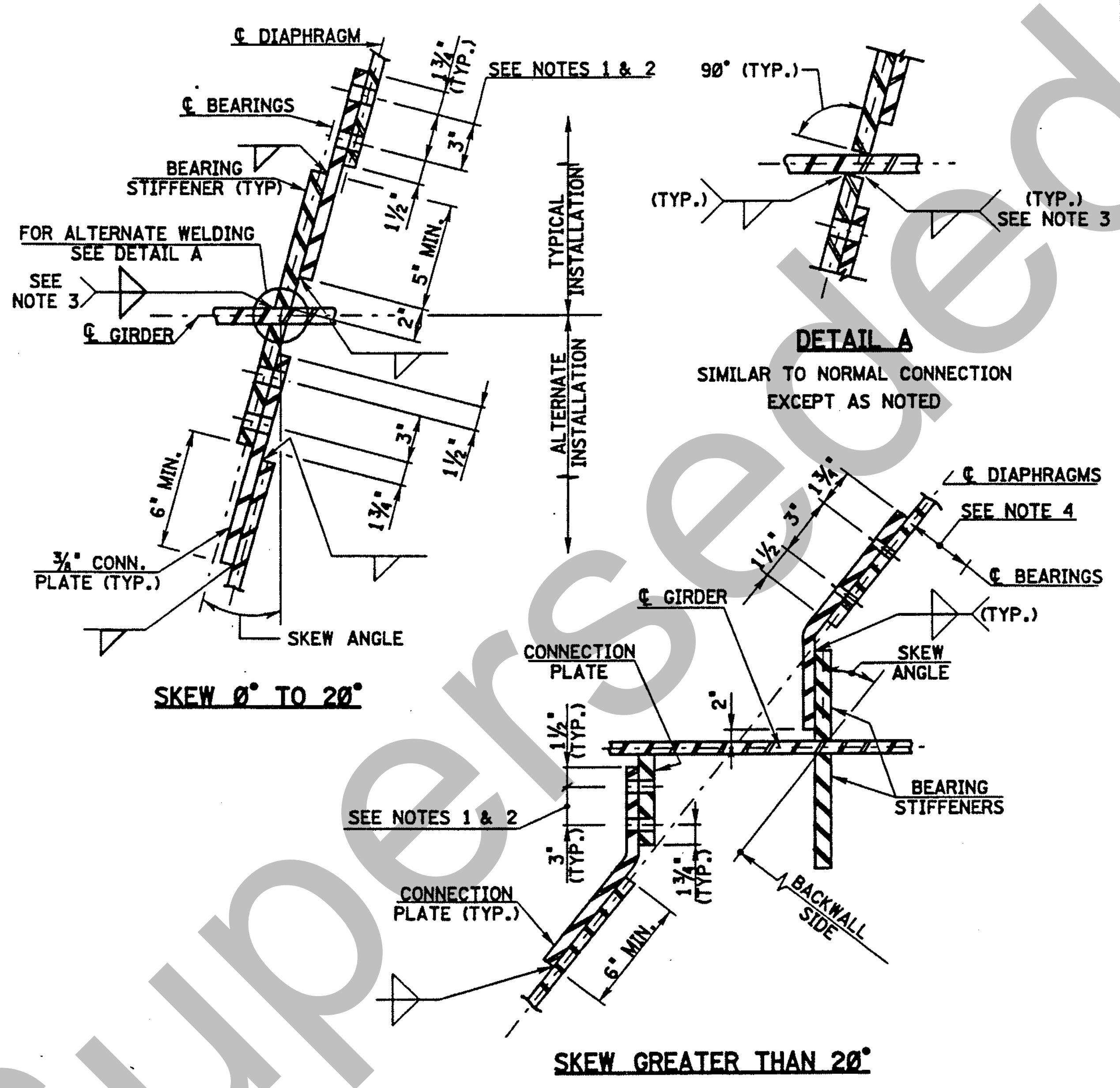
NOTES:

1. k = FLANGE THICKNESS + FILLET, AS INDICATED IN AISC TABLES OF BEAM DIMENSIONS
2. MODIFY THE DISTANCE BETWEEN THE BOTTOM GIRDER FLANGE AND THE LOWER DIAPHRAGM COMPONENT WHEN LOWER LATERAL BRACING IS USED. INDICATE MODIFICATIONS ON THE DESIGN DRAWINGS.
3. 1 1/16" DIAMETER HOLE IN BEARING STIFFENERS; 15/16" DIAMETER HOLE IN CONNECTION PLATE FOR ⅞" DIAMETER ASTM A325 BOLTS STD. SIZE HOLES ARE PERMITTED. UNTHREADED SHANK OF BOLT SHALL BE OF SUFFICIENT LENGTH TO NOT ALLOW ANY THREADS TO EXIST IN THE PLANE BETWEEN THE TWO CONNECTED PARTS.

CROSSFRAME DETAILS (SHEET 3 OF 3) ALTERNATE END DIAPHRAGM	ISSUED: 2002 REV:	PLATE 3.9-13



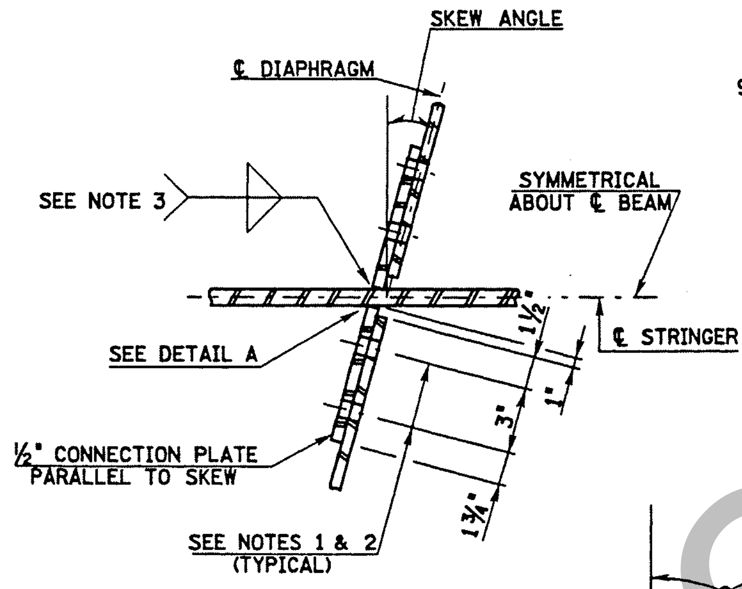
CONNECTION PLATE DETAILS (SHEET 1 OF 2) CONNECTION PLATE FOR GIRDER	ISSUED: 2002 REV:	PLATE 3.9-14



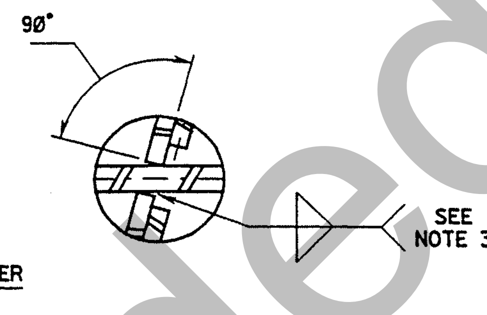
NOTES:

1. 1 1/16" DIAMETER HOLE IN CONNECTION PLATE, 15/16" DIAMETER HOLE IN CONNECTING MEMBER FOR 7/8" DIAMETER ASTM A325 BOLTS STD. SIZE HOLES ARE PERMITTED.
2. USE 7/8" DIAMETER ASTM A325 BOLTS HAVING AN UNTHREADED SHANK OF SUFFICIENT LENGTH TO NOT ALLOW ANY THREADS TO EXIST IN THE PLANE BETWEEN THE TWO CONNECTED PARTS (SHEAR PLANE).
3. WELD SIZE MUST BE IN ACCORDANCE WITH AWS D1.5, SUBSECTION 2.7.
4. POSITION DIAPHRAGM CONNECTION COMPONENTS SO AS TO CREATE MINIMUM OFFSET FROM CENTER LINE OF BEARINGS. DIAPHRAGM CONNECTION PLATE MAY BE PLACED BEHIND THE BEARING STIFFENER TO MINIMIZE OFFSET.

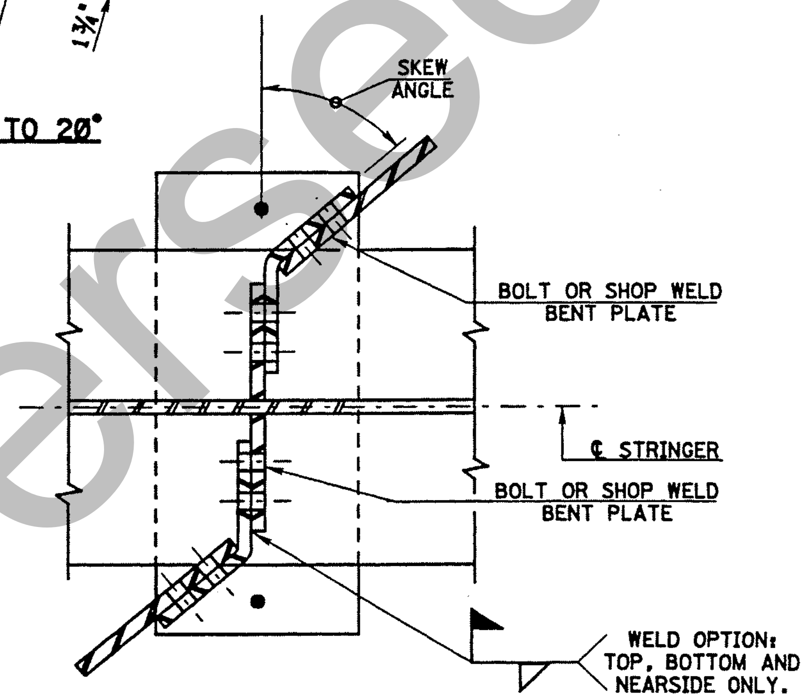
CROSSFRAME DETAILS (SHEET 2 OF 2) CONNECTION PLATE FOR STRINGER	ISSUED: 2002 REV:	PLATE 3.9-15



SKEW 0° TO 20°



DETAIL A

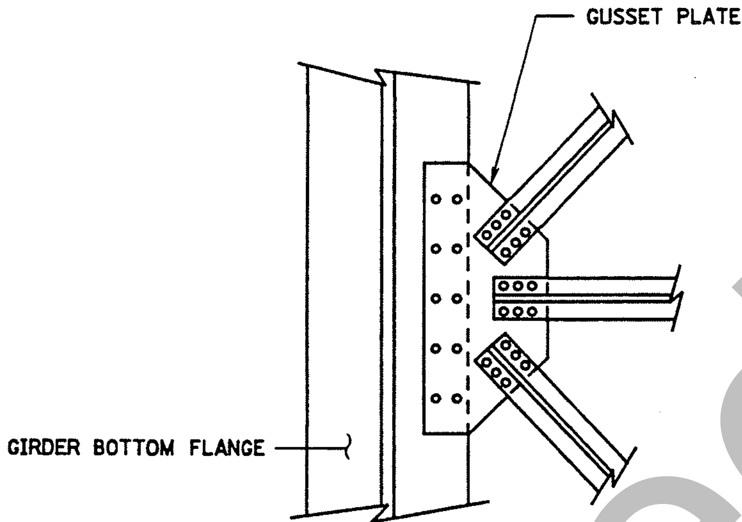


SKEWS GREATER THAN 20°

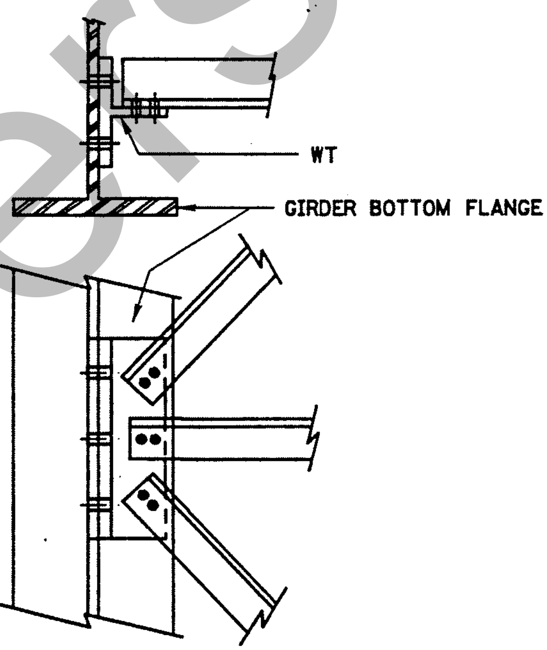
NOTES:

1. 1 1/16" DIAMETER HOLE IN CONNECTION PLATE; 15/16" DIAMETER HOLE IN CONNECTING MEMBER FOR 7/8" DIAMETER ASTM A325 BOLTS STD. SIZE HOLES ARE PERMITTED.
2. USE 7/8" DIAMETER ASTM A325 BOLTS HAVING AN UNTHREADED SHANK OF SUFFICIENT LENGTH TO NOT ALLOW ANY THREADS TO EXIST IN THE PLANE BETWEEN THE TWO CONNECTED PARTS (SHEAR PLANE).
3. WELD SIZE MUST BE IN ACCORDANCE WITH AWS D1.5, SUBSECTION 2.7.
4. POSITION DIAPHRAGM CONNECTION COMPONENTS SO AS TO CREATE MINIMUM OFFSET FROM CENTER LINE OF BEARINGS. DIAPHRAGM CONNECTION PLATE MAY BE PLACED BEHIND THE BEARING STIFFENER TO MINIMIZE OFFSET.

LATERAL BRACING DETAILS	ISSUED: 2002 REV:	PLATE 3.9-16

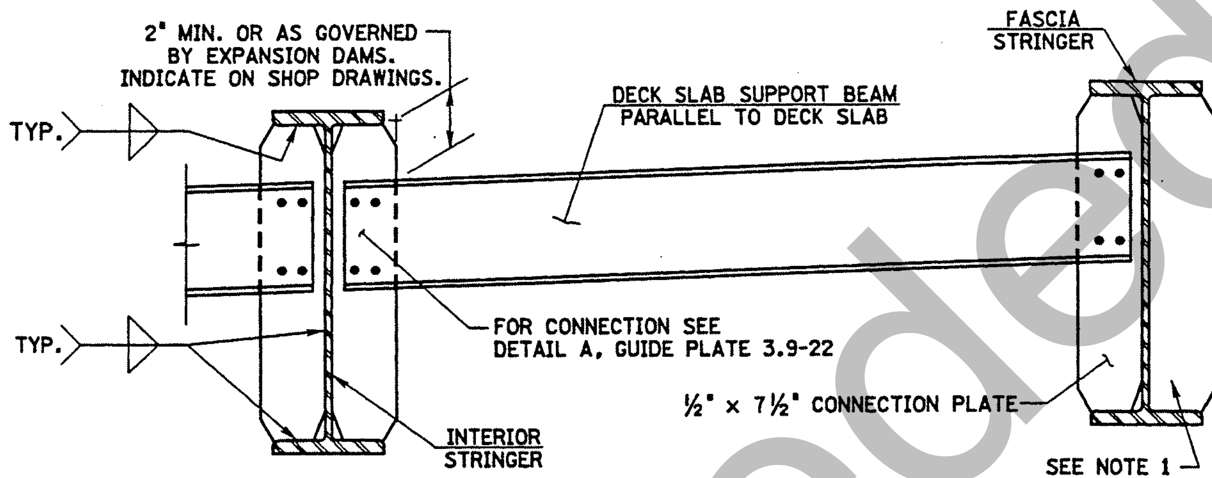


BOLTED ATTACHMENT
(CATEGORY B)



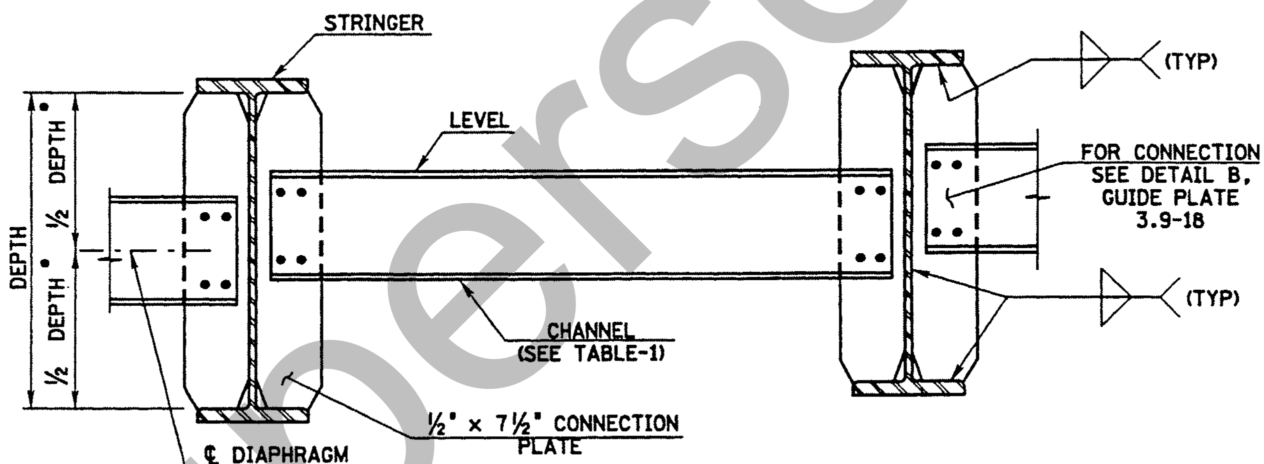
ALTERNATE BOLTED ATTACHMENT
(CATEGORY B)

ROLLED BEAM INTERMEDIATE DIAPHRAGM DETAILS (SHEET 1 OF 2)	ISSUED: 2002 REV:	PLATE 3.9-17



END DIAPHRAGM

FOR ROLLED SECTIONS



• - WHEREVER POSSIBLE

INTERMEDIATE DIAPHRAGM

FOR ROLLED SECTIONS
(SEE NOTE 2)

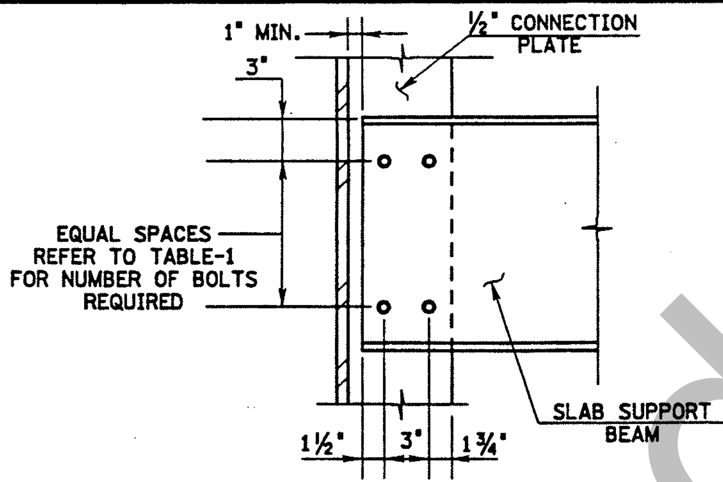
TABLE-1

STRINGER SIZE	DIAPHRAGM SIZE	NO. OF BOLTS
≥ 2'-3" DEPTH	C 15x33.9	8
UP TO 2'-0" DEPTH	C 12x25	6

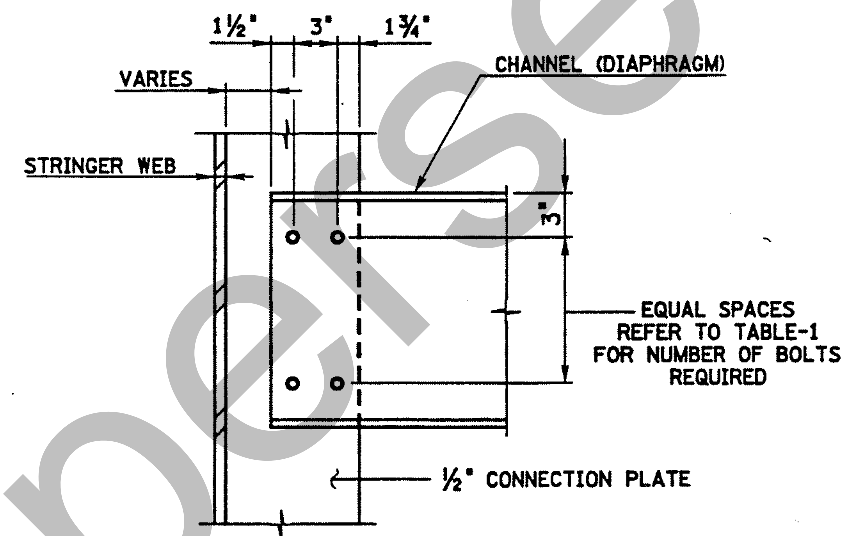
NOTES:

1. PROVIDE CONNECTION PLATE ON THE OUTSIDE FACE ALSO FOR TWO OR THREE GIRDER SYSTEMS.
2. INTERMEDIATE DIAPHRAGMS ON GUIDE PLATE 3.9-11 ARE AN ACCEPTABLE ALTERNATE.

ROLLED BEAM INTERMEDIATE DIAPHRAGM DETAILS (SHEET 2 OF 2)	ISSUED: 2002 REV:	PLATE 3.9-18



DETAIL-A
END DIAPHRAGM
(SEE NOTES 1 & 2)



DETAIL B
INTERMEDIATE DIAPHRAGM
(SEE NOTE 1)

TABLE-1

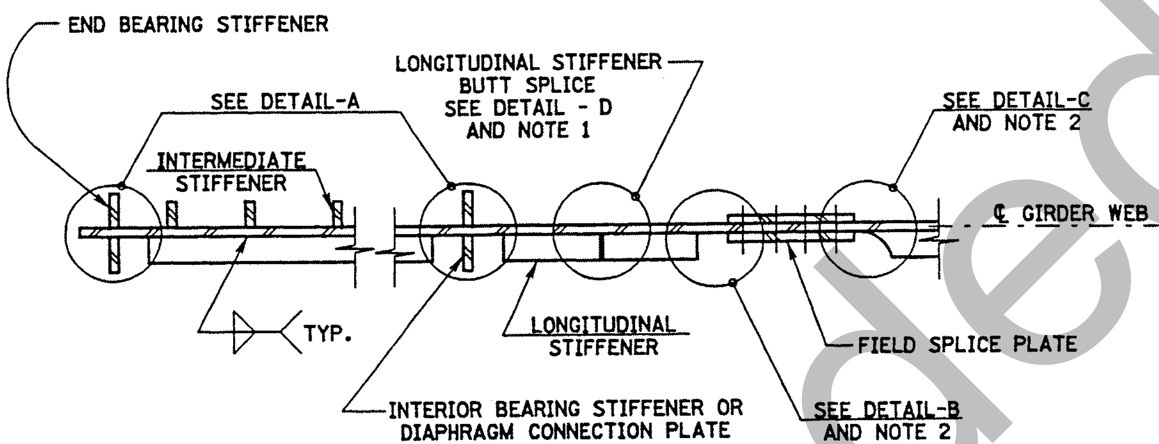
STRINGER SIZE	DIAPHRAGM SIZE	NO. OF BOLTS
≥ 2'-3" DEPTH	C 15x33.9	8
UP TO 2'-0" DEPTH	C 12x25	6

NOTES:

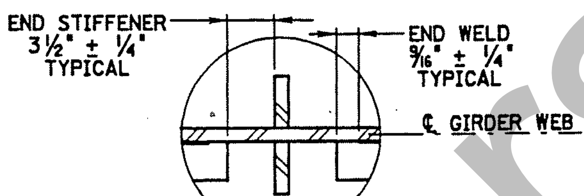
1. 1 1/16" DIAMETER HOLE IN CONNECTION PLATE; 15/16" DIAMETER HOLE IN CONNECTING MEMBER FOR 7/8" DIAMETER ASTM A325 BOLTS STD. SIZE HOLES ARE PERMITTED.

2. USE 7/8" DIAMETER ASTM A325 BOLTS HAVING AN UNTHREADED SHANK OF SUFFICIENT LENGTH TO NOT ALLOW ANY THREADS TO EXIST IN THE PLANE BETWEEN THE TWO CONNECTED PARTS (SHEAR PLANE).

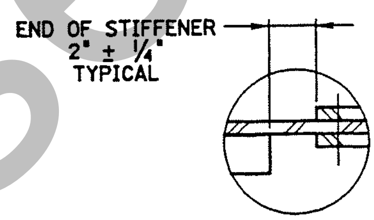
LONGITUDINAL/TRANSVERSE STIFFENER INTERSECTION DETAILS	ISSUED: 2002 REV:	PLATE 3.9-19



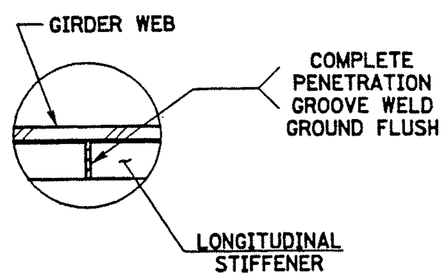
PLAN VIEW



DETAIL-A

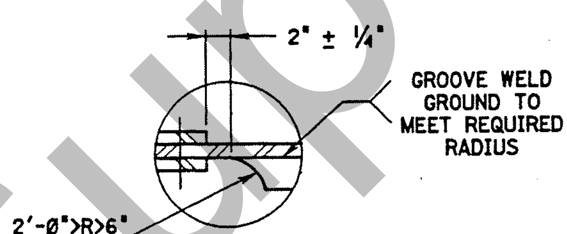


DETAIL-B



DETAIL-D

(SEE NOTE 1)



DETAIL-C

NOTES:

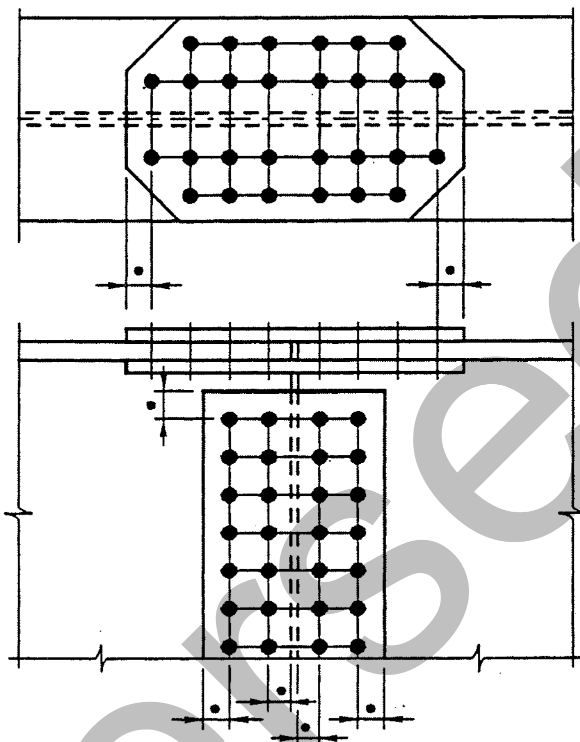
1. PERFORM NON-DESTRUCTIVE TESTING ON LONGITUDINAL STIFFENER BUTT WELDS PRIOR TO ATTACHMENT TO GIRDER.

2. USE DETAIL-C. DETAILS A AND B ARE APPLICABLE ONLY IN THE COMPRESSION ZONE. THERE SHALL BE NO CATEGORY D, E, OR E′ DETAILS IN TENSION ZONE.

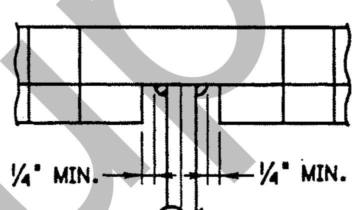
MAIN MEMBER EDGE DISTANCE	ISSUED: 2002 REV:	PLATE 3.9-20

NOTE

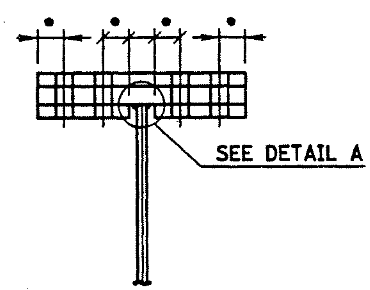
EDGES NOTED THUS: • TO BE 1¾" FOR ⅞" DIA. BOLTS & 2" FOR 1" DIA. BOLTS



TYPICAL FIELD SPLICE



DETAIL A

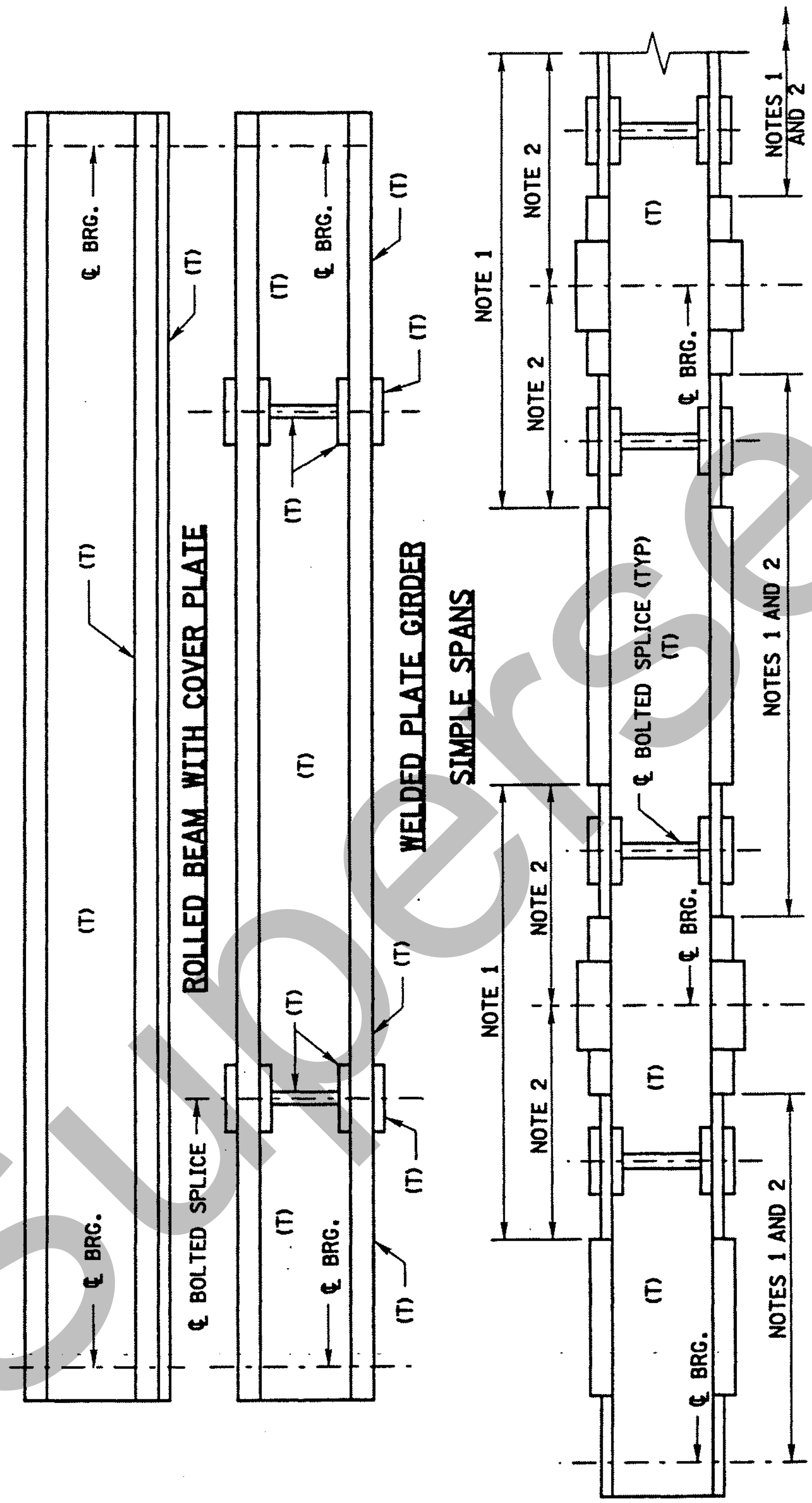


NOTE

ALL MAIN LOAD CARRYING CONNECTIONS SHOULD BE DESIGNED WITH A MINIMUM OF ⅛"(¼" PREFERRED) ADDITIONAL EDGE DISTANCE BEYOND THE AASHTO MINIMUM REQUIREMENTS. THIS WILL PROVIDE A TOLERANCE FOR PUNCHING, DRILLING & REAMING.

TOUGHNESS REQUIREMENTS, CHARPY V-NOTCH TESTS	ISSUED: 2002 REV:	PLATE 3.9-21

REFERENCE SUBSECTION 1.24.2 (d) AND (e) OF THIS MANUAL AND NJDOT STANDARD SPECIFICATIONS 503.03.

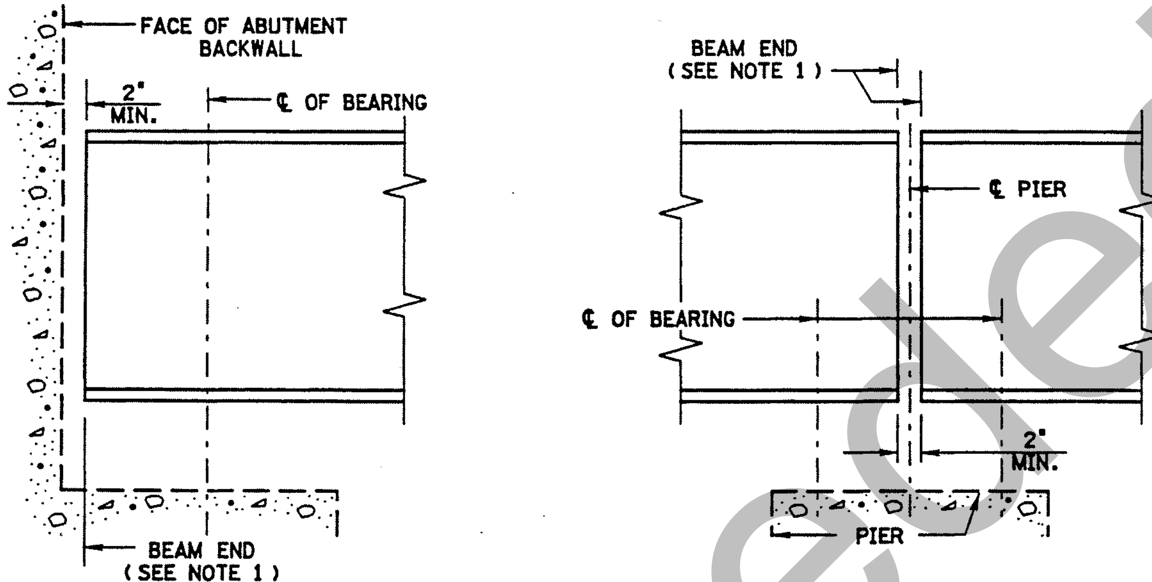


NOTES:

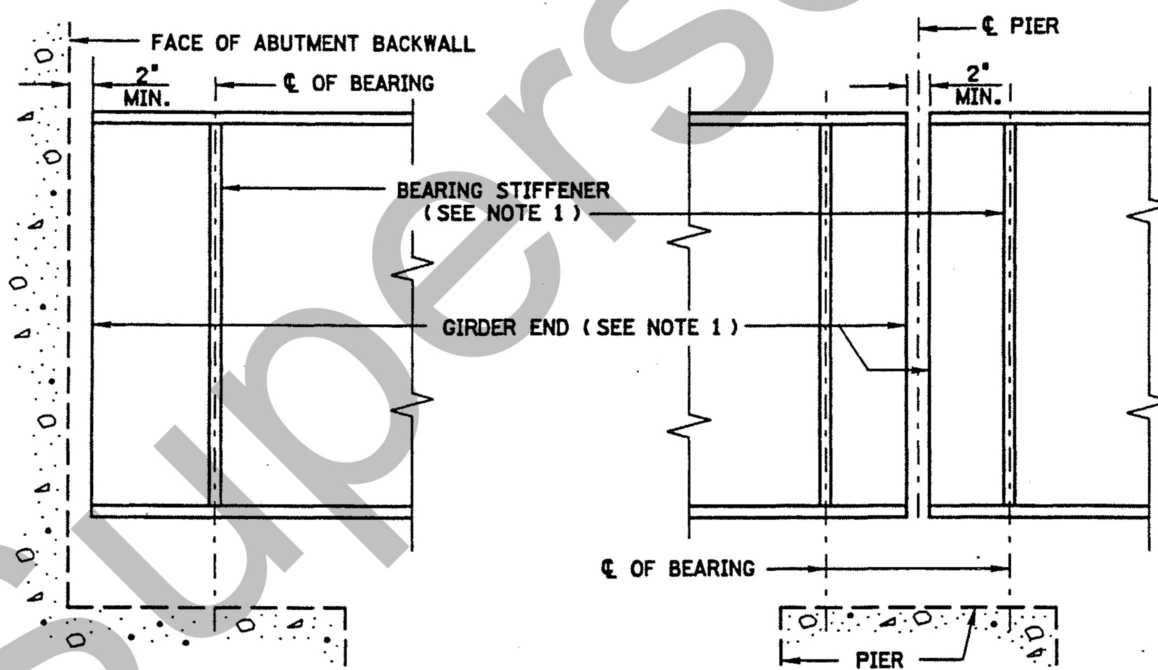
1. (T) DESIGNATION SHALL BE SHOWN FOR ALL TOP OR BOTTOM FLANGE PLATES, WEB PLATES, WEB SPLICE PLATES AND TOP OR BOTTOM FLANGE SPLICE PLATES WITHIN THESE LIMITS THAT ARE UNDER TENSION FROM D.L., OR L.L. OR BOTH. WHEN AN OPTIONAL BOLTED FIELD SPLICE IS SHOWN ON THE PLANS IN THIS AREA, ADD: "IF THE OPTIONAL BOLTED FIELD SPLICE IS NOT USED, TOUGHNESS REQUIREMENTS SPECIFIED ARE MANDATORY FOR THE TOP FLANGE PLATE."

2. DESIGNER SHALL FURNISH DIMENSIONS AT THESE LOCATIONS TO DEFINE TENSION LIMITS.

FASCIA BEAM END CLEARANCES	ISSUED: 2002 REV:	PLATE 3.9-22



ROLLED BEAMS

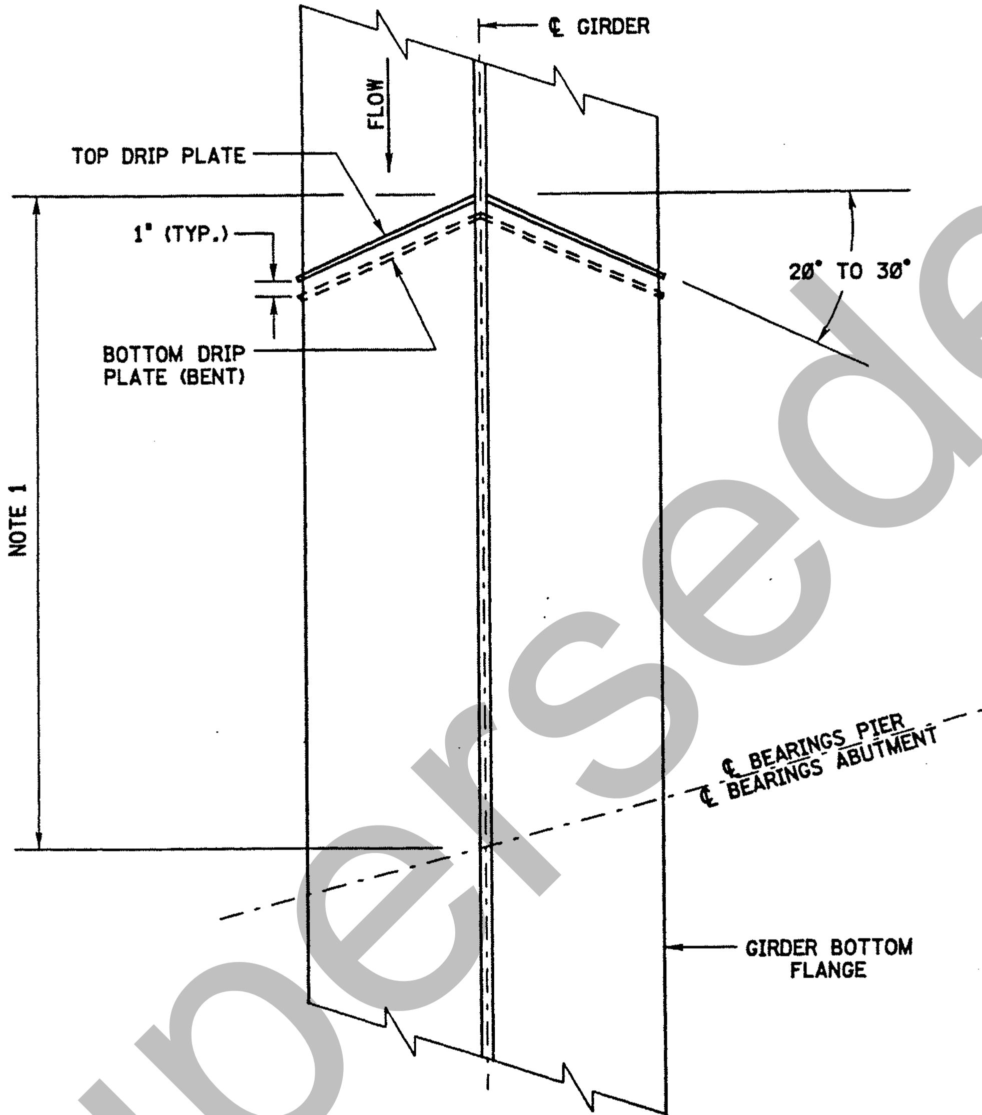


WELDED GIRDERS

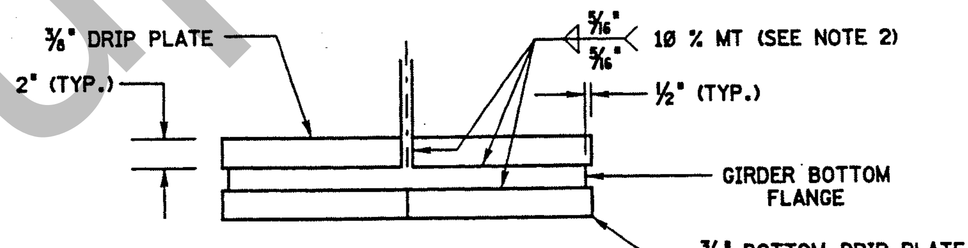
NOTES:

1. BEAM ENDS, GIRDER ENDS AND BEARING STIFFENERS SHALL BE NORMAL TO FLANGE.
2. FOR PRESTRESSED BEAMS, PROVIDE MINIMUM CLEARANCE OF 4" BETWEEN BEAM END AND ABUTMENT BACKWALL AND 3" BETWEEN BEAM ENDS AT PIER LOCATIONS.

DRIP PLATE DETAIL FOR WEATHERING STEEL	ISSUED: 2002 REV:	PLATE 3.9-23



PLAN



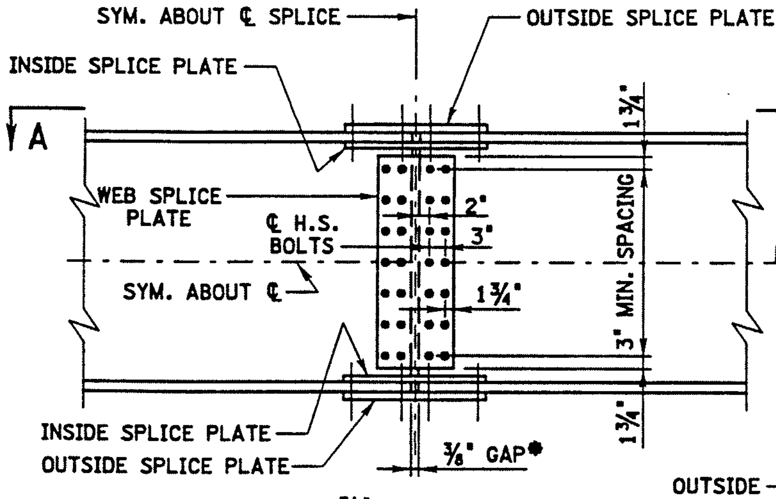
SECTION

NOTES:

1. DRIP PLATES SHALL BE LOCATED AT A DISTANCE THAT ENSURES NO RUNOFF ON SUBSTRUCTRE.

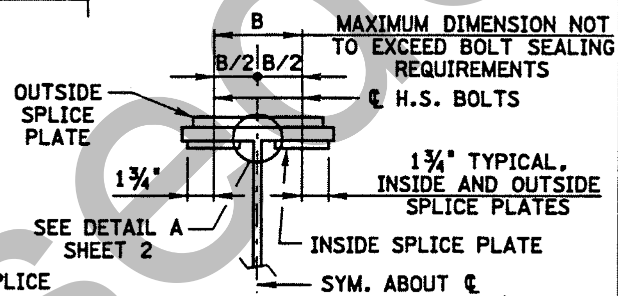
2. THE DRIP PLATES SHALL BE CLIPPED TO CLEAR THE WEB/FLANGE WELD.

BOLTED FIELD SPLICE DETAILS (SHEET 1 OF 2)	ISSUED: 2002 REV:	PLATE 3.9-24

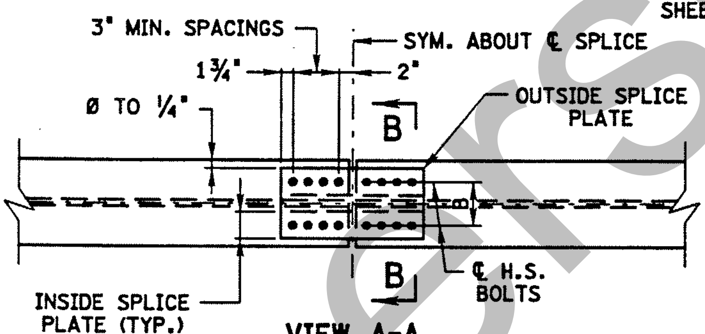


* USE 3/8" GAP FOR DESIGN, DETAIL AS 1/4" GAP ON DRAWINGS.

WEB SPLICE DETAIL



SECTION B-B



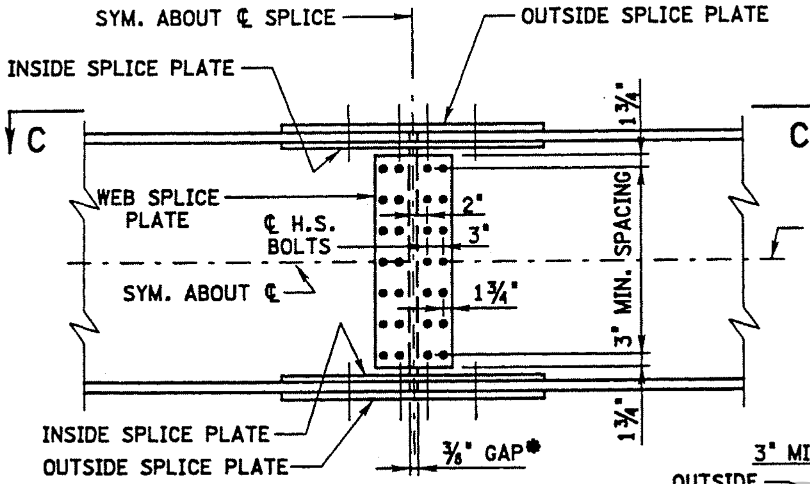
VIEW A-A

FLANGE SPLICE DETAIL - TYPE 1

NOTES:

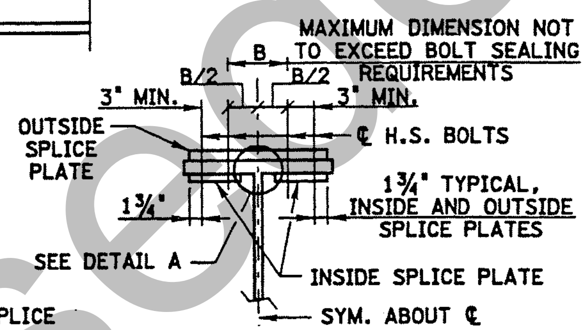
1. DETAILS SHOWN ARE FOR 7/8" DIAMETER HIGH STRENGTH BOLTS.
2. BOLT SPACINGS SHOWN ARE PREFERRED MINIMUMS.
3. EDGE DISTANCES SHOWN ARE MINIMUMS BASED ON SHEARED OR GAS CUT EDGES PLUS AN ADDITIONAL 1/4" CLEARANCE TO PROVIDE A TOLERANCE FOR PUNCHING, DRILLING AND REAMING.
4. FOR THE MINIMUM EDGE DISTANCES, THE BEARING CAPACITY OF THE WEB PLATE, ESPECIALLY THIN WEB PLATES, MAY BE SIGNIFICANTLY LESS THAN THE BOLT SHEAR CAPACITY RESULTING IN THE PLATE BEARING CAPACITY CONTROLLING THE DESIGN. THE DESIGNER SHOULD ADJUST THE WEB EDGE DISTANCES, INCREASING THE PLATE BEARING CAPACITY, TO MINIMIZE THE NUMBER OF GAGE LINES OF WEB BOLTS. THE DESIGNER SHOULD INCREASE THE WEB EDGE DISTANCE TO OBTAIN A DESIGN WITH THE TYPICAL 2 OR 3 ROWS OF WEB SPLICE BOLTS.
5. DESIGNER TO VERIFY INSTALLATION CLEARANCES AS ILLUSTRATED IN AISC MANUAL OF STEEL CONSTRUCTION.
6. DESIGNER TO INDICATE WHETHER OR NOT THE BOLTS ARE DESIGNED FOR THREADS EXCLUDED FROM SHEAR PLANE.
7. CAPACITY OF COMPONENT SPLICE PLATE TO EQUAL CAPACITY OF COMPONENT. COMPONENT BEING TOP FLANGE, WEB OR BOTTOM FLANGE.
8. CHECK GIRDER CAPACITY FOR REDUCTION DUE TO BOLT HOLES IN THE TENSION FLANGE USING THE EFFECTIVE NET AREA ACCORDING TO AASHTO LRFD SUB-SECTION 6.10.3.6.
9. THE EFFECTIVE COMPRESSION FLANGE AREA SHALL BE TAKEN EQUAL TO THE GROSS AREA OF THE COMPRESSION FLANGE.
10. DESIGNER TO VERFY THAT BOLT SPACINGS FOR FLANGE SPLICES AND WEB SPLICES DO NOT EXCEED BOLT SEALING REQUIREMENTS.

BOLTED FIELD SPLICE DETAILS (SHEET 2 OF 2)	ISSUED: 2002 REV:	PLATE 3.9-25

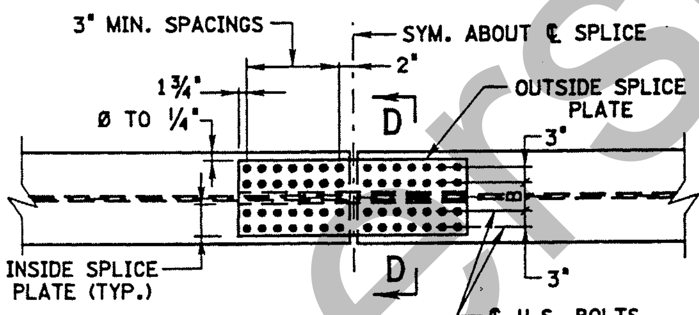


* USE ⅜" GAP FOR DESIGN, DETAIL AS ¼" GAP ON DRAWINGS.

WEB SPLICE DETAIL

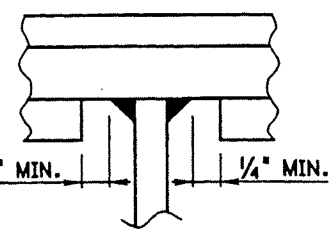


SECTION D-D

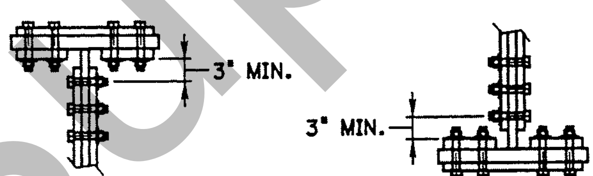


VIEW C-C

FLANGE SPLICE DETAIL - TYPE 2



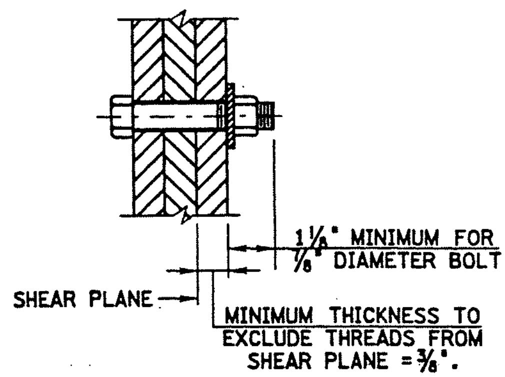
DETAIL A



TOP FLANGE

BOTTOM FLANGE

⅞" DIAMETER BOLT ENTERING AND TIGHTENING CLEARANCES



BOLT SHEAR PLANE

MINIMUM PLATE THICKNESS IS ⅜".

NOTE:
BASED ON 1½" THREAD LENGTH FOR ⅞" DIAMETER BOLT

NOTE:

SEE SHEET 1 FOR GENERAL NOTES.

STRUCTURAL STEEL NOTES TO BE SHOWN ON CONTACT PLANS	ISSUED: 2002 REV:	PLATE 3.9-26

1. WELDING SHALL CONFORM TO THE CURRENT AASHTO/AWS D1.5 WELDING CODE WITH NJDOT AMENDMENTS. WELDING AND NONDESTRUCTIVE TESTING SYMBOLS SHALL CONFORM TO SYMBOLS FOR WELDING, BRAZING AND NONDESTRUCTIVE EXAMINATION AWS A2.4.

2. JOINT WELDING PROCEDURES, OVERALL FABRICATION METHODS, AND QUALITY CONTROL INSPECTION PROCEDURE SHALL BE INCLUDED AS WRITTEN PROCEDURE SPECIFICATIONS WITH THE SHOP PLAN SUBMISSION.

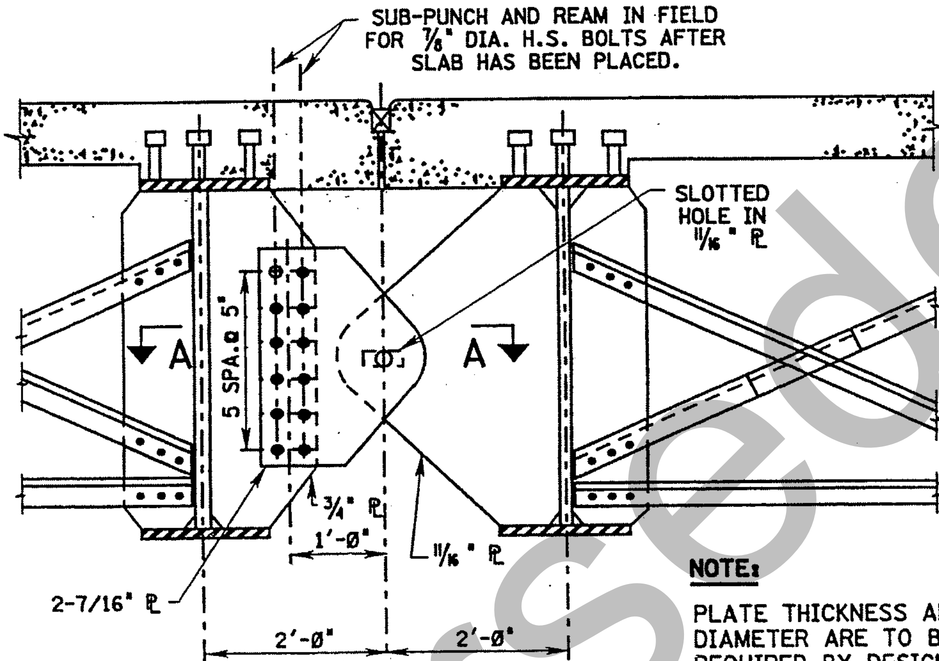
3. FLANGE AND WEB SHOP SPLICES SHALL BE LOCATED WHERE SHOWN ON PLANS. MINOR CHANGES IN LOCATION, TOGETHER WITH ANY ADDITIONAL SPLICES REQUESTED, SHALL BE SUBJECT TO THE APPROVAL OF THE ENGINEER. LENGTHS OF PLATES SHALL BE CONSISTENT WITH LENGTHS OF PLATES AVAILABLE FROM THE MILL. LOCATION SHALL BE AT POINTS OF REDUCED TENSILE STRESS. WEB SPLICES SHALL BE AT LEAST 12" FROM FLANGE SPLICES AND/OR TRANSVERSE INTERMEDIATE STIFFENER AND/OR CONNECTION PLATES FOR DIAPHRAGMS.

4. WHEN FLANGES ARE DETAILED ON THE CONTRACT PLANS AS A SERIES OF VARYING THICKNESS PLATES, THE CONTRACTOR MAY, FOR THE PURPOSE OF ELIMINATING BUTT WELDS, EXTEND THE LENGTH OF THE THICKER PLATE TO THE END OF THE NEXT THINNER PLATE OR TO THE END OF THE MEMBER, PROVIDED THE MAXIMUM PLATE THICKNESS DOES NOT EXCEED 1.5 TIMES THE THICKNESS OF THE THINNER PLATE PLUS 3/8", SUBJECT TO APPROVAL BY THE ENGINEER. IF THE CONTRACTOR INCREASES THE THICKNESS OF THE BOTTOM FLANGE PLATE AT A BEARING LOCATION, HE SHALL MAINTAIN THE ORIGINAL GIRDER ELEVATION BY MAKING SUITABLE CHANGES IN THE ELEVATION OF THE CONCRETE MASONRY.

5. ALLOWANCES SHALL BE MADE IN THE SHOP FOR SHRINKAGE DUE TO WELDING AND BURNING. IF UNEVEN SHRINKAGE IS ANTICIPATED, CAMBER ORDINATES SHALL BE ADJUSTED ACCORDINGLY.

6. FLANGE AND WEB SHOP SPLICES ARE TO BE COMPLETED AND WELDMENTS INSPECTED BEFORE FITTING AND WELDING FLANGES TO WEBS. FABRICATION METHODS WHICH MAY BE REQUIRED FOR SPECIAL CONDITIONS, SHALL BE INCLUDED IN THE WRITTEN WELDING AND PROCEDURE SPECIFICATIONS OF THE SHOP PLANS.

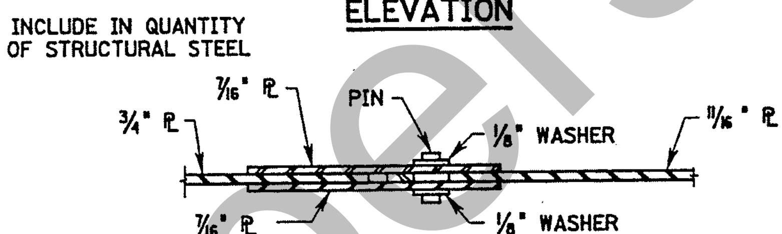
SHEAR LOCK AT LONGITUDINAL OPEN JOINTS IN DECK SLAB	ISSUED: BDC04MB-01	PLATE 3.9-27



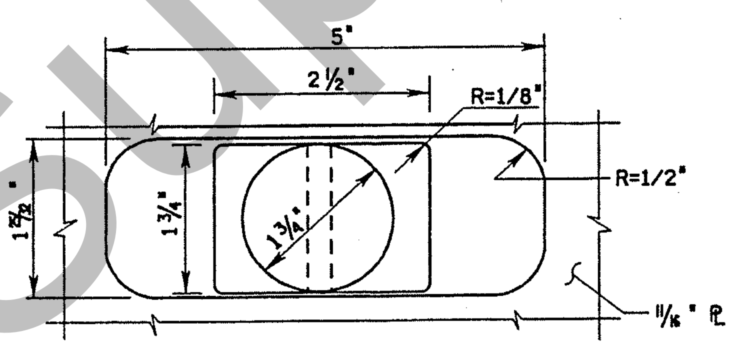
NOTE:

PLATE THICKNESS AND PIN DIAMETER ARE TO BE AS REQUIRED BY DESIGN.

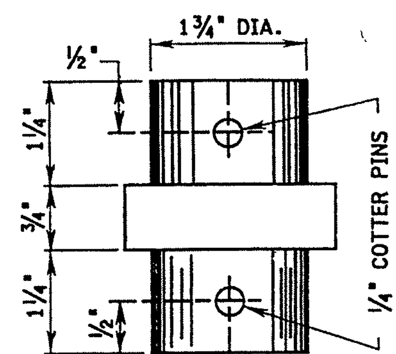
ELEVATION



SECTION A - A

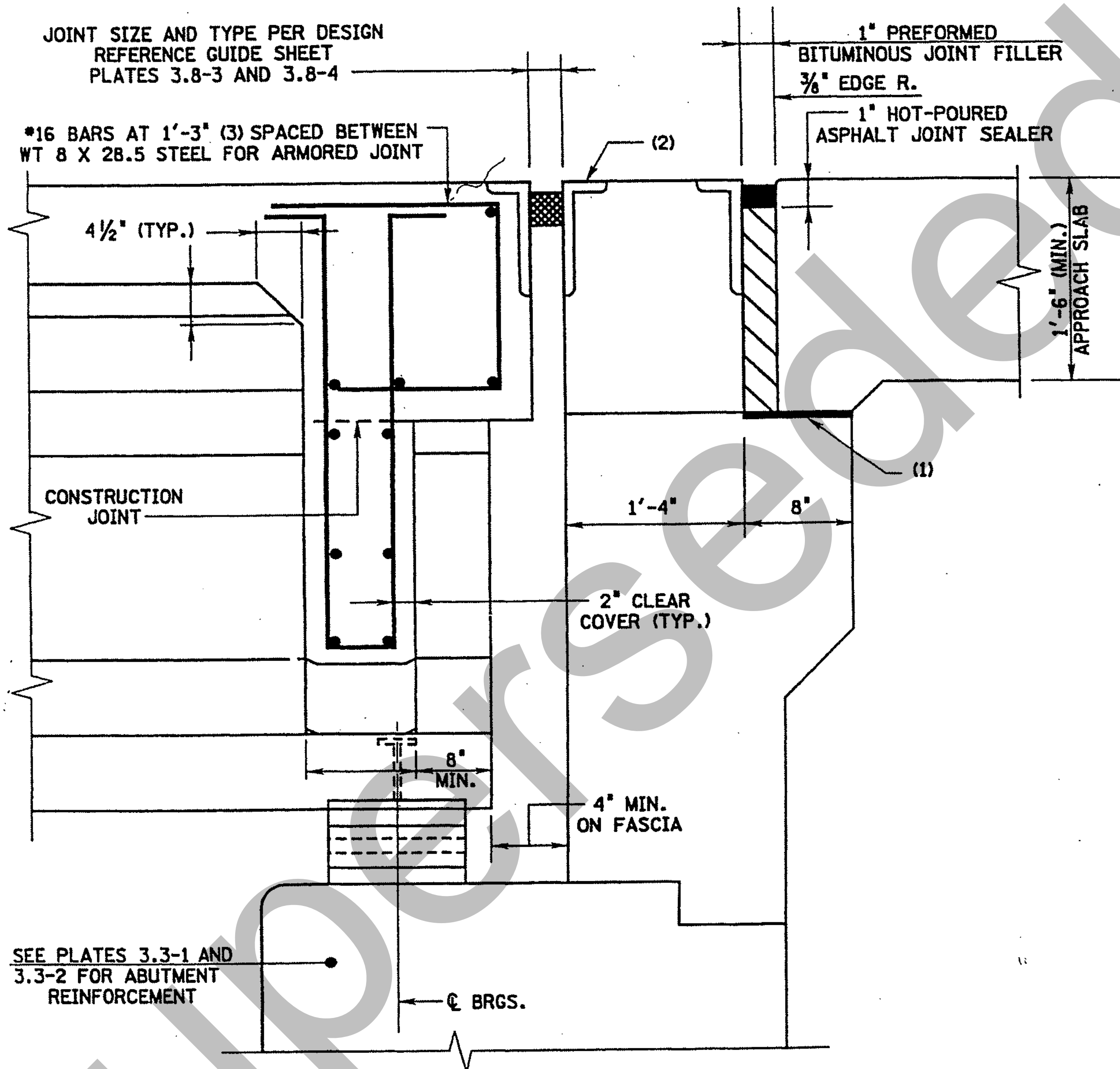


SLOTTED HOLE DETAIL



DETAIL OF PIN

SECTION AT ABUTMENT, PC I-BEAMS	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.10-1



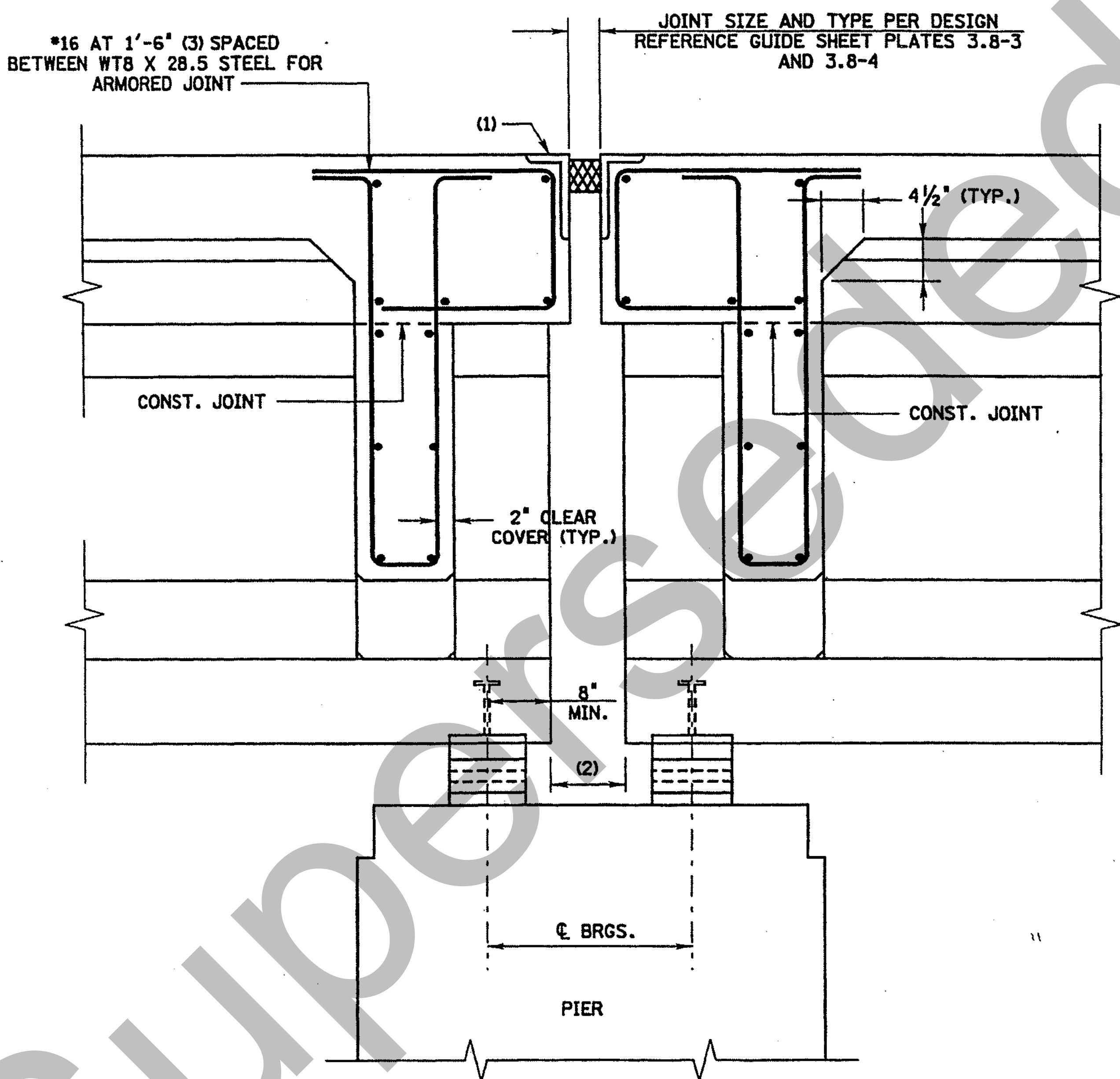
NOTES:

1. A 1/4" THICK PIECE OF PREFORMED BITUMINOUS JOINT FILLER SHALL BE LAID IN AND COVERED WITH ASPHALT ROOFING CEMENT ON THE SURFACE WHERE THE APPROACH SLAB SHALL REST.

2. REFERENCE PLATES 3.8-11 AND 3.8-13 FOR TYPICAL ARMORED JOINT DETAILS FOR PRESTRESSED CONCRETE I-BEAMS.

3. THE #16 BARS IN THE HAUNCH BETWEEN BEAMS SHALL BE LAPPED TO THE TOP LONGITUDINAL REINFORCEMENT AND SHALL BE CORROSION PROTECTED. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.

SECTION AT PIER, PC I-BEAMS	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.10-2



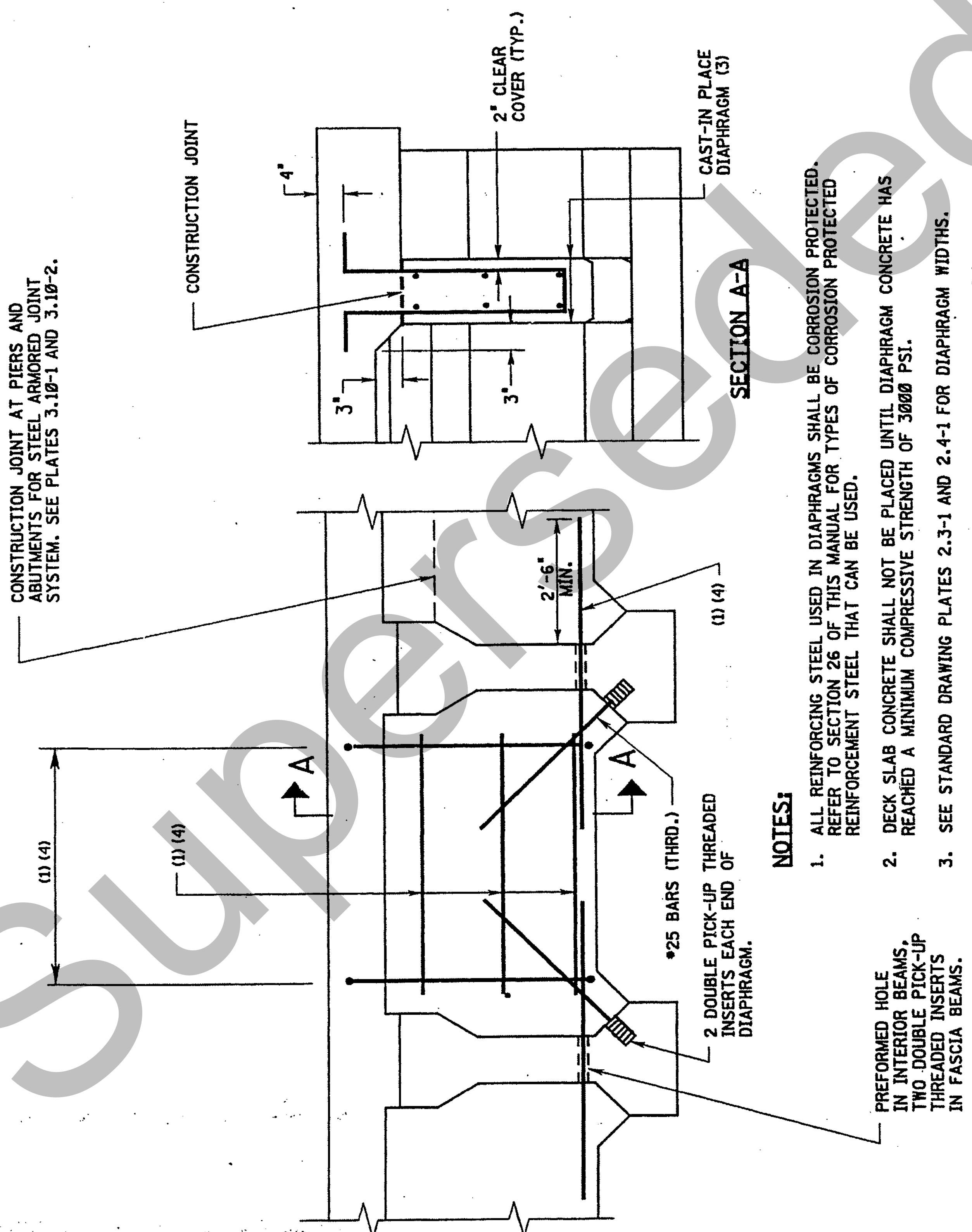
NOTES:

1. REFERENCE PLATES 3.8-11, 3.8-12 AND 3.8-13 FOR TYPICAL DETAILS OF ARMORED JOINT SYSTEM FOR PRESTRESSED CONCRETE I-BEAMS.

2. THE MINIMUM CLEARANCE BETWEEN THE ENDS OF FASCIA BEAMS SHALL BE 3".

3. THE #16 BARS IN THE HAUNCH BETWEEN BEAMS SHALL BE LAPPED TO THE TOP LONGITUDINAL REINFORCEMENT AND SHALL BE CORROSION PROTECTED. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.

CAST-IN-PLACE END DIAPHRAGM FOR PC I-BEAMS AT BEARINGS	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.10-3

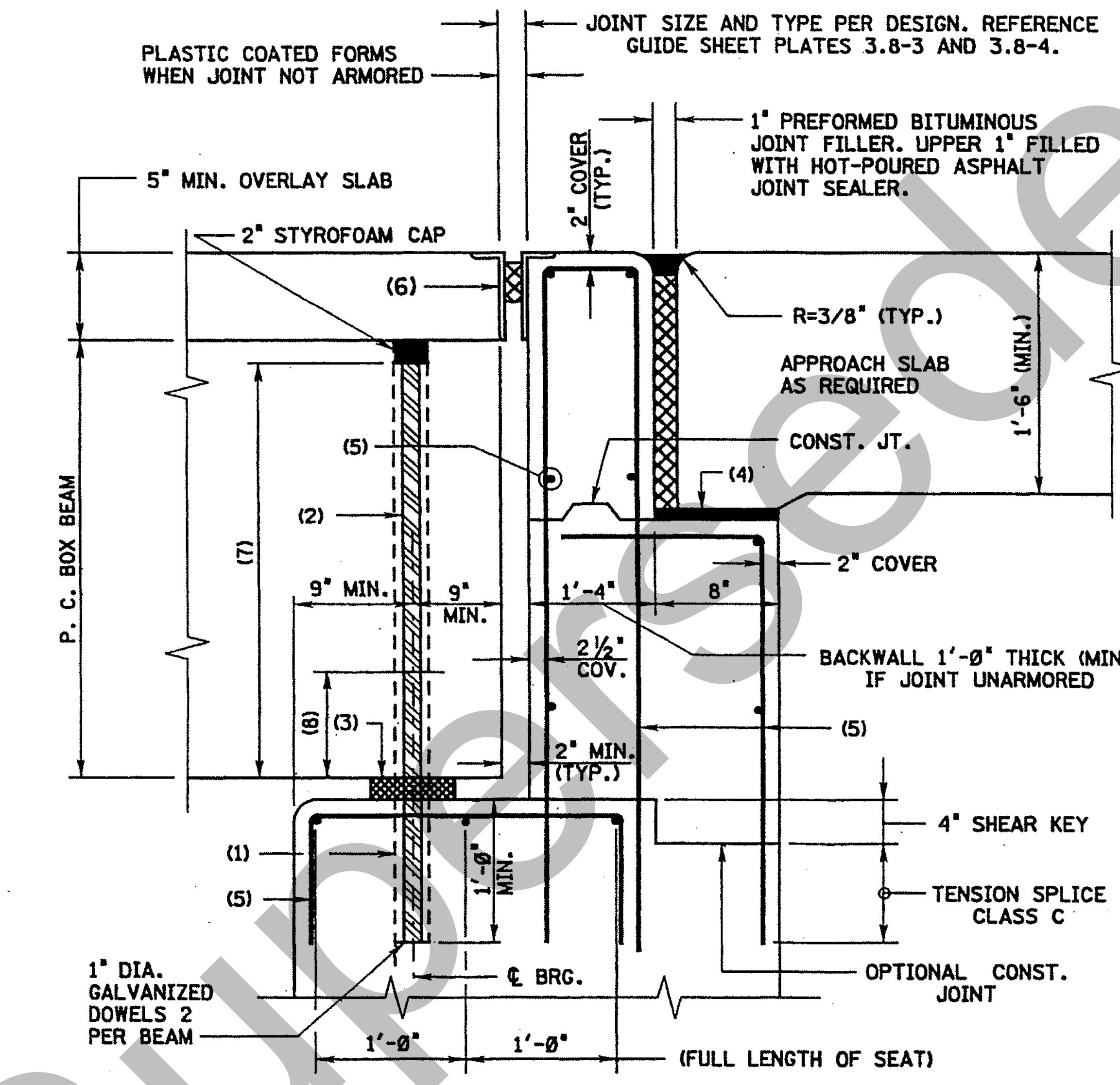


NOTES:

1. ALL REINFORCING STEEL USED IN DIAPHRAGMS SHALL BE CORROSION PROTECTED. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.
2. DECK SLAB CONCRETE SHALL NOT BE PLACED UNTIL DIAPHRAGM CONCRETE HAS REACHED A MINIMUM COMPRESSIVE STRENGTH OF 3000 PSI.
3. SEE STANDARD DRAWING PLATES 2.3-1 AND 2.4-1 FOR DIAPHRAGM WIDTHS.
4. REINFORCEMENT NOT DESIGNATED SHALL BE AS REQUIRED BY DESIGN.

SECTION AT ABUTMENT, PC ADJACENT SLAB AND BOX BEAMS	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.10-4

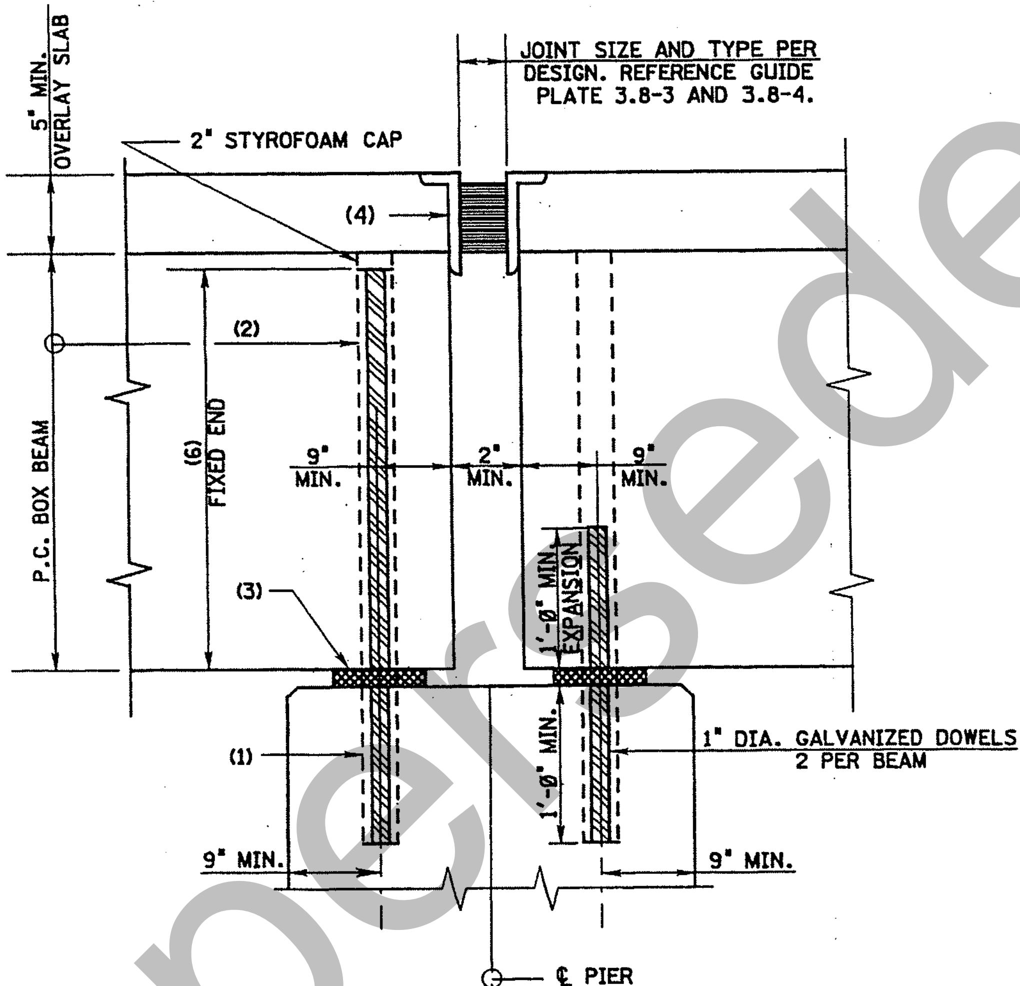
NOTE: ARMORING NOT REQUIRED FOR SPANS LESS THAN 55'-0".



NOTES:

1. 2" DIA. HOLES IN ABUTMENT SEAT TO BE CORED AFTER BEAMS ARE ERECTED AND THE TRANSVERSE TIES ARE TENSIONED, FILLED WITH NON-SHRINK GROUT.
2. FILL WITH MASTIC OR HOT-POURED RUBBER ASPHALT JOINT SEALER AT THE EXPANSION BEARINGS. FILL WITH NON-SHRINK GROUT OR LOW MODULUS EPOXY MORTAR AT THE FIXED BEARINGS.
3. REFERENCE PLATE 3.10-9 FOR REINFORCED ELASTOMERIC BEARING PAD DETAILS.
4. A 1/4" THICK PIECE OF PREFORMED BITUMINOUS JOINT FILLER SHALL BE LAID IN AND COVERED WITH ASPHALT ROOFING CEMENT ON THE SURFACE WHERE THE APPROACH SLAB SHALL REST.
5. CORROSION PROTECTED REINFORCEMENT. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.
6. REFERENCE GUIDE SHEET PLATES 3.8-14 AND 3.8-15 FOR ARMORED JOINT DETAILS
7. DOWELS CUT 2" TO ALLOW FOR STYROFOAM CAP FOR FIXED BEARING.
8. 1'-0" MINIMUM LENGTH FOR EXPANSION BEARING.

SECTION AT FIXED PIER, PC ADJACENT SLAB AND BOX BEAMS	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.10-5



NOTES:

1. 2" DIA. HOLES IN PIER SEAT TO BE CORED AFTER BEAMS ARE ERECTED AND TIE RODS TIGHTENED, EXCEPT FOR RIGID FRAME AND HAMMERHEAD PIERS IN WHICH CASE ANCHOR BOLTS SHALL BE SET IN 3" DIA. SLEEVES, FILLED WITH NON-SHRINK GROUT.

2. FILL WITH MASTIC OR HOT-POURED RUBBER ASPHALT JOINT SEALER AT EXPANSION BEARINGS. FILL WITH NON-SHRINK GROUT OR LOW MODULUS EPOXY MORTAR AT FIXED BEARINGS.

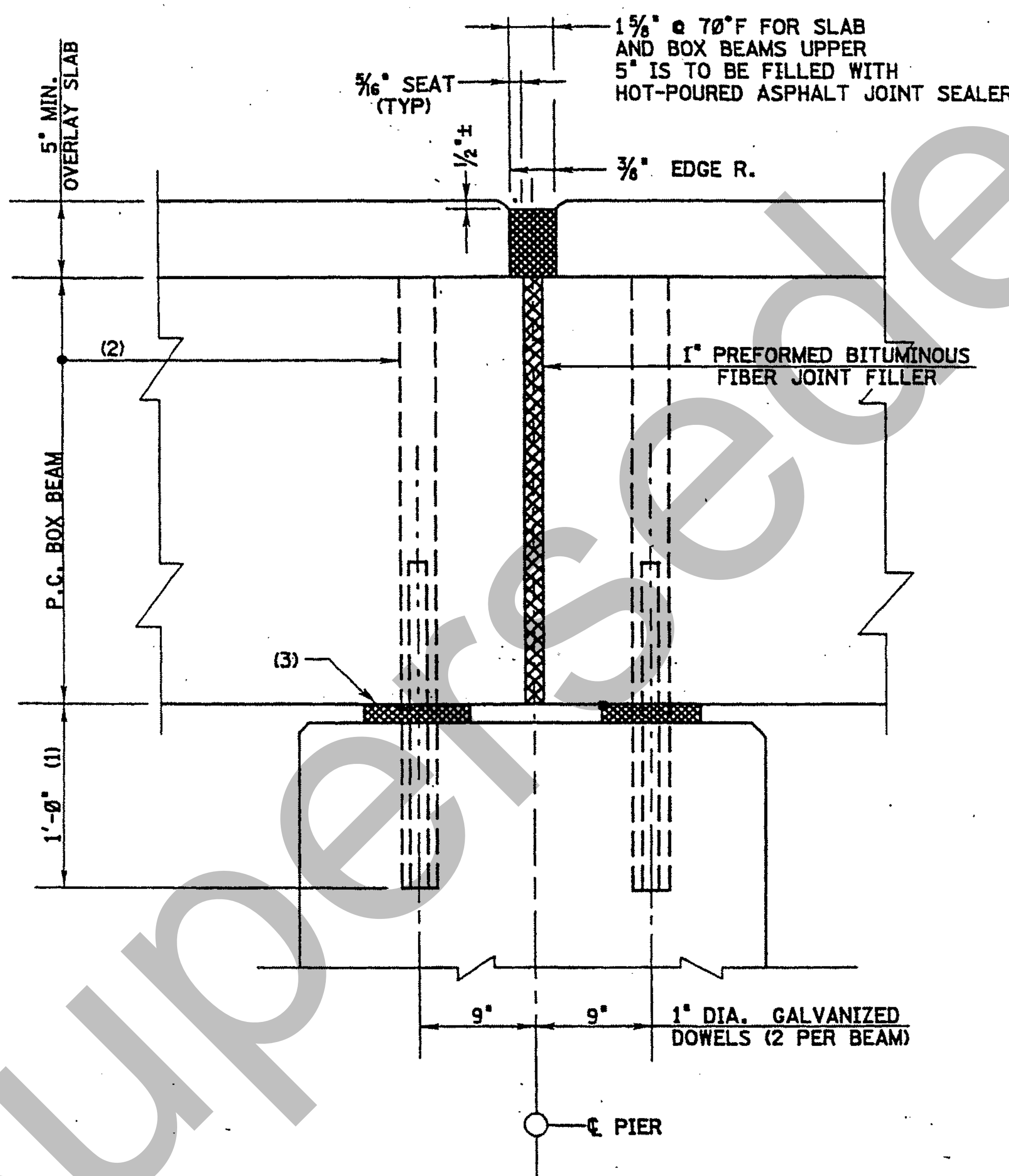
3. FOR ELASTOMERIC BEARING PAD DETAILS SEE PLATE 3.10-9.

4. REFERENCE GUIDE SHEET PLATES 3.8-14 AND 3.8-15 FOR ARMORED JOINT DETAILS FOR BOX BEAMS.

5. PIER CAP REINFORCING STEEL SHALL BE CORROSION PROTECTED. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.

6. DOWELS CUT 2" TO ALLOW FOR STYROFOAM CAP FOR FIXED BEARINGS.

SECTION AT PIER, PC ADJACENT SLAB AND BOX BEAMS, SPANS < 55 FEET	ISSUED: 2002 REV:	PLATE 3.10-6



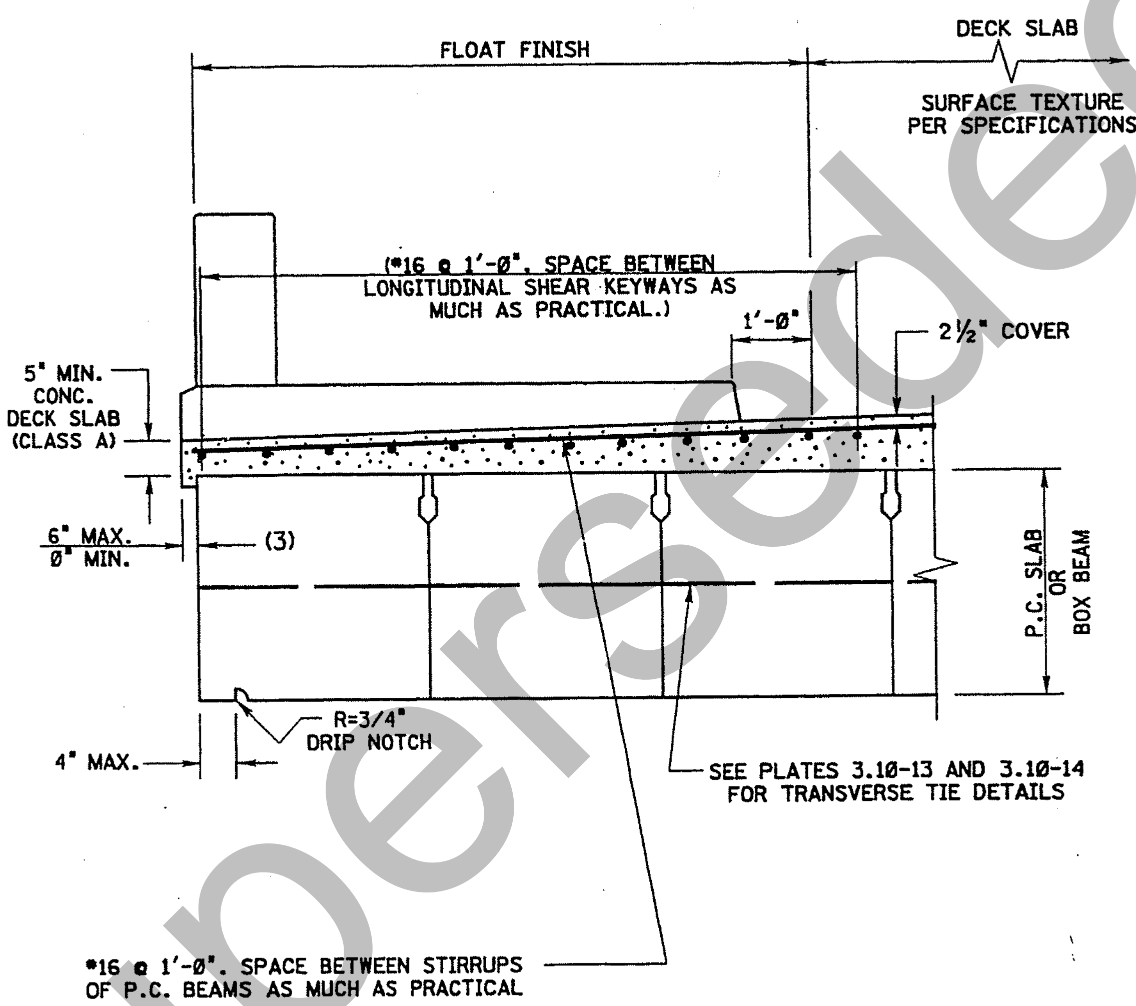
NOTES:

1. 2" DIA. HOLES IN ABUTMENT SEAT TO BE DRILLED OR CORED AFTER BEAMS ARE ERECTED AND TIE RODS TIGHTENED. FILL WITH NON-SHRINK GROUT.

2. FILL WITH MASTIC OR HOT-POURED RUBBER ASPHALT JOINT SEALER AT EXPANSION END. FILL WITH NON-SHRINK GROUT OR LOW MODULUS EPOXY MORTAR AT FIXED END.

3. FOR ELASTOMERIC BEARING PAD SEE PLATE 3.10-9.

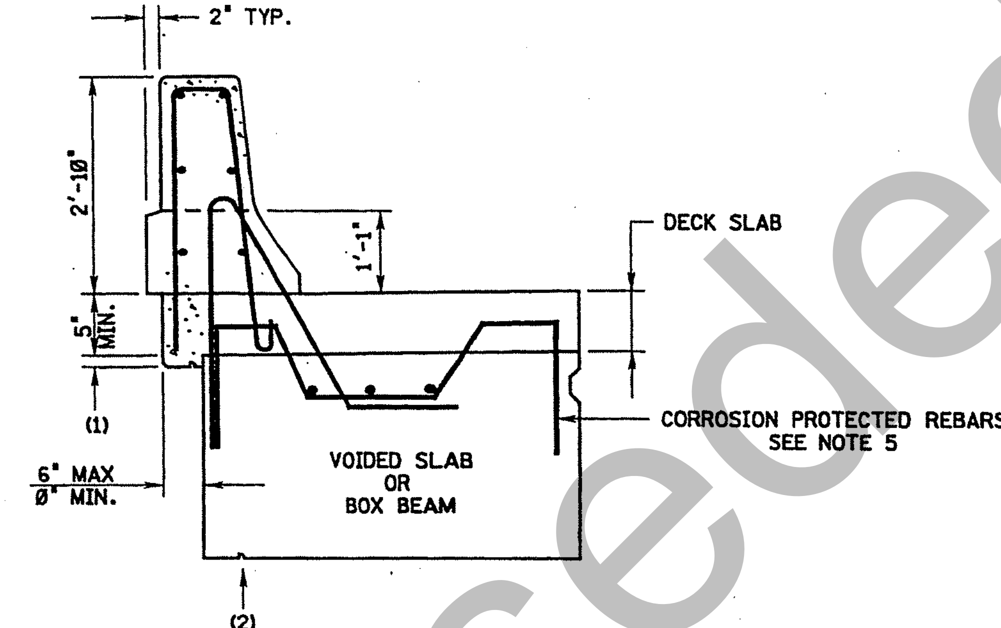
PRESTRESSED CONCRETE SLAB AND BOX BEAMS - DECK OVERLAY DETAILS	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.10-7



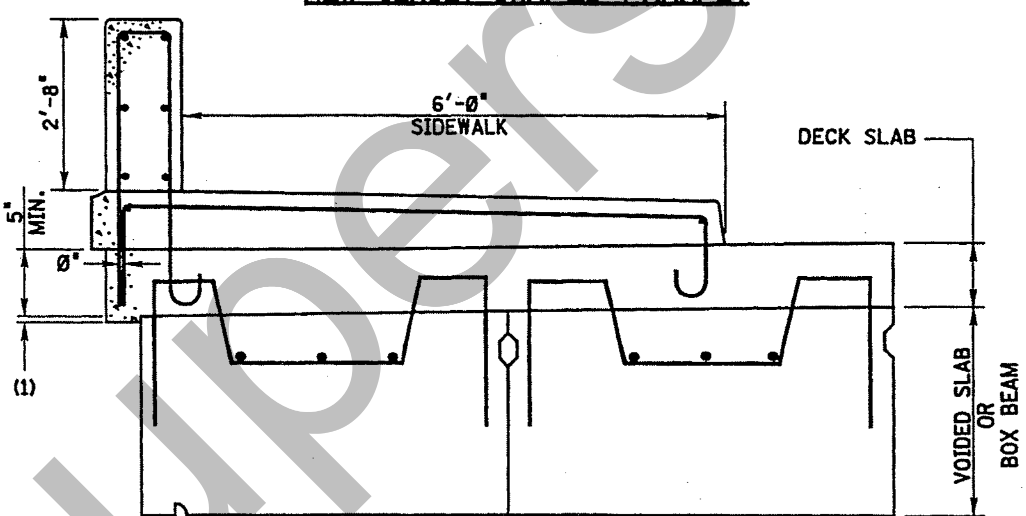
NOTES:

1. REFERENCE SUBSECTION 1.25.10 OF THIS MANUAL FOR THE APPLICATION LIMITS OF EPOXY WATERPROOFING SEAL COAT.
2. PROVIDE ¾" DRIP NOTCH ON FASCIA BEAMS.
3. OVERHANGS LARGER THAN 6" SHALL BE APPROVED BY THE ENGINEER AT THE PRELIMINARY SUBMISSION.
4. REFERENCE PLATE 3.10-8 FOR FURTHER DETAILS.
5. ALL REINFORCING STEEL SHALL BE CORROSION PROTECTED. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.

PRESTRESSED CONCRETE SLAB AND BOX BEAMS - PARAPET DETAILS	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.10-8



NEW JERSEY SHAPED PARAPET

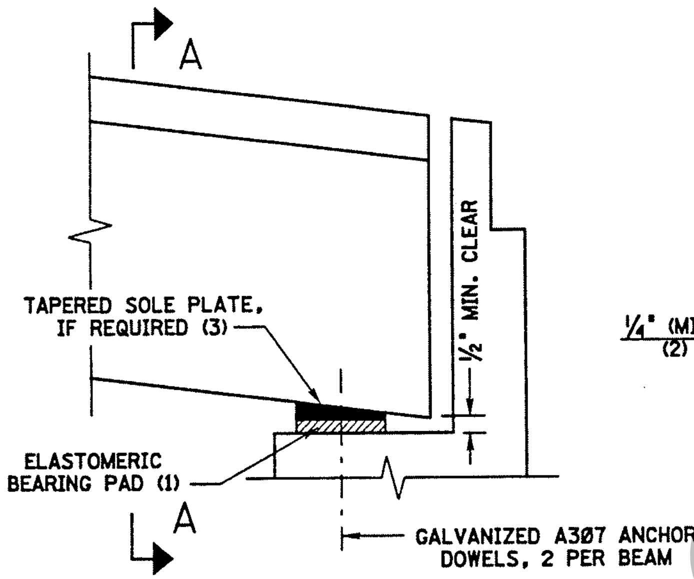


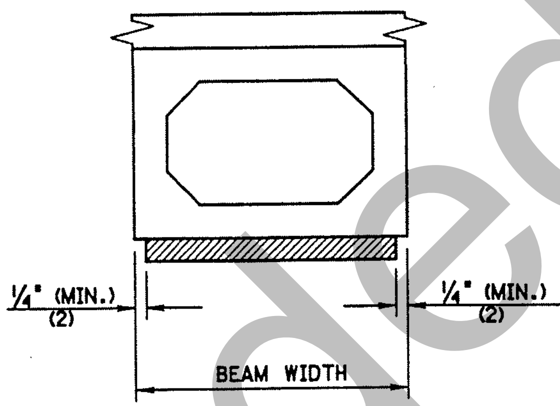
2'-8" PARAPET WITH SIDEWALK

NOTES:

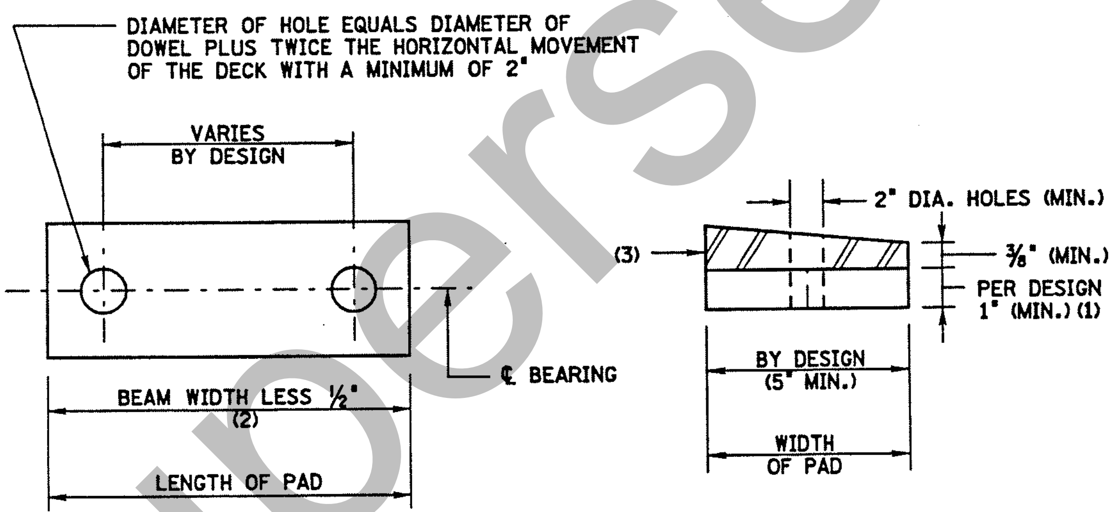
1. 1" MINIMUM THICKNESS FOR OVERHANGS GREATER THAN 3". PROVIDE 3/4" DRIP NOTCH AS NEEDED ON UNDERSIDE FOR OVERHANGS LARGER THAN 4".
2. PROVIDE 3/4" DRIP NOTCH ON FASCIA BEAMS.
3. PROVIDE ADEQUATE REINFORCEMENT IN SLAB OVERHANG, #16 BARS MINIMUM.
4. SEE BRIDGE CONSTRUCTION DETAILS (BCD-3) FOR MORE DETAILS ON PARAPETS.
5. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.

ELASTOMERIC BEARING PADS FOR PRESTRESSED CONCRETE BOX BEAMS	ISSUED: 2002 REV:	PLATE 3.10-9





SECTION A-A

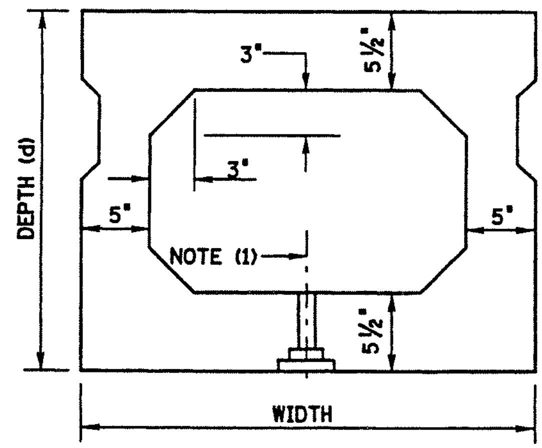


SECTION THROUGH REINFORCED BEARING PAD

NOTES:

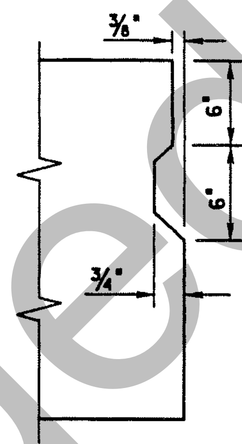
1. THE TAPERING OF ELASTOMER LAYERS IS NOT PERMITTED FOR LAMINATED (REINFORCED) ELASTOMERIC BEARING PADS. TAPERED EXTERNAL SOLE PLATES OR GROUT PADS MAY BE UTILIZED IF NECESSARY. REINFORCED ELASTOMERIC BEARING PADS SHALL BE DESIGNED IN ACCORDANCE WITH THE CURRENT AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS. HOLES SHALL BE DEDUCTED WHEN COMPUTING THE SHAPE FACTOR.
2. SMALLER LENGTH BEARING PADS MAY BE UTILIZED PER DESIGN REQUIREMENTS, EXCEPT THAT THE EDGES OF THE BEAM SHALL NOT OVERHANG THE BEARING PAD BY MORE THAN 6".
3. TAPERED SOLE PLATE SHALL BE BONDED TO THE ELASTOMERIC BEARING PAD AND SHALL BE GALVANIZED. MINIMUM THICKNESS OF SOLE PLATE SHALL BE ⅜".

PRESTRESSED CONCRETE BOX BEAMS STANDARD SECTIONS	ISSUED: 2002 REV:	PLATE 3.10-10

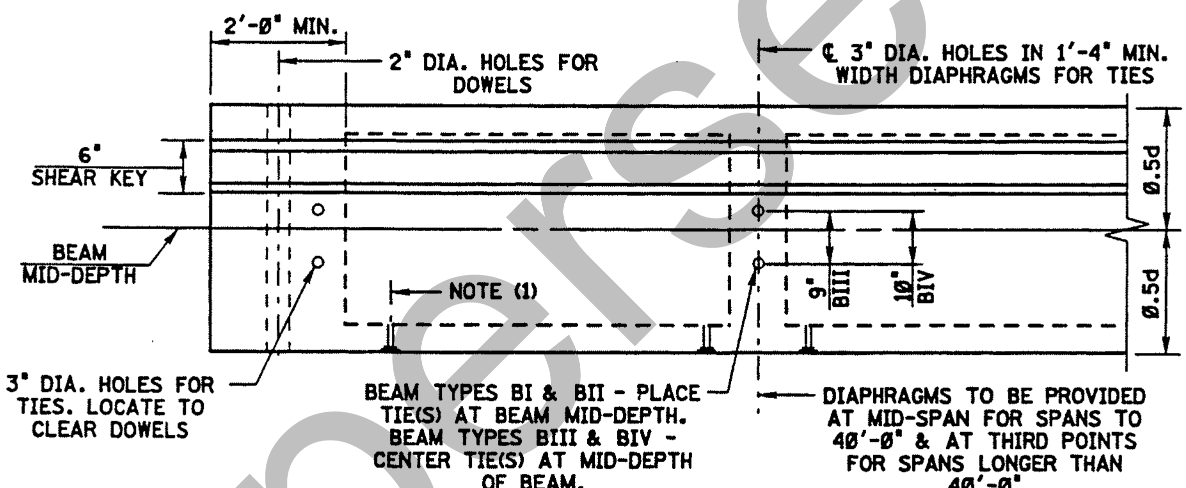


TYPICAL BOX BEAM SECTION

NOTE: KEYWAYS SHALL BE FILLED WITH GROUT IN ACCORDANCE WITH 1.25.6.1.b.



TYPICAL KEYWAY DETAIL
(OMIT ON OUTSIDE FACE OF FASCIA BEAM)



TYPICAL BOX BEAM ELEVATION

TYPICAL SECTION PROPERTIES

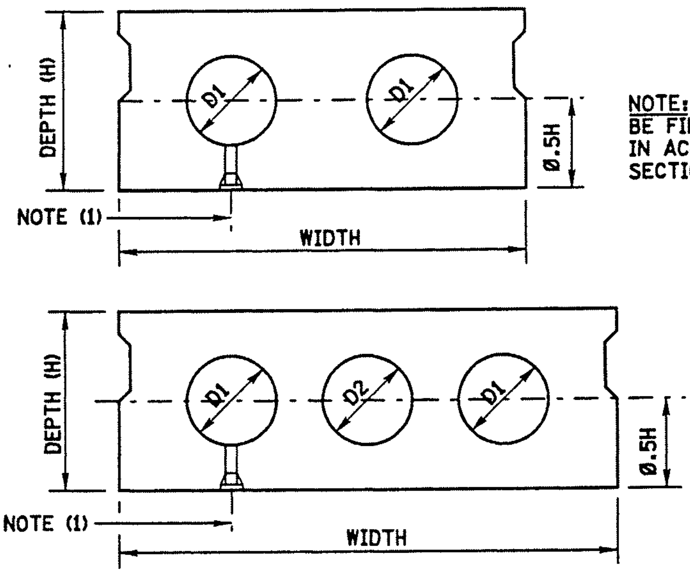
TYPE	WIDTH (FT)	DEPTH (IN)	WEIGHT (LBS/FT)	NET AREA (IN^2)	Ix (IN^4)	Yb (IN)	Sb (IN^3)	St (IN^3)
BI-36	3	27	584	561	50,334	13.35	3770	3687
BII-36	3	33	647	621	85,153	16.29	5227	5096
BIV-36	3	39	709	681	131,145	19.25	6813	6640
BIII-36	3	42	740	711	158,644	20.73	7653	7459
BI-48	4	27	722	693	65,941	13.37	4932	4838
BII-48	4	33	784	753	110,499	16.33	6767	6629
BIII-48	4	39	847	813	168,367	19.29	8728	8542
BIV-48	4	42	878	843	203,088	20.78	9773	9571

NOTE (1): 1" ID NON-METALLIC VOID DRAINING DEVICE. BOTH ENDS OF EACH VOID (TYPICAL). LOCATE TO CLEAR STRANDS AND AT LOWEST ELEVATION. } NOTE AND TYPICAL LOCATION TO BE SHOWN ON CONTRACT PLANS. VERIFY ON SHOP PLANS ACCORDINGLY.

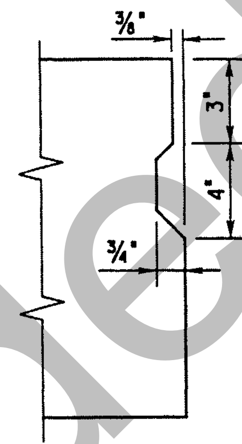
PRESTRESSED CONCRETE SLAB BEAMS STANDARD SECTIONS

ISSUED: 2002
REV:

PLATE 3.10-11



NOTE: KEYWAYS SHALL BE FILLED WITH GROUT IN ACCORDANCE WITH SECTION 1.25.6.1.b.

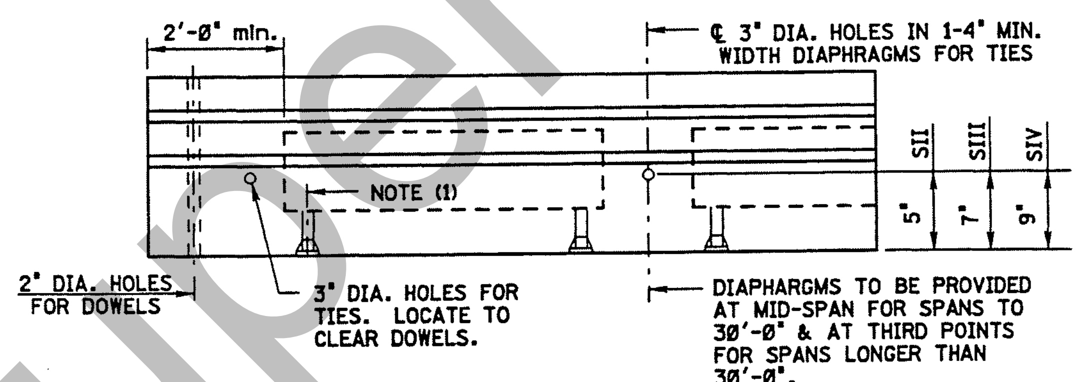


TYPICAL KEYWAY DETAIL

(OMIT ON OUTSIDE FACE OF FASCIA BEAM)

TYPICAL SLAB BEAM SECTION

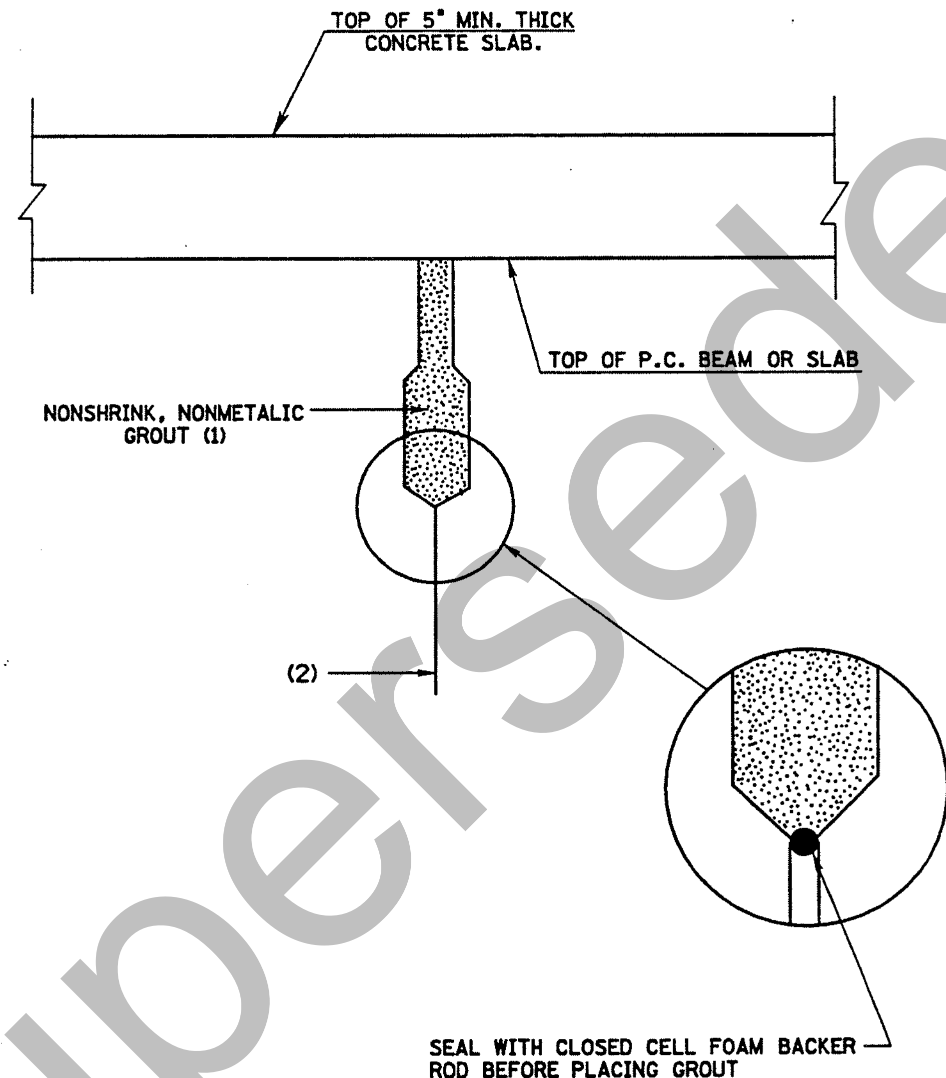
NOTE (1): 1" ID NON-METALLIC VOID DRAINING DEVICE. BOTH ENDS OF EACH VOID (TYPICAL).LOCATE TO CLEAR STRANDS AND AT LOWEST ELEVATION.
} NOTE AND TYPICAL LOCATION TO BE SHOWN ON CONTRACT PLANS. VERIFY ON SHOP PLANS ACCORDINGLY.



TYPICAL SLAB BEAM ELEVATION

TYPICAL SECTION PROPERTIES									
TYPE	WIDTH FT.	DEPTH IN.	NO. OF VOIDS	VOID DIA. IN.		WEIGHT LBS./FT.	NET AREA IN^2	Ix IN^4	S IN^3
				D1	D2				
SII-36	3	15	2	8	-	457	439	9.725	1296
SIII-36	3	18	2	1Ø	-	511	491	16.514	1835
SIV-36	3	21	2	12	-	552	53Ø	25.747	2452
SII-48	4	15	3	8	8	593	569	12.897	172Ø
SIII-48	4	18	3	1Ø	1Ø	654	628	21.855	2428
SIV-48	4	21	3	12	1Ø	733	7Ø3	34.517	3287

PRESTRESSED CONCRETE SLAB AND BOX BEAMS, GROUTED KEY WAY DETAILS	ISSUED: 2002 REV:	PLATE 3.10-12

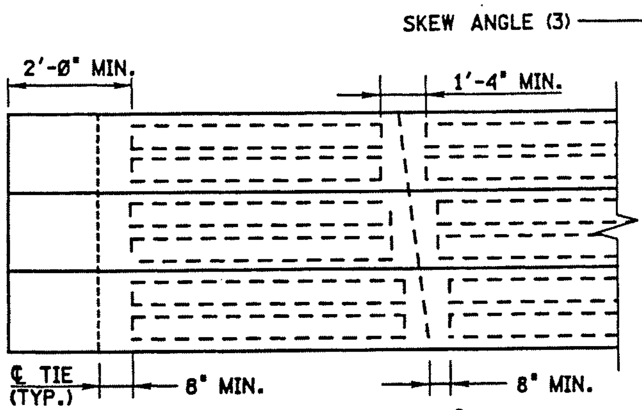


NOTES:

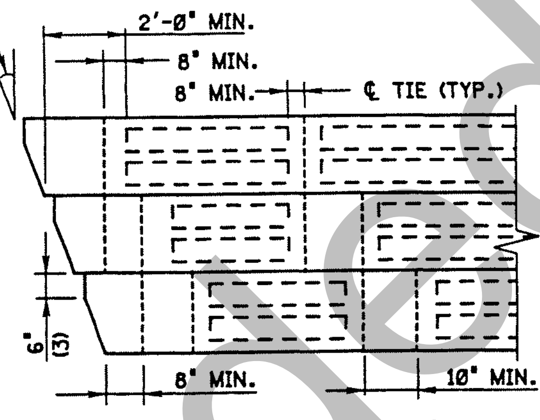
1 . FILL SHEAR KEY WITH NONMETALLIC, NONSHRINK GROUT IN ACCORDANCE WITH SECTION 1.25.6.1.b OF THIS MANUAL.

2 . THE BOTTOM JOINT OPENING BETWEEN ADJACENT BOX BEAMS SHALL NOT EXCEED ½".

PRESTRESSED CONCRETE VOIDED SLAB BEAMS, TRANSVERSE TIE DETAILS	ISSUED: 2002 REV:	PLATE 3.10-13

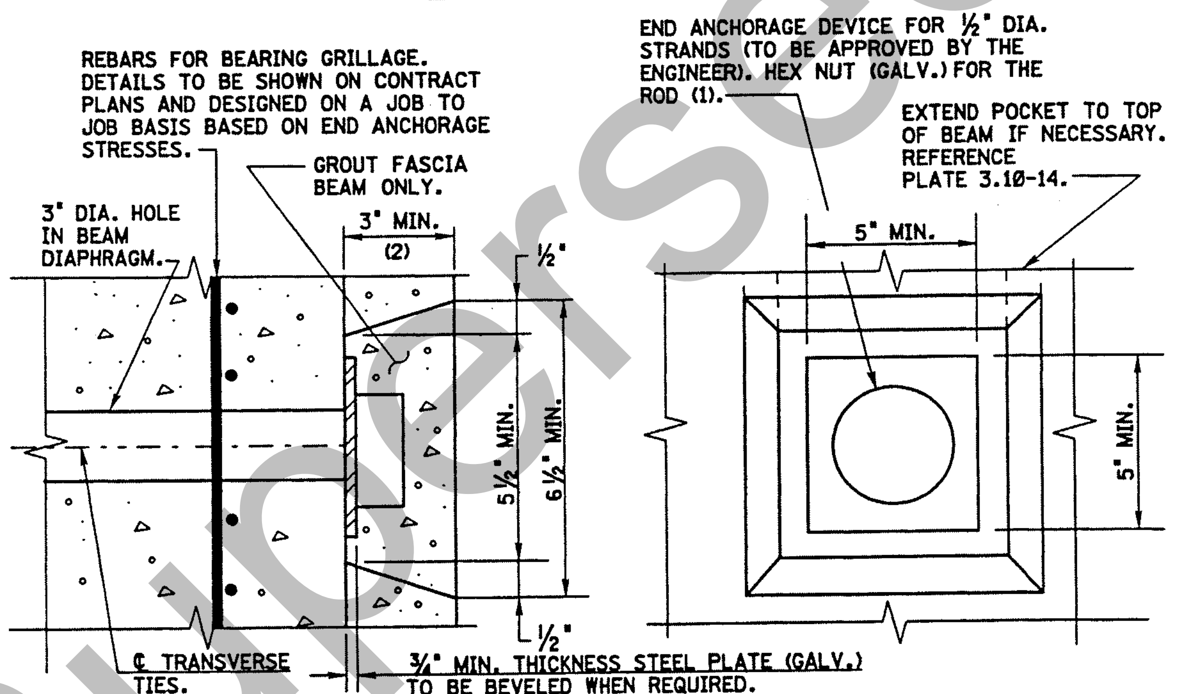


SKEWS UP TO 15°



SKEWS IN EXCESS OF 15°

PART PLANS OF DECK



DETAILS OF END ANCHORAGE AND POCKET

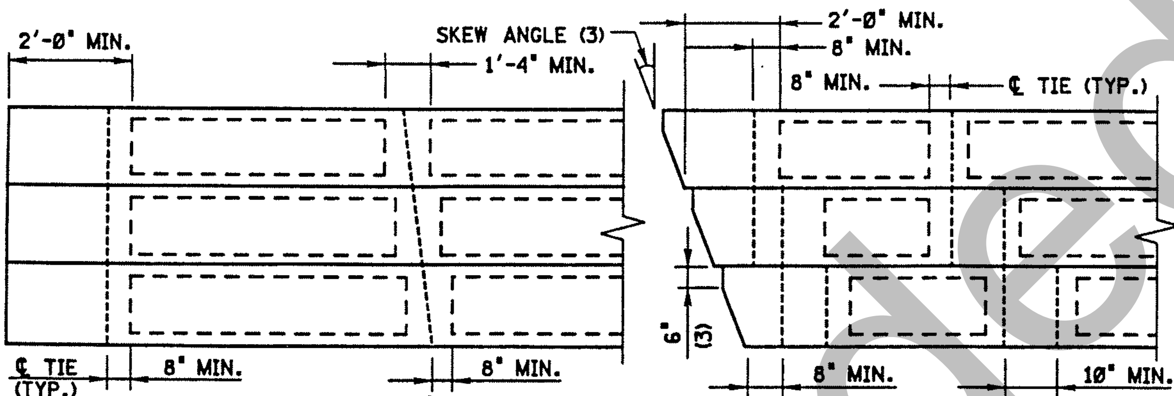
NOTES:

1. TRANSVERSE TIES SHALL BE ½" DIA. 270 KSI POLYSTRAND OR EQUIVALENT OR HIGH TENSILE STRENGTH STEEL ALLOY TIE RODS 1⅜" DIA. PER SPECIFICATIONS. THE APPLICATION OF TENSION TO TRANSVERSE TIES AND GROUTING OF THE LONGITUDINAL KEYWAYS SHALL BE IN ACCORDANCE WITH 1.25.6.1. THE COMPUTATION OF THE REQUIRED FORCE PER DUCT SHALL BE IN ACCORDANCE WITH 1.25.6.3. RECESSED POCKETS AT FASCIA BEAMS TO BE FILLED WITH NONMETALLIC, NONSHRINK GROUT AFTER TENSIONING OF TIES. END ANCHORAGE DEVICE FOR ½" DIA. TIE STRANDS TO BE APPROVED BY THE ENGINEER.

2. STEEL PLATE AND HAND HOLE SIZE MAY VARY FROM THE DIMENSIONS SHOWN DEPENDING UPON LOADING, SKEW OR THE END ANCHORAGE DEVICE SELECTED.

3. ACUTE CORNERS OF BEAMS MAY BE SQUARED OFF AS SHOWN FOR SKEWS OVER 20°.

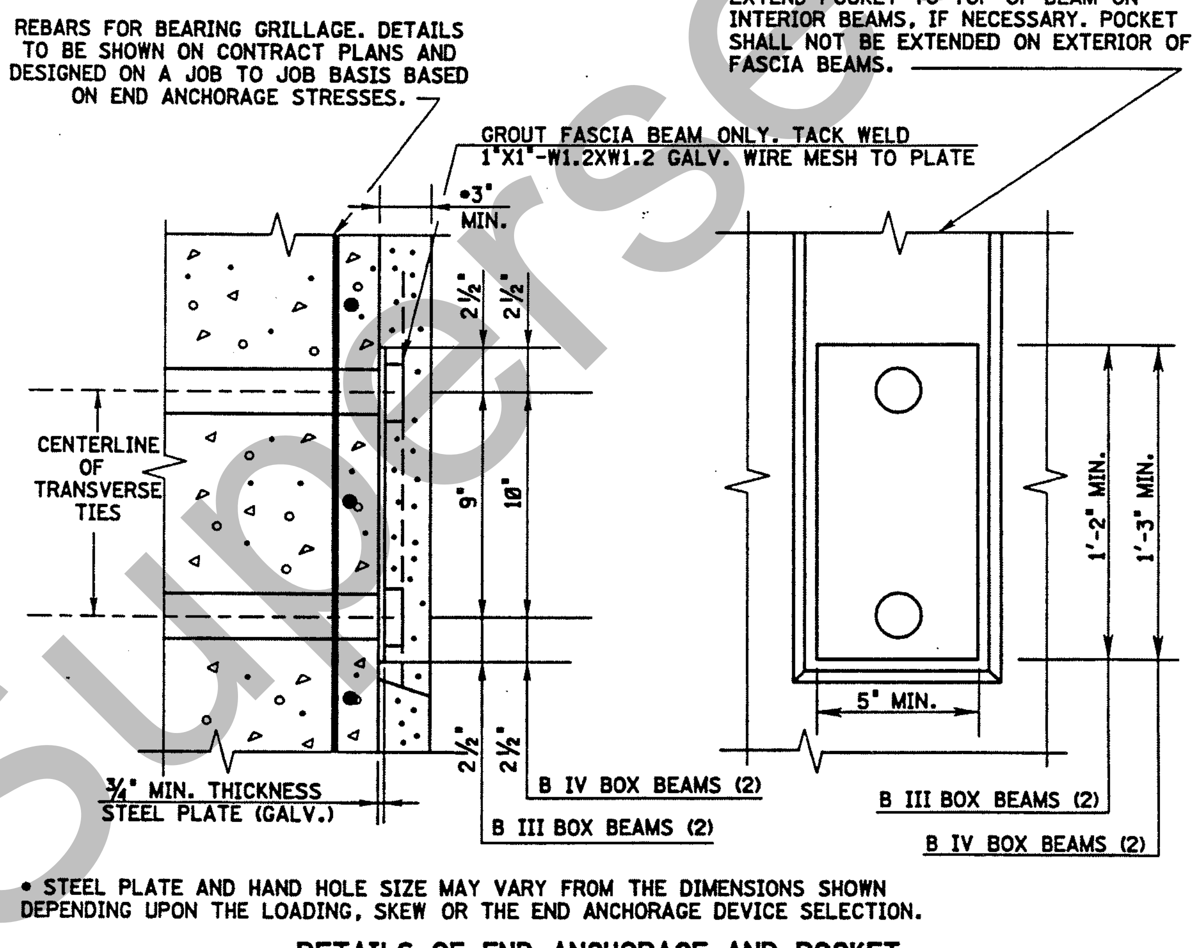
PRESTRESSED CONCRETE BOX BEAMS, TRANSVERSE TIE DETAILS	ISSUED: 2002 REV:	PLATE 3.10-14



SKEWS UP TO 15°

SKEWS IN EXCESS OF 15°

PART PLAN OF DECK



• STEEL PLATE AND HAND HOLE SIZE MAY VARY FROM THE DIMENSIONS SHOWN DEPENDING UPON THE LOADING, SKEW OR THE END ANCHORAGE DEVICE SELECTION.

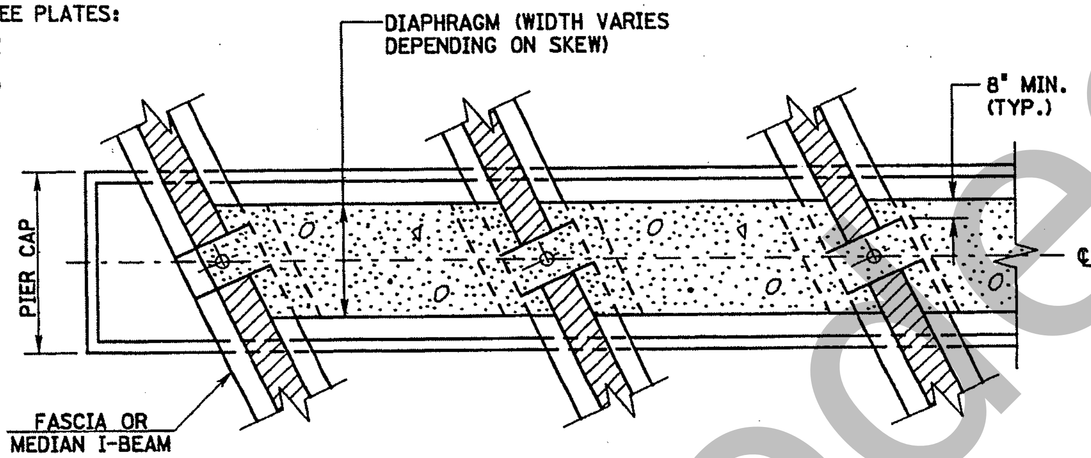
DETAILS OF END ANCHORAGE AND POCKET

NOTES:

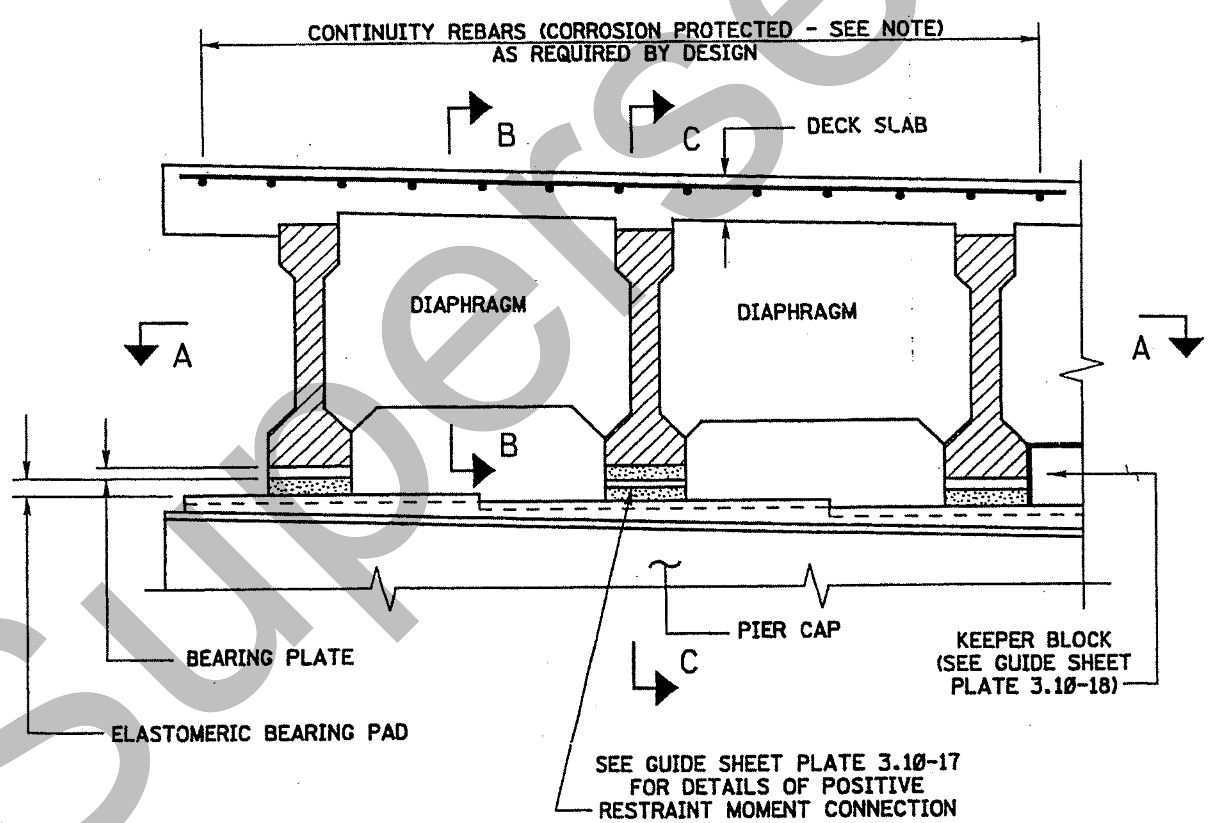
1. SEE PLATE 3.10-13 FOR ALL OTHER NOTES AND DETAILS.
2. FOR B I AND B II BOX BEAMS REFER TO PLATE 3.10-13.
3. ACUTE CORNERS OF BEAMS MAY BE SQUARED OFF AS SHOWN FOR SKEWS OVER 20°.

CONTINUITY DESIGN FOR LIVE LOAD, PC I-BEAM DIAPHRAGMS	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.10-15

ALSO SEE PLATES:
3.10-16
3.10-17
3.10-18



SECTION: A-A



TYPICAL ELEVATION

FOR SECTIONS B-B AND C-C, SEE GUIDE SHEET PLATE 3.10-16.

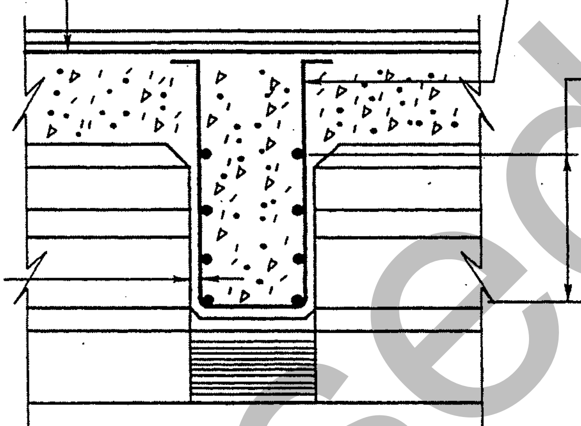
NOTE:

REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.

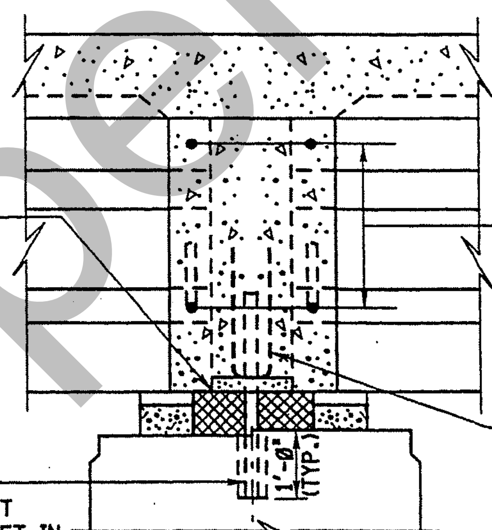
CONTINUITY DESIGN FOR LIVE LOAD, PC I-BEAM DIAPHRAGM REINFORCEMENT (SHEET 1 OF 2)

CONTINUITY DESIGN FOR LIVE LOAD, PC I-BEAM DIAPHRAGM REINFORCEMENT (SHEET 1 OF 2)	ISSUED: 2002 REV:	PLATE 3.10-16

ALSO SEE PLATES
3.10-15
3.10-17
3.10-18



SECTION B-B

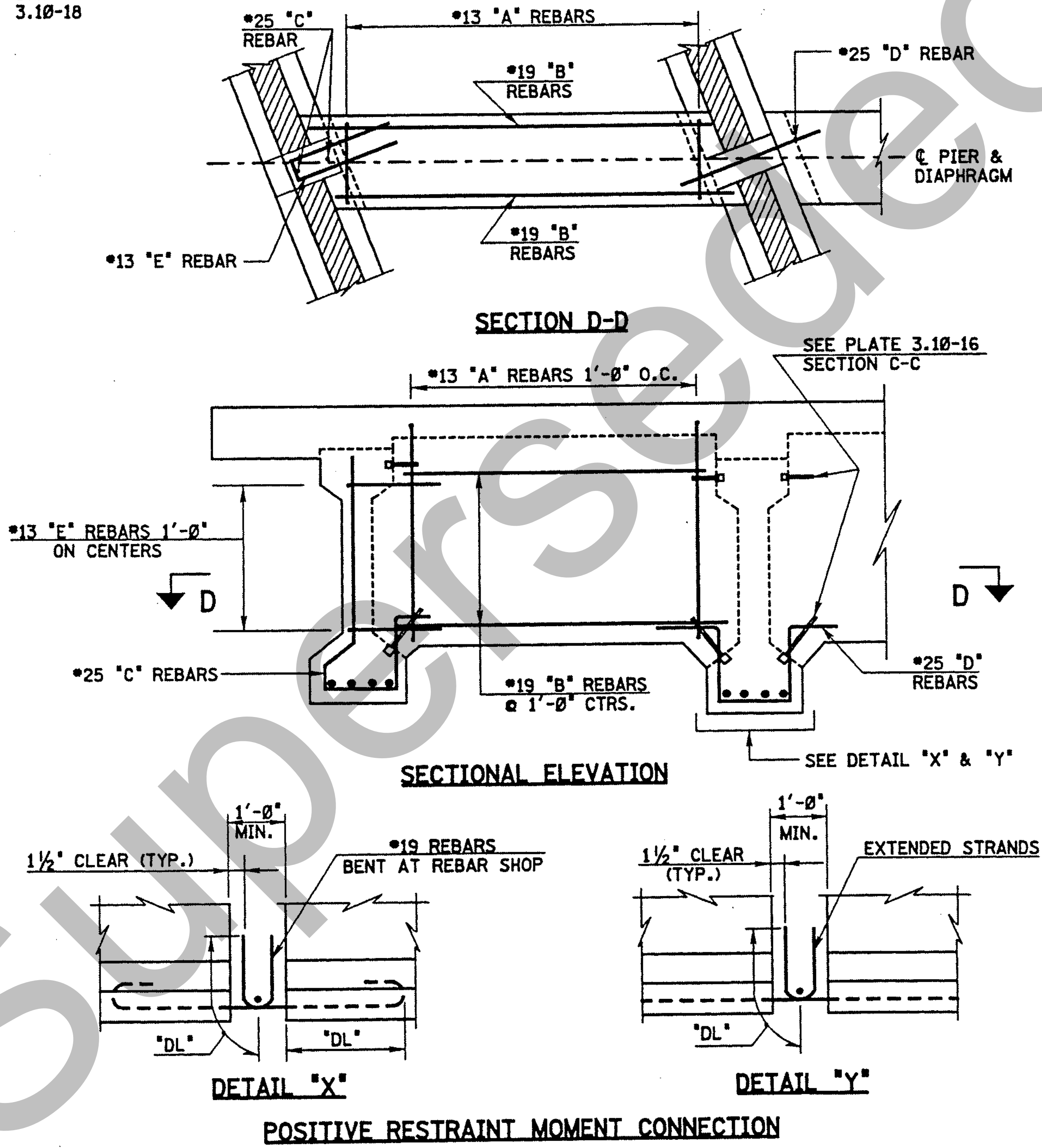


SECTION C-C

(NOTE TO DESIGNER: DETAILS AND NOTE TO BE SHOWN ON PIER PLANS).

CONTINUITY DESIGN FOR LIVE LOAD, PC I-BEAM DIAPHRAGM REINFORCEMENT (SHEET 2 OF 2)	ISSUED: 2002 REV:	PLATE 3.10-17

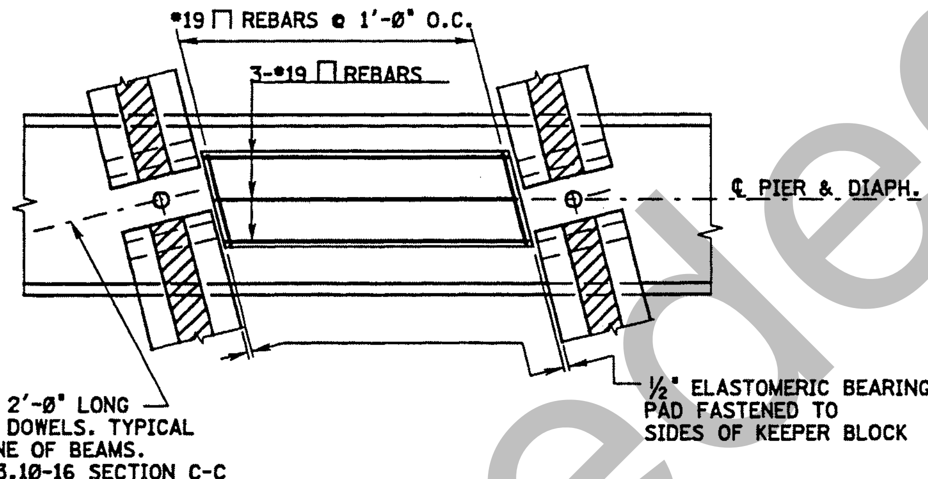
ALSO SEE PLATES
3.10-15
3.10-16
3.10-18



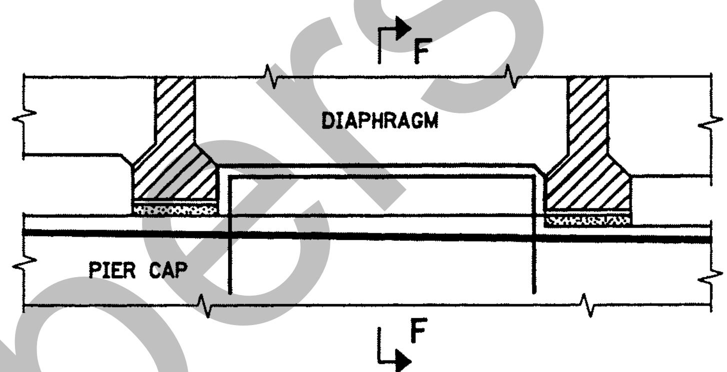
NOTE: DETAIL "X" OR "Y" (CONTRACTOR'S OPTION) TO BE SHOWN ON SHOP DRAWINGS.
NOTE TO DESIGNER: BOTH DETAILS TO BE SHOWN ON PLANS TOGETHER WITH DIMENSION "DL" (DEVELOPMENT LENGTH) AND NUMBER OF REBARS OR STRANDS AS REQUIRED BY DESIGN.

CONTINUITY DESIGN FOR LIVE LOAD, PC I-BEAM KEEPER BLOCKS	ISSUED: 2002 REV:	PLATE 3.10-18

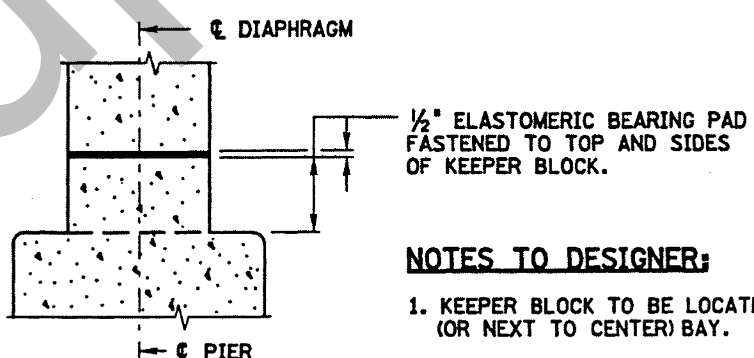
ALSO SEE PLATES
3.10-15
3.10-16
3.10-17



TYPICAL TOP VIEW
(DIAPHRAGMS NOT SHOWN)



TYPICAL ELEVATION



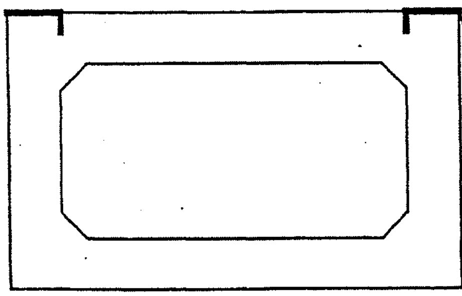
SECTION F-F

NOTES TO DESIGNER:

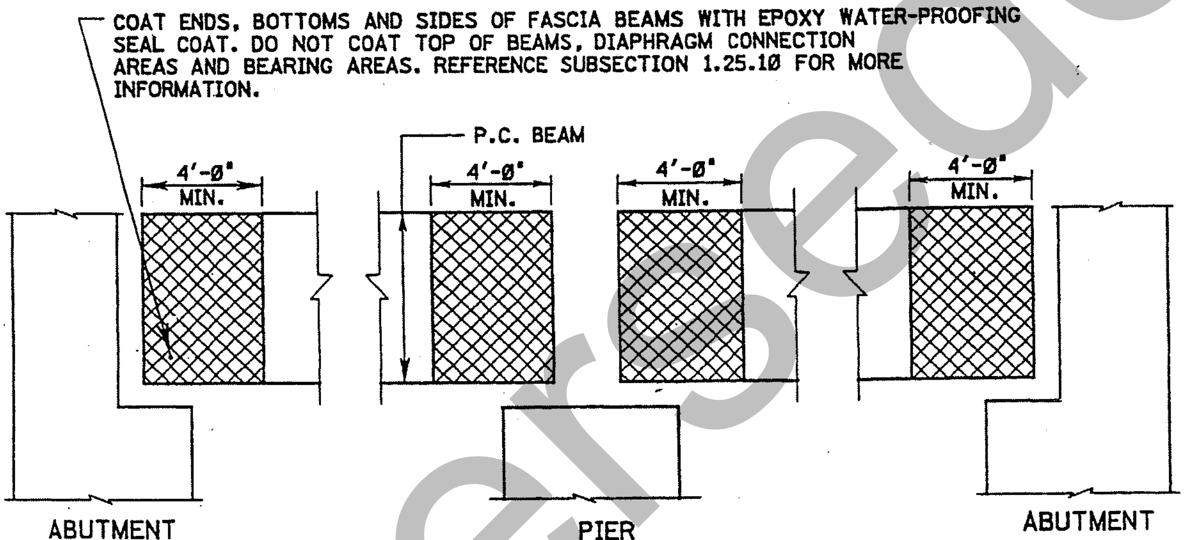
1. KEEPER BLOCK TO BE LOCATED IN CENTER (OR NEXT TO CENTER) BAY.

2. THESE DETAILS MAY BE UTILIZED IN THE SEISMIC RETROFIT OF APPLICABLE PROJECTS.

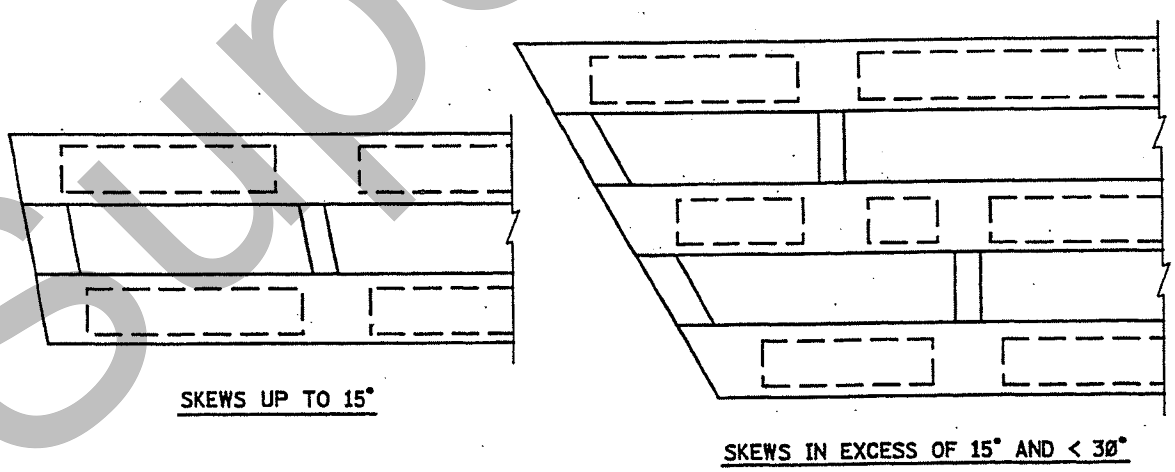
P.C. SPREAD BOX BEAMS DESIGN DETAILS	ISSUED: 2002 REV:	PLATE 3.10-19



WELD ANCHORS FOR S.I.P. FORMS



LIMITS FOR EPOXY WATERPROOFING SEAL COAT

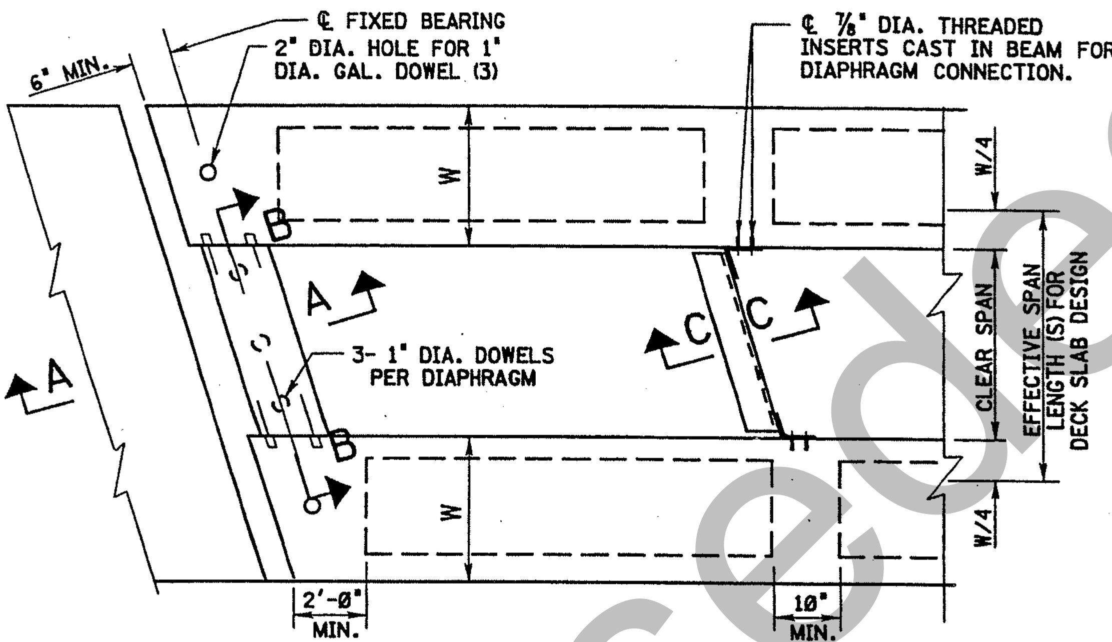


DIAPHRAGM ARRANGEMENT (N.T.S.)

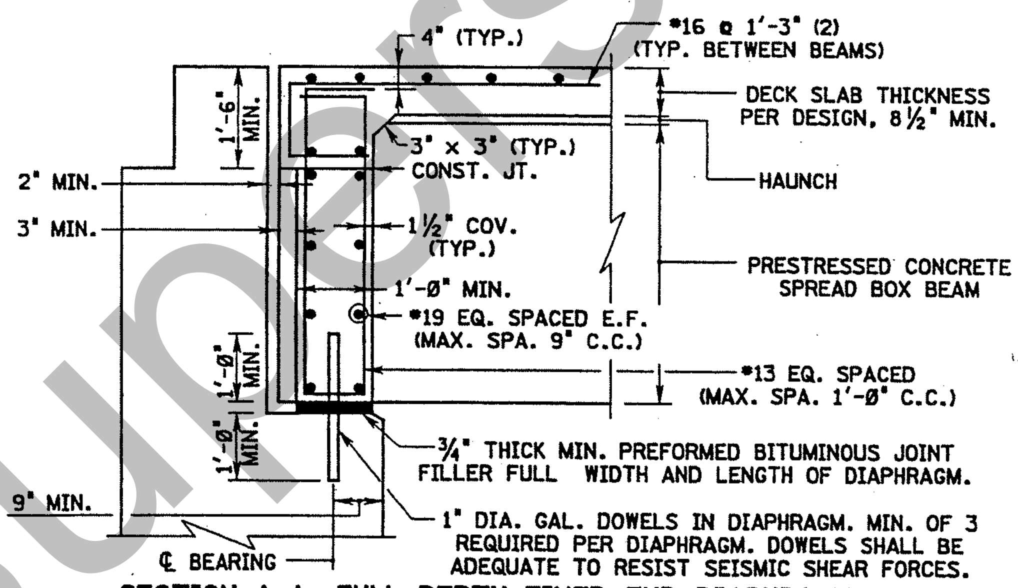
NOTE:

REFERENCE SECTION 1.25.7 FOR DESIGN REQUIREMENTS.

P.C. SPREAD BOX BEAMS DIAPHRAGM DETAILS (SHEET 1 OF 3)	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.10-20

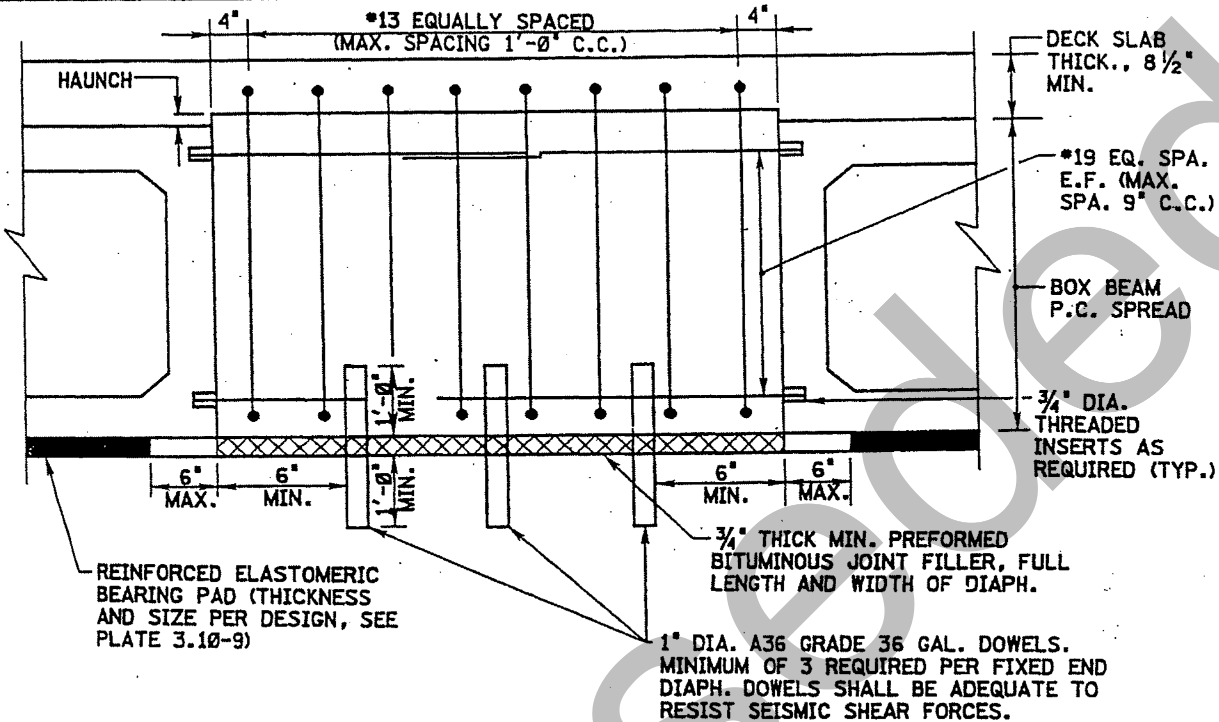


PLAN

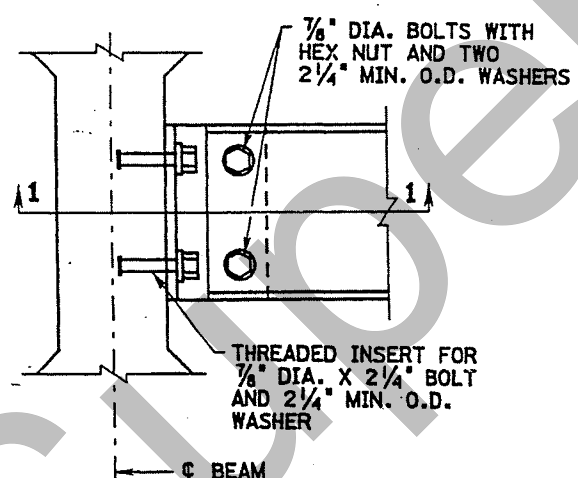


SECTION A-A. FULL DEPTH FIXED END DIAPHRAGM

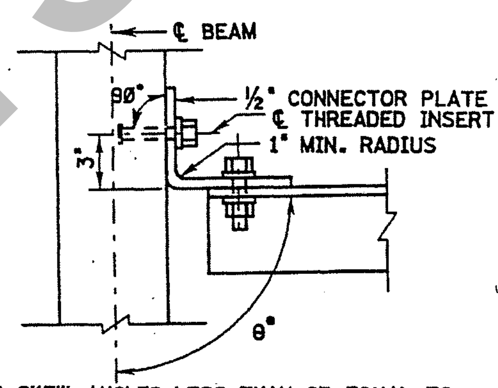
NOTES:
1. ALL REINFORCING STEEL, DOWELS AND DIMENSIONS SHOWN ARE MINIMUM. MODIFY DETAILS AS REQUIRED BY DESIGN.
2. THE #16 BARS IN THE HAUNCH BETWEEN BEAMS SHALL BE LAPPED TO THE TOP LONGITUDINAL REINFORCEMENT AND SHALL BE CORROSION PROTECTED. SEE NOTE 7.
3. REFERENCE NOTES 1 AND 2 ON GUIDE SHEET PLATES 3.10-4, 3.10-5 AND 3.10-6 FOR THE CORING AND FILLING OF DOWEL HOLES IN ABUTMENTS AND PIER SEATS.
4. ALL REINFORCING STEEL IN END DIAPHRAGMS SHALL BE CORROSION PROTECTED. SEE NOTE 7.
5. INTERMEDIATE DIAPHRAGMS SHALL BE STEEL.
6. END DIAPHRAGMS SHALL BE CAST IN PLACE CONCRETE.
7. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.



SECTION B-B. FIXED END DIAPHRAGM



SECTION C-C INTERMEDIATE DIAPHRAGM



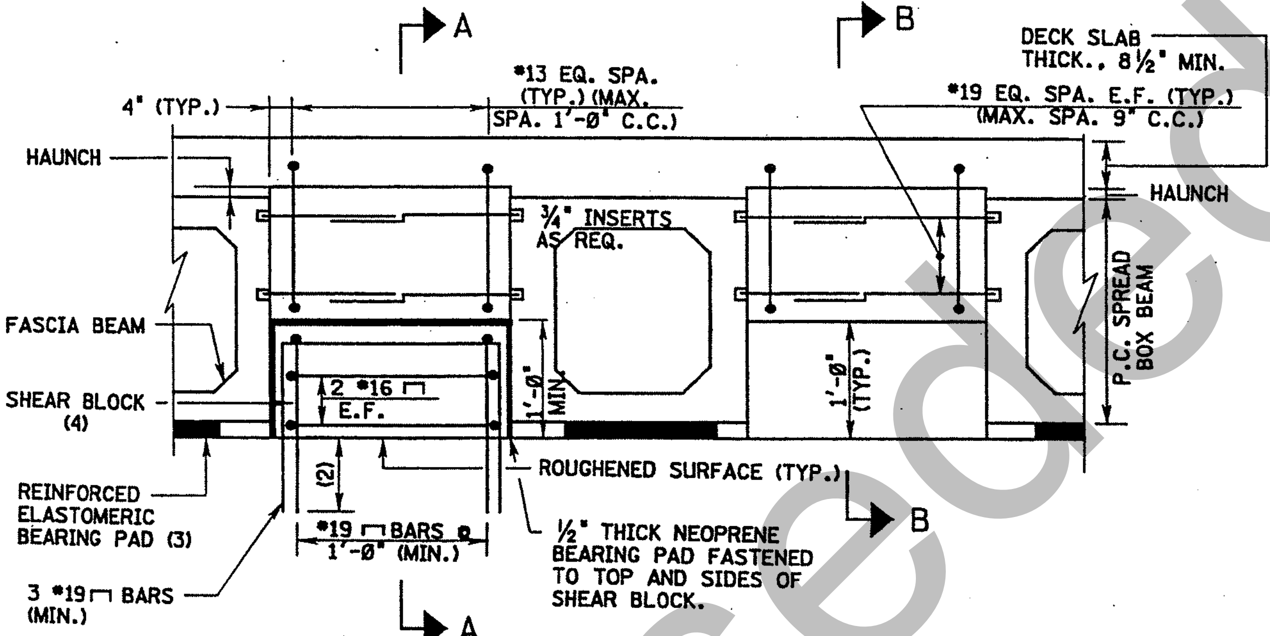
* FOR SKEW ANGLES LESS THAN OR EQUAL TO 20°, USE θ = 90° MINUS THE SKEW ANGLE. FOR SKEW ANGLES GREATER THAN 20°, USE θ = 90°

SECTION 1-1

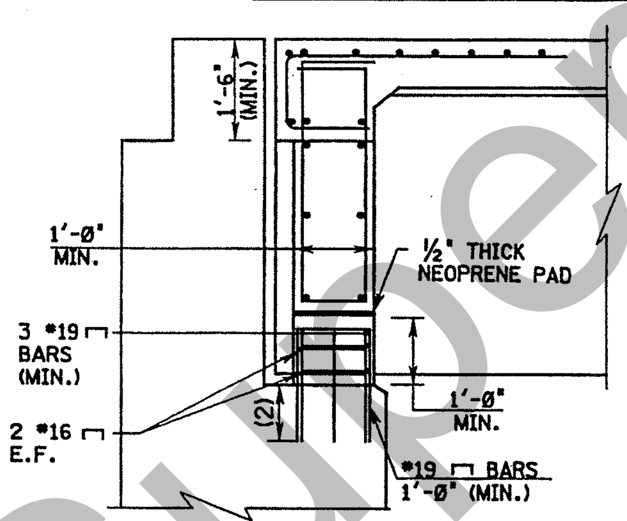
NOTES:

1. REFERENCE SECTION 1.25.7 FOR DESIGN REQUIREMENTS.
2. REFERENCE NOTES 1 AND 2 ON GUIDE SHEET PLATES 3.10-4, 3.10-5 AND 3.10-6 FOR THE CORING AND FILLING OF DOWEL HOLES IN ABUTMENTS AND PIER SEATS.
3. WHEN UTILITIES MUST BE LOCATED BETWEEN THE BEAMS INTERMEDIATE DIAPHRAGMS MAY BE REDUCED IN HEIGHT TO 1'-6" MINIMUM.
4. ALL REINFORCING STEEL, DOWELS AND DIMENSIONS SHOWN ARE MINIMUM. MODIFY DETAILS AS REQUIRED BY DESIGN.

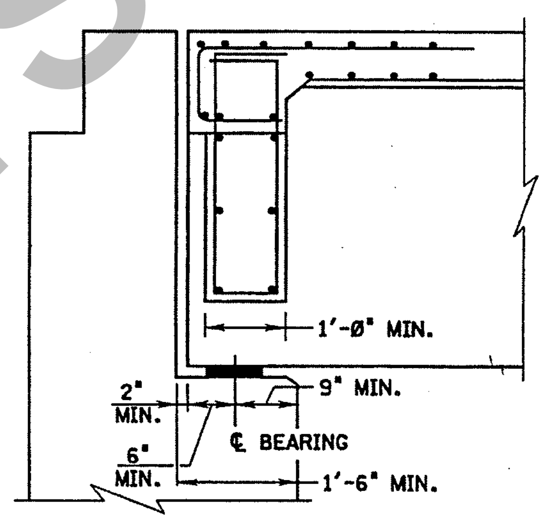
P.C. SPREAD BOX BEAMS DIAPHRAGM DETAILS (SHEET 3 OF 3)	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.10-22



TYPICAL DIAPHRAGM AT ABUTMENT OR PIER (EXPANSION)



SECTION A-A

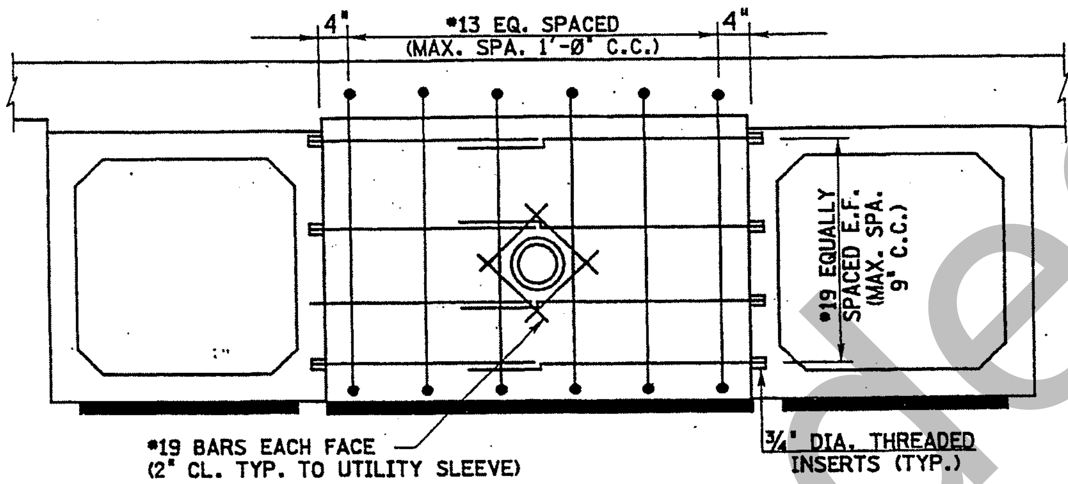


SECTION B-B

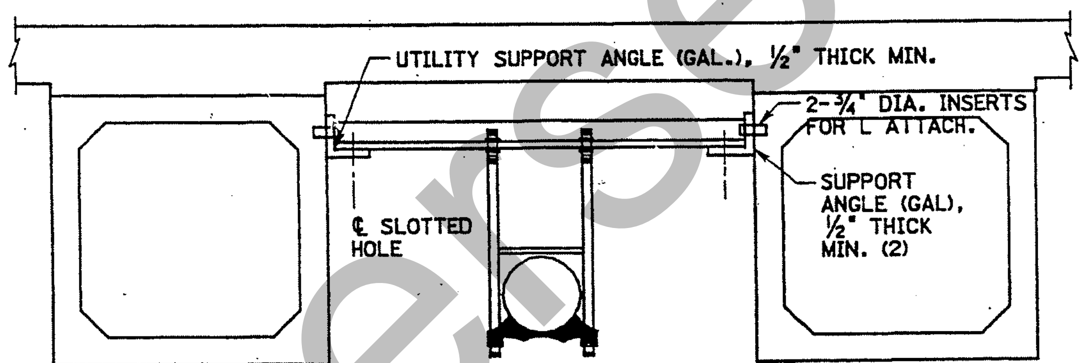
NOTES:

1. ALL REINFORCING IN END DIAPHRAGMS AND SHEAR BLOCKS SHALL BE CORROSION PROTECTED. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.
2. EMBEDMENT LENGTH PER DESIGN REQUIREMENTS SHALL BE SHOWN ON THE PLANS.
3. THE THICKNESS AND SIZE OF REINFORCED ELASTOMERIC BEARING PADS SHALL BE DETERMINED PER DESIGN REQUIREMENTS.
4. SHEAR BLOCKS ARE REQUIRED AS A MINIMUM BETWEEN EACH FASCIA AND THE FIRST INTERIOR BEAM. PROVIDE ADDITIONAL OR LARGER SHEAR BLOCKS AS REQUIRED FOR SEISMIC DESIGN CONSIDERATIONS AND FOR HIGHLY SKEWED STRUCTURES.
5. REFERENCE GUIDE SHEET PLATE 3.10-20 FOR OTHER NOTES AND DETAILS.
6. ALL REINFORCING STEEL, DOWELS AND DIMENSIONS SHOWN ARE MINIMUM. MODIFY DETAILS AS REQUIRED BY DESIGN.

P.C. SPREAD BOX BEAMS UTILITY DETAILS	ISSUED: 2002 REV:	PLATE 3.10-23



UTILITY AT FULL DEPTH DIAPHRAGM



TYPICAL INTERMEDIATE UTILITY SUPPORT

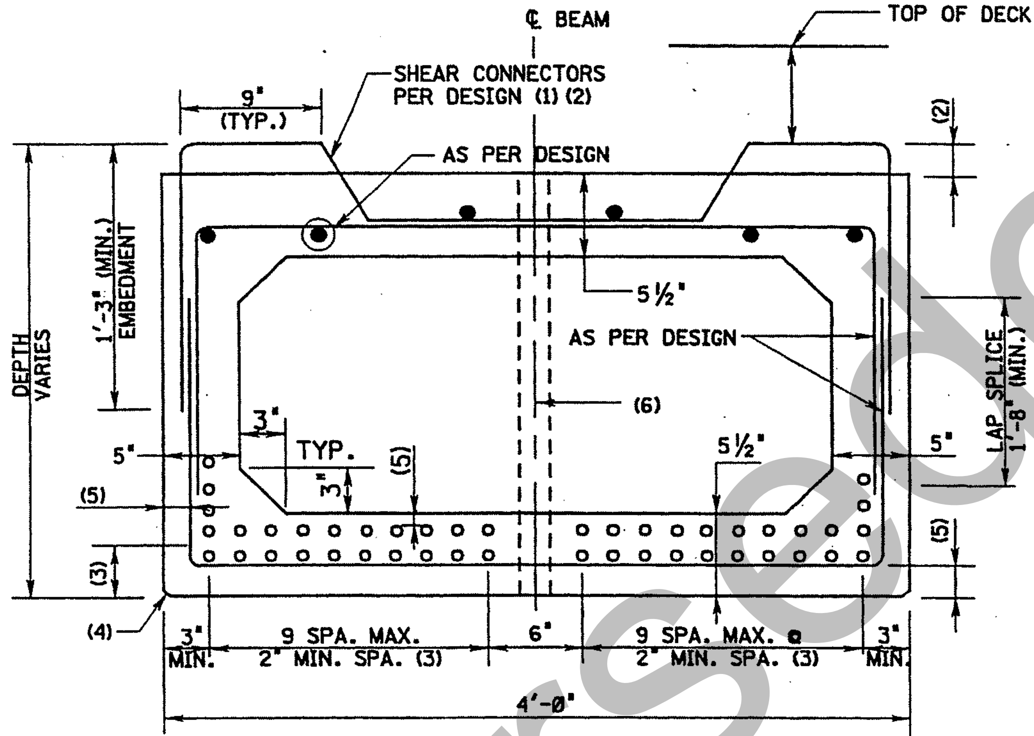
NOTES:

1. UTILITIES SHALL NOT PROTRUDE BELOW THE BOTTOM OF THE BEAMS UNLESS OTHERWISE APPROVED BY THE MANAGER, BUREAU OF STRUCTURAL ENGINEERING.

2. THE SUPPORT ANGLES SHALL BE ATTACHED TO EACH BOX BEAM WITH 2-3/4" DIA. BOLTS (MIN.). THREADED INSERTS SHALL BE PROVIDED IN THE BOX BEAMS FOR ANGLE ATTACHMENTS. THE UTILITY SUPPORT ANGLE SHALL BE SUPPLIED WITH SLOTTED HOLES FOR HORIZONTAL FIELD ADJUSTMENT.

3. A FULL DEPTH SLEEVED DIAPHRAGM MAY BE USED AT INTERMEDIATE DIAPHRAGM LOCATIONS AS LONG AS THE UTILITY IS APPROXIMATELY CENTERED IN THE DIAPHRAGM AND THE UTILITY IS LESS THAN HALF THE DEPTH OF THE DIAPHRAGM. OTHER DETAILS ARE ACCEPTABLE PENDING APPROVAL BY THE MANAGER, BUREAU OF STRUCTURAL ENGINEERING.

P.C. SPREAD BOX BEAMS REINFORCEMENT DETAILS	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.10-24



SPREAD BOX BEAM SECTION (N.T.S.)

NOTES:

1. SHEAR CONNECTORS SHALL BE CORROSION PROTECTED. REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.

2. SHEAR CONNECTORS SHALL PENETRATE AT LEAST 2" ABOVE THE BOTTOM OF THE DECK SLAB, HOWEVER, THE TOP OF THE SHEAR CONNECTOR SHALL BE 3" MINIMUM BELOW THE TOP OF THE DECK SLAB.

3. NUMBER AND ARRANGEMENT OF PRESTRESSING SRANDS PER DESIGN REQUIREMENTS. THE CENTER OF GRAVITY OF PRESTRESSING STRANDS SHALL BE NOTED ON THE PLANS.

4. BOTTOM CORNERS OF ALL BEAMS SHALL HAVE ¾" CHAMFERS. EXTERIOR BEAMS SHALL HAVE ¾" RADIUS DRIP NOTCH (REFERENCE GUIDE SHEET PLATE 3.10-7).

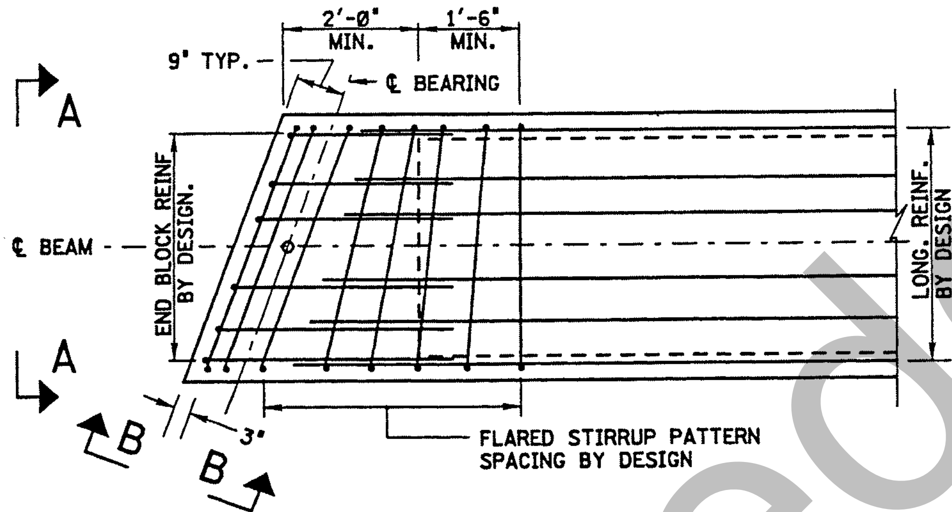
5. MINIMUM CONCRETE COVER:
   TOP SLAB AND SIDES - 2" MINIMUM
   BOTTOM SLAB - 1½" MINIMUM
   INSIDE VOID - 1" MINIMUM
   END - 1½" MINIMUM

6. CENTER LINE 2" DIAMETER DOWEL HOLE LOCATED IN BEAM END AND 1" DIAMETER NONMETALIC VOID DRAINING DEVICE LOCATED AT THE END OF EACH VOID (TYPICAL). ON BRIDGES WITH SLOPING BEARING SEATS, THE VOID DRAINING DEVICE SHALL BE LOCATED IN THE LOW POINT OF EACH VOID, IF POSSIBLE. LOCATE DOWEL HOLES AND VOID DRAIN HOLES TO CLEAR STRANDS AND MILD REINFORCING STEEL. NOTE AND TYPICAL LOCATION TO BE SHOWN ON CONTRACT PLANS. VERIFY ON SHOP PLANS ACCORDINGLY.

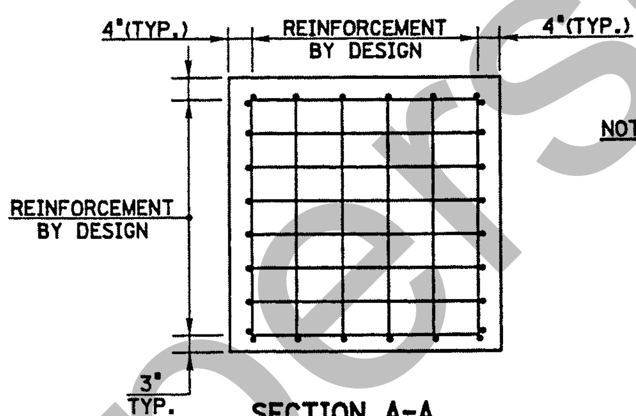
7. REFERENCE GUIDE SHEET PLATE 3.10-25 TYPICAL END BLOCK REINFORCEMENT.

8. ~~AT A MINIMUM 6 #16 BARS SHALL BE PROVIDED TO WITHSTAND THE REQUIRED STRAND TENSIONING.~~ THE DESIGNER SHALL VERIFY IF THIS STEEL DISTRIBUTION IS SUFFICIENT TO OVERCOME POTENTIAL CONCRETE CRACKING AT THIS LOCATION.

P.C. SPREAD BOX BEAMS, END BLOCK REINFORCEMENT DETAILS	ISSUED: 2002 REV:	PLATE 3.10-25



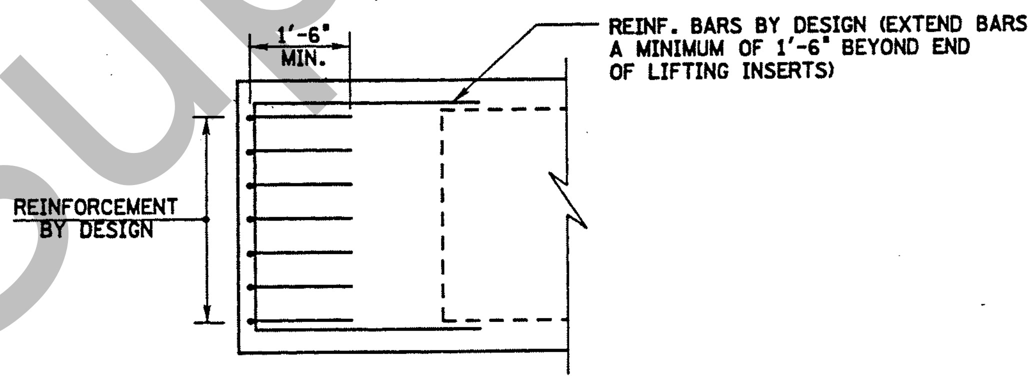
PLAN BEAM REINFORCEMENT



NOTE: MINIMUM COVER ON THE ENDS OF THE BEAM SHALL BE 1½".

SECTION A-A

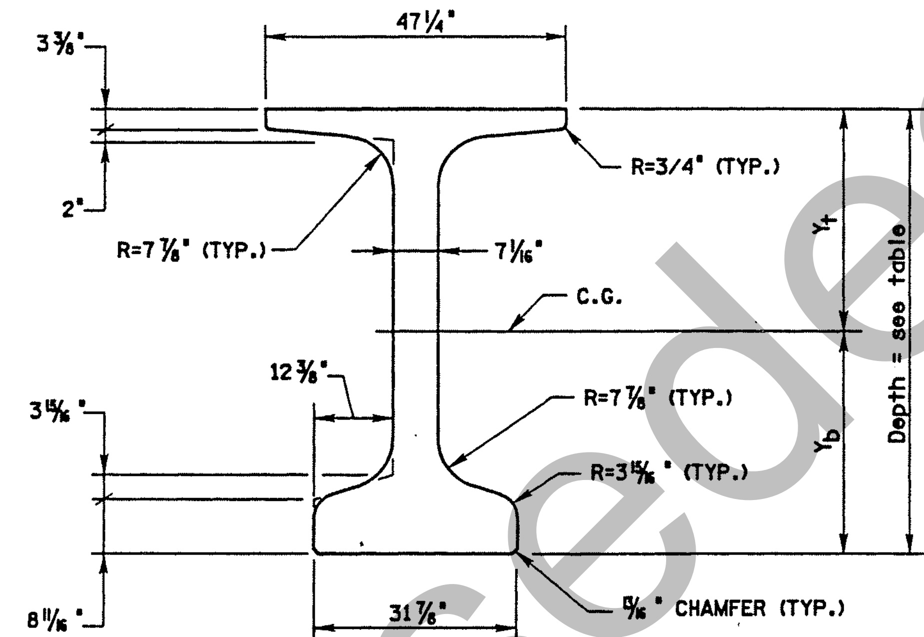
END BLOCK REINFORCEMENT SECTION



SECTION B-B

END BLOCK REINFORCEMENT ELEVATION

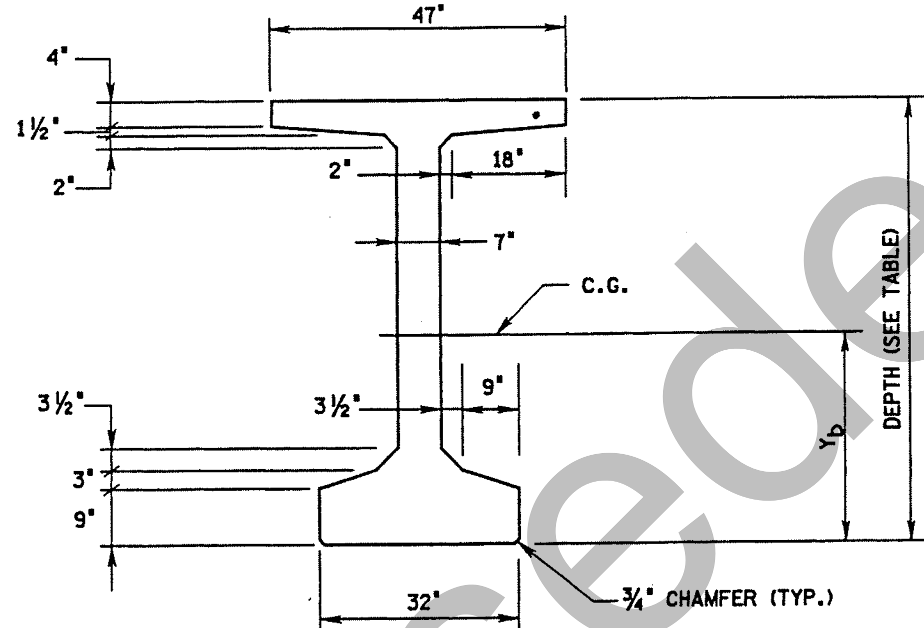
NEW ENGLAND BULB-TEE GIRDERS STANDARD SECTIONS	ISSUED: 2002 REV:	PLATE 3.10-26



TYPICAL BEAM SECTION

TYPICAL SECTION PROPERTIES									
BEAM TYPE	DEPTH (IN)	WEIGHT (LB/FT)	AREA (IN^2)	Ix-c.g. ($IN^4 \times 10^3$)	Iy-c.g. ($IN^4 \times 10^3$)	Yt (IN)	Yb (IN)	St ($IN^3 \times 10^3$)	Sb ($IN^3 \times 10^3$)
NEBT 1400	55 1/8"	894	857	352.97	62.23	28 7/8"	26 1/4"	12.202	13.397
NEBT 1600	63"	952	913	492.03	62.47	31"	30"	14.894	16.425
NEBT 1800	70 7/8"	1010	969	660.45	62.71	37 3/16"	33 11/16"	17.754	19.618

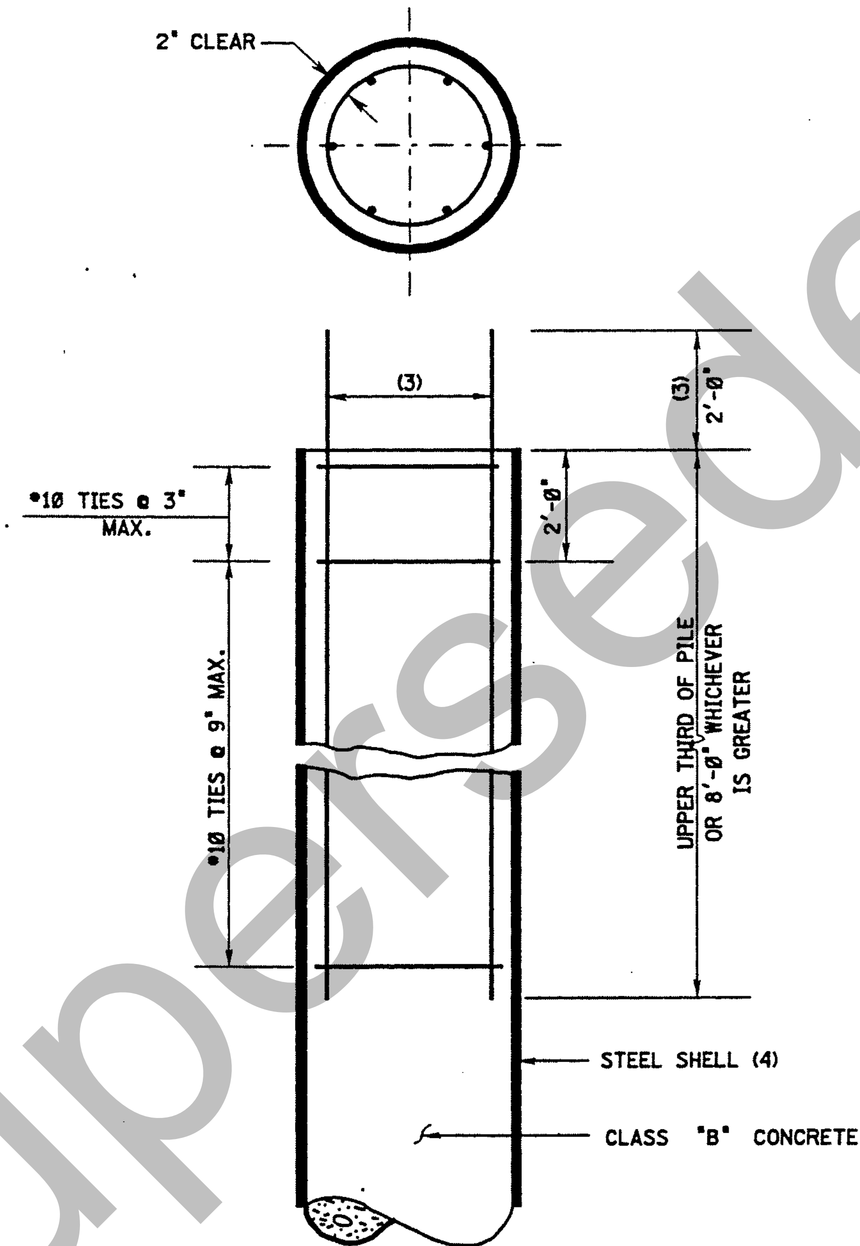
PCEF BULB-TEE GIRDERS STANDARD SECTIONS	ISSUED: 2002 REV:	PLATE 3.10-27



TYPICAL BEAM SECTION

TYPICAL SECTION PROPERTIES					
BEAM TYPE	DEPTH (IN)	WEIGHT (LB/FT)	AREA (IN^2)	Ix-c.g. (IN^4x10^3)	Yb (IN)
XB 55 47	55	903	866.7	355.8	26.07
XB 63 47	63	961	922.7	500.0	29.77
XB 71 47	71	1020	978.7	673.6	33.51

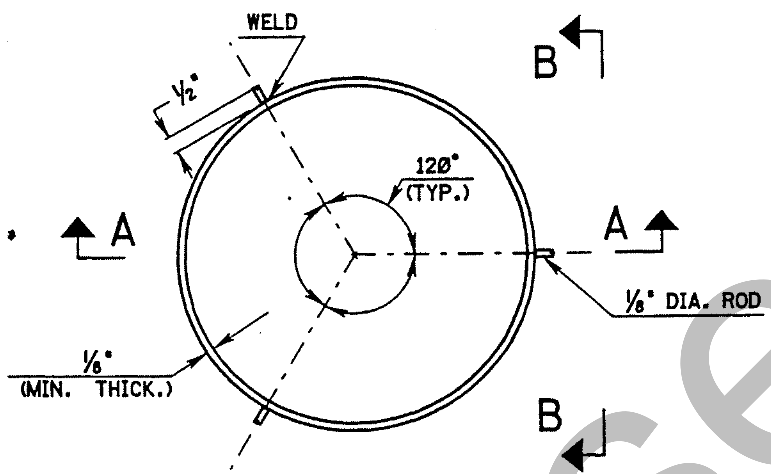
REINFORCEMENT STEEL FOR CAST-IN-PLACE CONCRETE PILES	ISSUED: 2002 REV:	PLATE 3.11-1



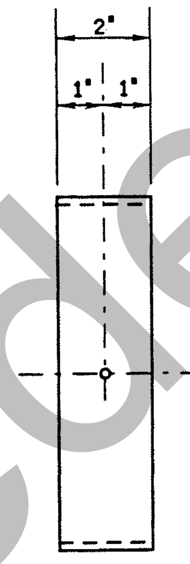
NOTES:

1. SEE CONTRACT DRAWINGS FOR DIMENSIONS OF PILE.
2. APPROVED METAL SPACERS SHALL BE ATTACHED TO THE TOP AND BOTTOM TIES TO INSURE THAT THE REQUIRED CLEAR DISTANCE TO THE SHELL IS MAINTAINED.
3. PILE DESIGN SHALL CONFORM TO SEISMIC PERFORMANCE ZONE 2 REQUIREMENTS OF SUBSECTION 5.13.4.6.2 OF AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS.
4. STEEL SHELL SHALL BE IN CONFORMANCE WITH SECTION 917.09 OF NJDOT STANDARD SPECIFICATIONS.

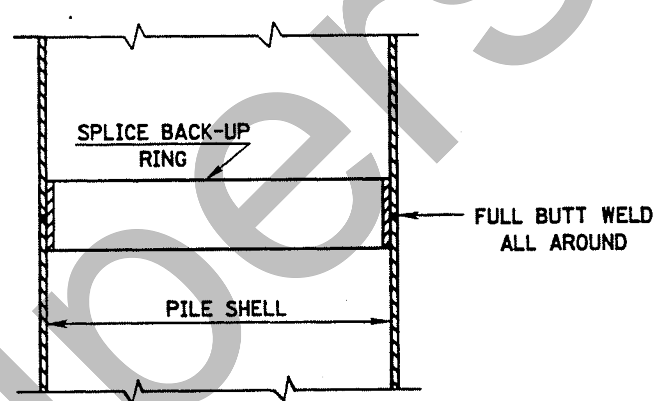
PILE SPLICE FOR CAST-IN-PLACE CONCRETE PILES	ISSUED: 2002 REV:	PLATE 3.11-2



PLAN



SECTION B - B



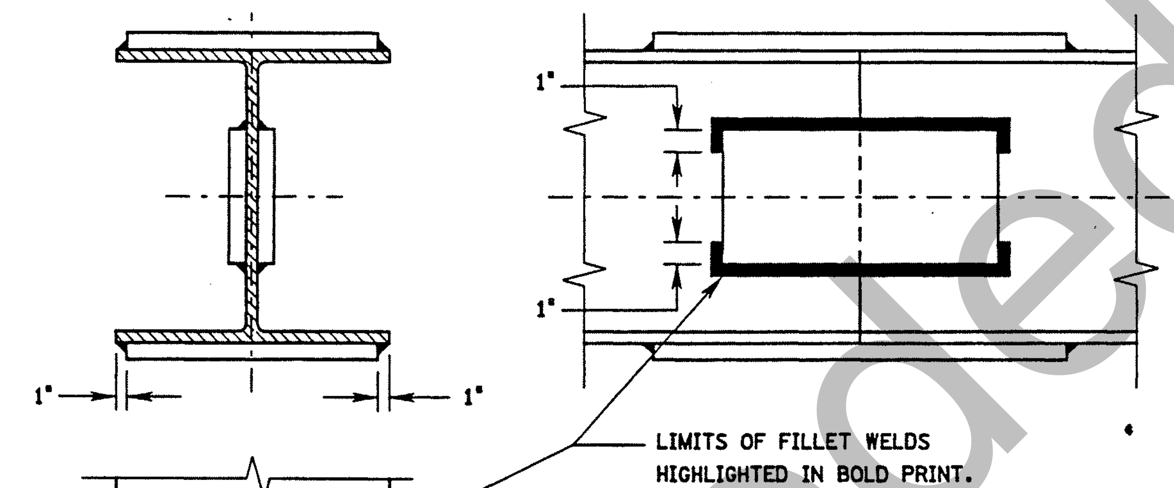
SECTION A - A

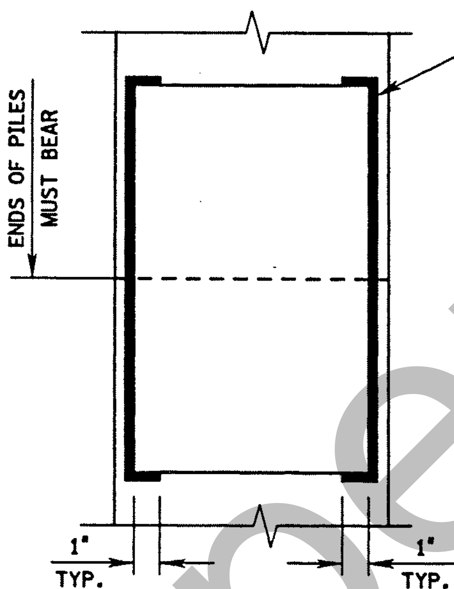
NOTES:

1. APPROVED COMMERCIAL PILE SPLICE BACK-UP RING MAY BE USED IN LIEU OF THE TYPE DETAILED. BACK-UP RING SHALL HAVE A TIGHT FIT.

2. WELDING SHALL BE AS PER A.W.S. REQUIREMENTS.

STEEL PILE SPLICE, ALTERNATE 1	ISSUED: 2002 REV:	PLATE 3.11-3



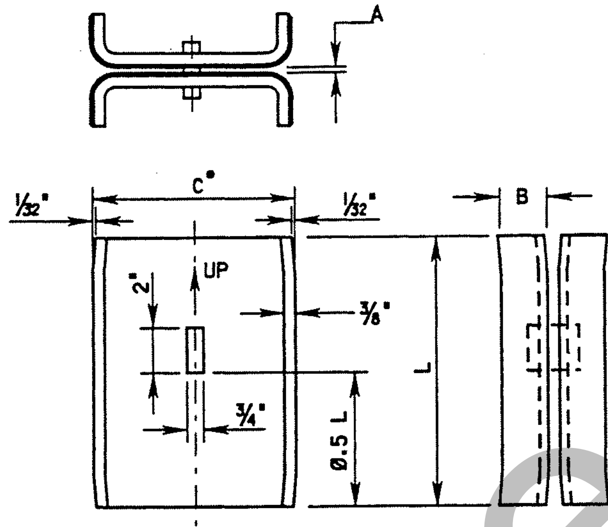


PLAN NOTES:

ALL WELDING TO BE 3/8" CONTINUOUS FILLET. THE UPPER PILE SECTION, WITH SPLICE PLATES ATTACHED, SHALL BE SET IN PLACE ON TOP OF THE DRIVEN SECTION AND TAPPED SEVERAL TIMES WITH THE HAMMER TO IMPROVE THE BEARING CONTACT, AFTER WHICH WELDING SHALL BE COMPLETED.

H-PILE SECTIONS	FLANGE PLATES		WEB PLATES	
	SIZE	LENGTH	SIZE	LENGTH
HP10x42	8"X5/8"	1'- 2"	5"X1/2"	0'- 9"
HP10x57	8"X3/4"	1'- 5"	6"X1/2"	1'- 0"
HP12x53	10"X5/8"	1'- 6"	5 1/4" X1/2"	0'- 11"
HP12x74	10"X 1"	2'- 0"	6"X5/8"	1'- 3"
HP14x73	12 1/4" X3/4"	2'- 1"	6"X1/2"	1'- 1"
HP14x89	12 3/8" X7/8"	2'- 5"	7"X5/8"	1'- 6"
HP14x102	12 5/8" X 1"	2'- 9"	7"X3/4"	1'- 8"
HP14x117	12 5/8" X 1"	3'- 1"	8"X3/4"	1'- 11"

STEEL PILE SPLICE, ALTERNATE 2 (SHEET 1 OF 2)	ISSUED: 2002 REV:	PLATE 3.11-4

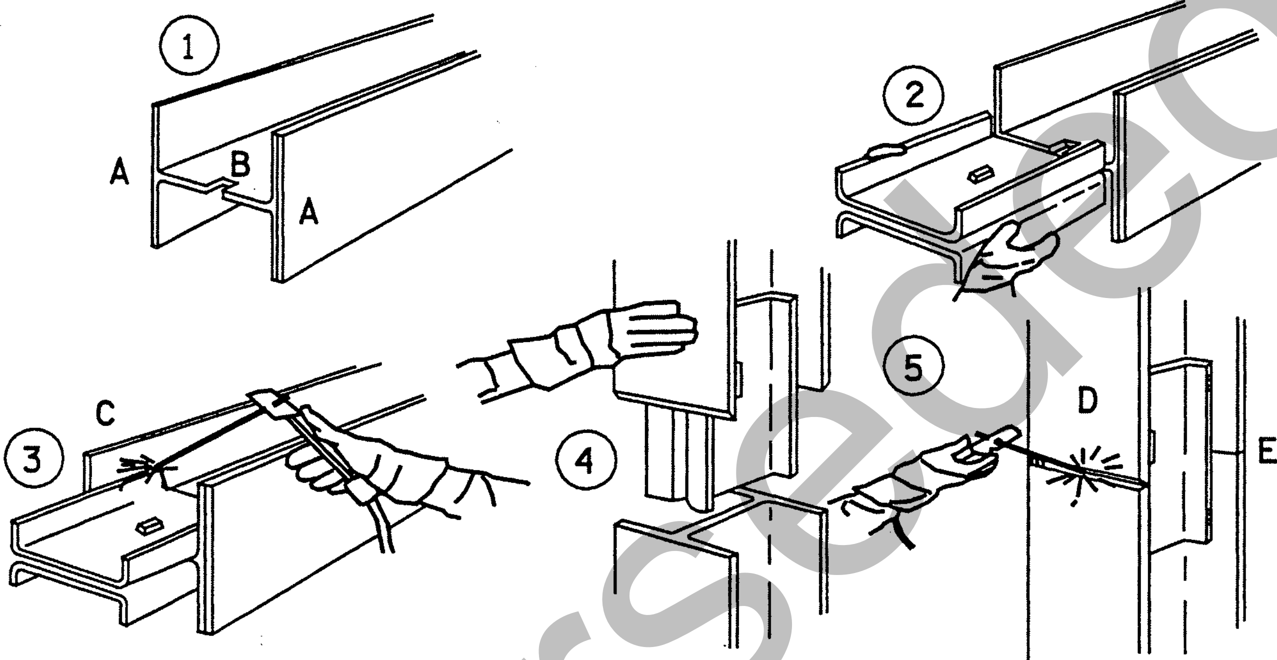


DETAIL OF STEEL BEARING H-PILE SPLICER								
HP-PILE			SPLICER SLEEVE-3/8" THICK ASTM A36 STEEL				WELDING	
NOMINAL SIZE (IN.)	WEIGHT LBS./FT.	METAL THICK. (IN.)	A (IN.)	B (IN.)	C* (IN.)	L (IN.)	MIN. WELD SIZE (IN.)	TOTAL LEN. OF WELD (IN.) **
14	117	13/16	15/16	2 3/4	12 7/16	16	7/16	50
14	102	11/16	13/16	2 3/4	12 7/16	16	7/16	50
14	89	5/8	11/16	2 3/4	12 7/16	16	3/8	49
14	73	1/2	5/8	2 3/4	12 7/16	16	3/8	49
12	84	11/16	3/4	2 1/2	10 3/4	14	7/16	44
12	74	5/8	11/16	2 1/2	10 3/4	14	3/8	44
12	63	1/2	5/8	2 1/2	10 3/4	14	3/8	44
12	53	7/16	1/2	2 1/2	10 3/4	14	5/16	44
10	57	9/16	5/8	2	8 3/4	12	5/16	40
10	42	7/16	1/2	2	8 3/4	12	5/16	40
8	36	7/16	1/2	1 3/4	7	10	5/16	36

* TOLERANCE 1/16" ±
** INCLUDES EIGHT 5/16" X 2 1/2" FILLET WELDS NEAR CORNER OF SPLICER.
SEE PLATE 3.11-5 FOR DETAILS OF ASSEMBLY.

STEEL PILE SPLICE, ALTERNATE 2 (SHEET 2 OF 2)	ISSUED: 2002 REV:	PLATE 3.11-5

DETAILS OF ASSEMBLY



1. WITH THE PILE IN A HORIZONTAL POSITION ON THE GROUND, SCARF OUTSIDE EDGES OF FLANGES (A) AND TORCH CUT A NOTCH (7/8"X2 1/8") IN THE WEB (B) TO ACCOMMODATE THE KEY.

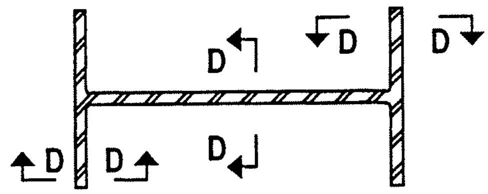
2. START SPLICER SLEEVE ON THE WEB AND FORCE THE SLEEVE ON UNTIL THE KEY SEATS IN THE NOTCH.

3. TACK WELD THE FLANGE OF THE SLEEVE (C) TO THE PILE (2 1/2" WELD) ON BOTH SIDES, STARTING NEAR THE END. USE 5/16" FILLET WELD. AFTER SEVERAL PILES ARE PREPARED TURN THEM (180 DEGREES) AND TACK WELD ON THE OPPOSITE SIDE. THE SPLICER CAN BE ATTACHED TO THE DRIVEN LENGTH OF PILE IF MORE CONVENIENT.

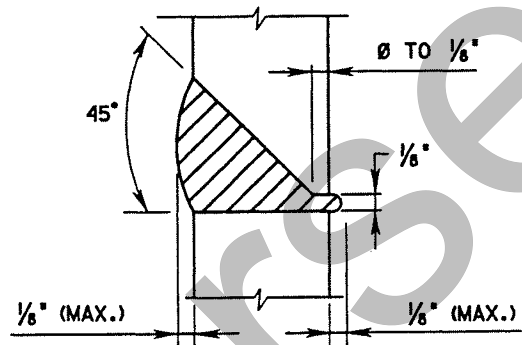
4. WHEN A SPLICE IS TO BE MADE HOIST A PREPARED SECTION INTO THE LEADS, GUIDE THE SLEEVE INTO POSITION AND FORCE TO CLOSE CONTACT.

5. WELD OUTSIDE FLANGES OF BUTTING SECTIONS (D) AND (E). DRIVE WHEN CONVENIENT.

STEEL PILE SPLICE, ALTERNATE 3	ISSUED: 2002 REV:	PLATE 3.11-6



SECTION AT JOINT



SECTION D-D

100% BUTT WELDED PILE SPLICE

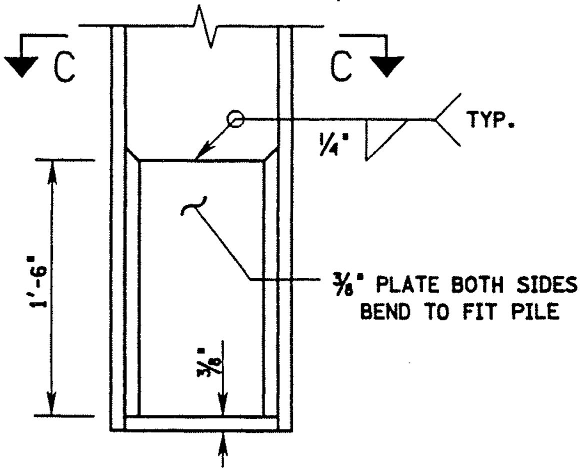
NOTES:

1. A.W.S. TYPE E7Ø16 OR E7Ø18 (LOW- HYDROGEN) ELECTRODES SHALL BE USED FOR 1ØØ% BUTT WELD SPLICES.

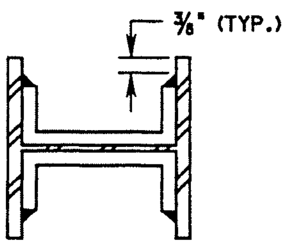
2. A.W.S. TYPE E6Ø1Ø AND E6Ø11 ELECTRODES OR E7Ø16 AND E7Ø18 (LOW- HYDROGEN) ELECTRODES, SHALL BE USED FOR THE ALTERNATE PLATE TYPE PILE SPLICE.

3. WELDING SHALL BE AS PER A.W.S. REQUIREMENTS.

PILE TIPS (SHEET 1 OF 2)	ISSUED: 2002 REV:	PLATE 3.11-7

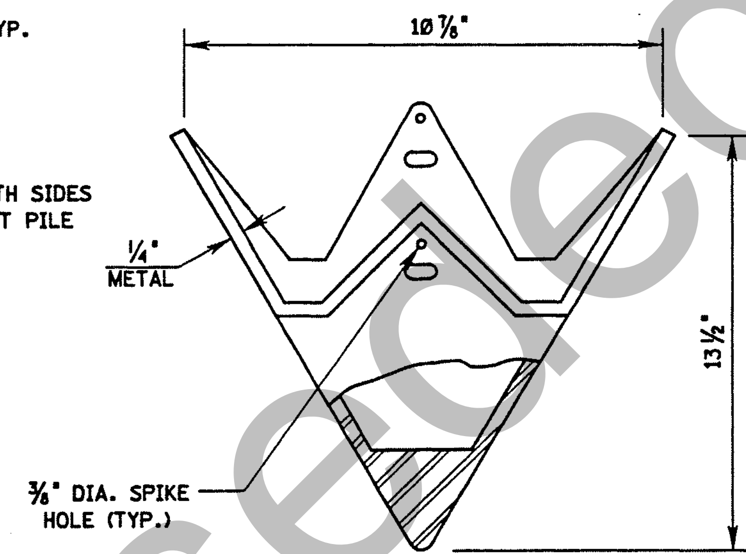


ELEVATION

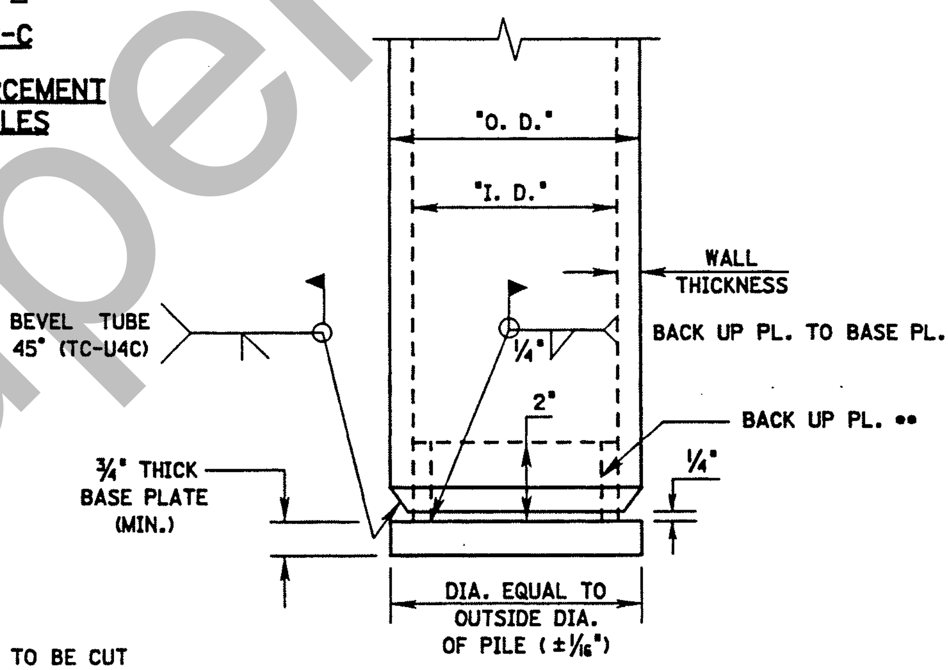


SECTION C-C

PILE TIP REINFORCEMENT FOR STEEL PILES



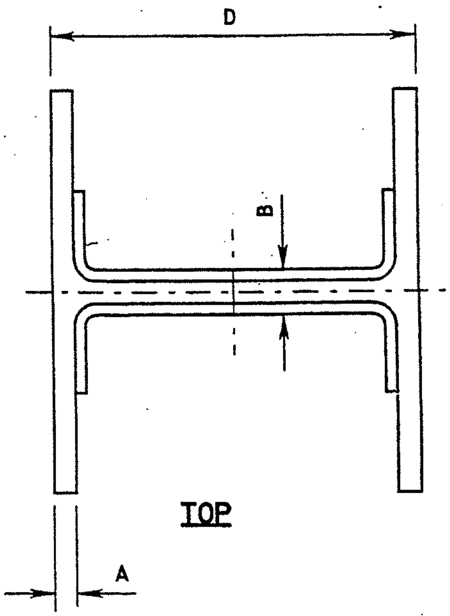
METAL PILE SHOE FOR TIMBER PILES



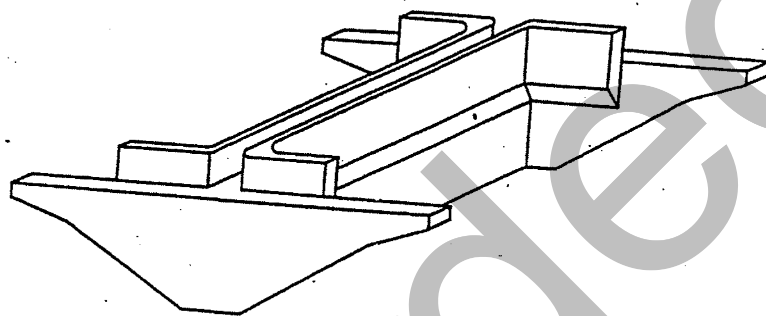
•• BACK UP PLATE: TO BE CUT FROM PILE AND BENT TO FIT "I. D." TIGHTLY ALL AROUND. BACK UP PLATE TO BE WELDED TO BASE PLATE.

CLOSURE PLATE FOR STEEL PIPE PILING & METAL SHELLS

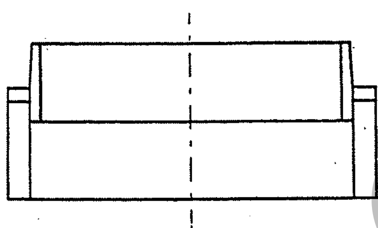
PILE TIPS (SHEET 2 OF 2)	ISSUED: 2002 REV:	PLATE 3.11-8



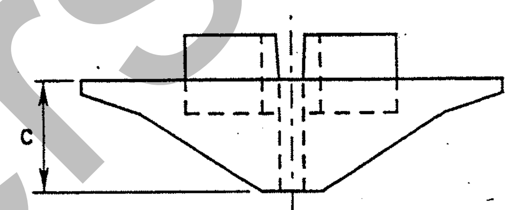
TOP



ORTHOGRAPHIC PROJECTION



FRONT



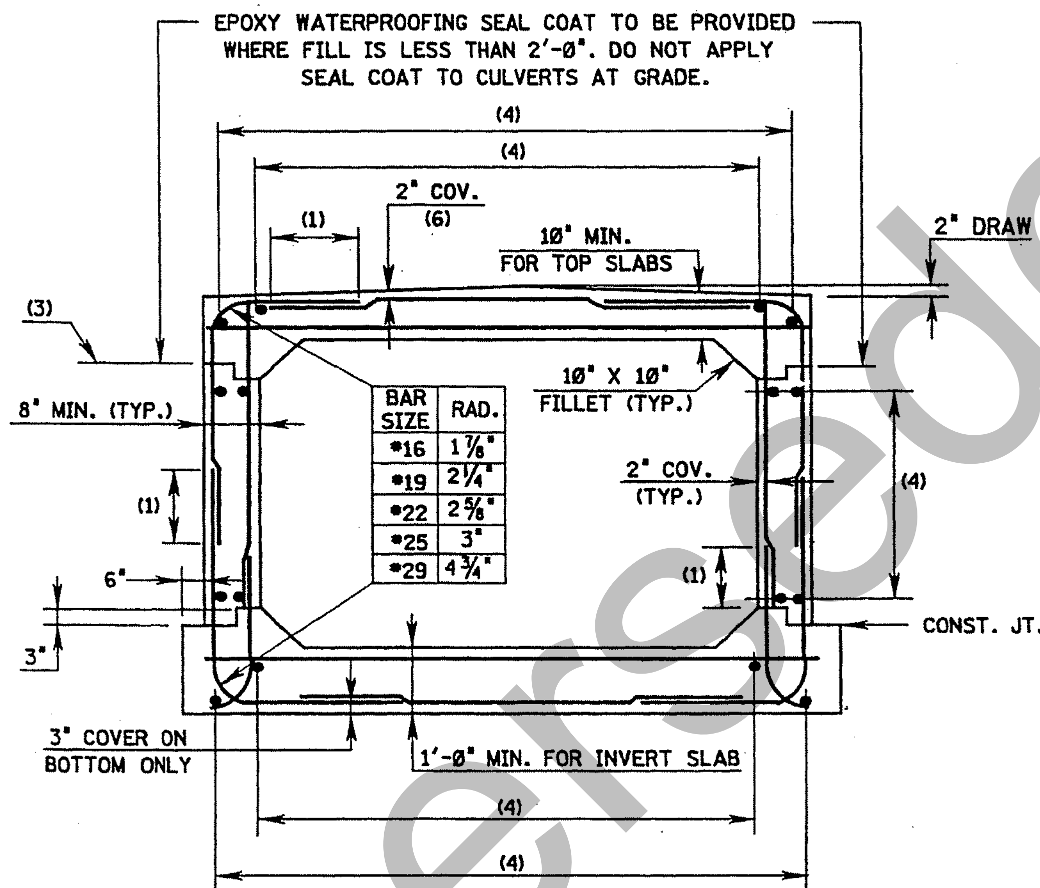
SIDE

DEPTH D	A	B	C	WEIGHT LBS.
10"	¾"	¾"	3"	17
12"	¾"	¾"	3½"	24
14"	1"	1"	4"	41

NOTES:

1. MATERIAL - CAST STEEL (AASHTO M103 (ASTM - A27) GRADE 65-35, CLASS 2).
2. ALL FILLETS = ⅜"
3. ALL WELDS BETWEEN H-PILE AND POINT TO BE IN ACCORDANCE WITH ANSI/AASHTO/AWS BRIDGE WELDING CODE D1.5 SPECIFICATION (LATEST EDITION). WELD FLANGES TO FITTINGS ON OUTSIDE FACES.

SINGLE CELL BOX CULVERT, CAST-IN-PLACE	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.12-1



BAR SIZE	RAD.
#16	1 7/8"
#19	2 1/4"
#22	2 5/8"
#25	3"
#29	4 3/4"

NOTES:

1. LAP SPLICE AND DEVELOPMENT LENGTHS SHALL BE DETERMINED BY THE DESIGNER IN ACCORDANCE WITH CURRENT AASHTO BRIDGE DESIGN CRITERIA.

2. WALL AND SLAB THICKNESSES SHOWN ABOVE ARE BASED ON AN 8'-0" WIDE BY 4'-0" HEIGHT CULVERT. INVERT SLAB THICKNESS IS EQUAL TO TOP SLAB THICKNESS PLUS 1".

3. SEE SUBSECTION 1.30.4.1 OF THIS MANUAL.

4. SIZE AND SPACING OF REBARS NOT DESIGNATED SHALL BE AS DETERMINED BY DESIGN. TOP MAT REINFORCING IN THE TOP SLAB SHALL BE CORROSION PROTECTED IF THE FILL OVER THE CULVERT IS LESS THAN 2'-0". REFER TO SECTION 26 OF THIS MANUAL FOR TYPES OF CORROSION PROTECTED REINFORCEMENT STEEL THAT CAN BE USED.

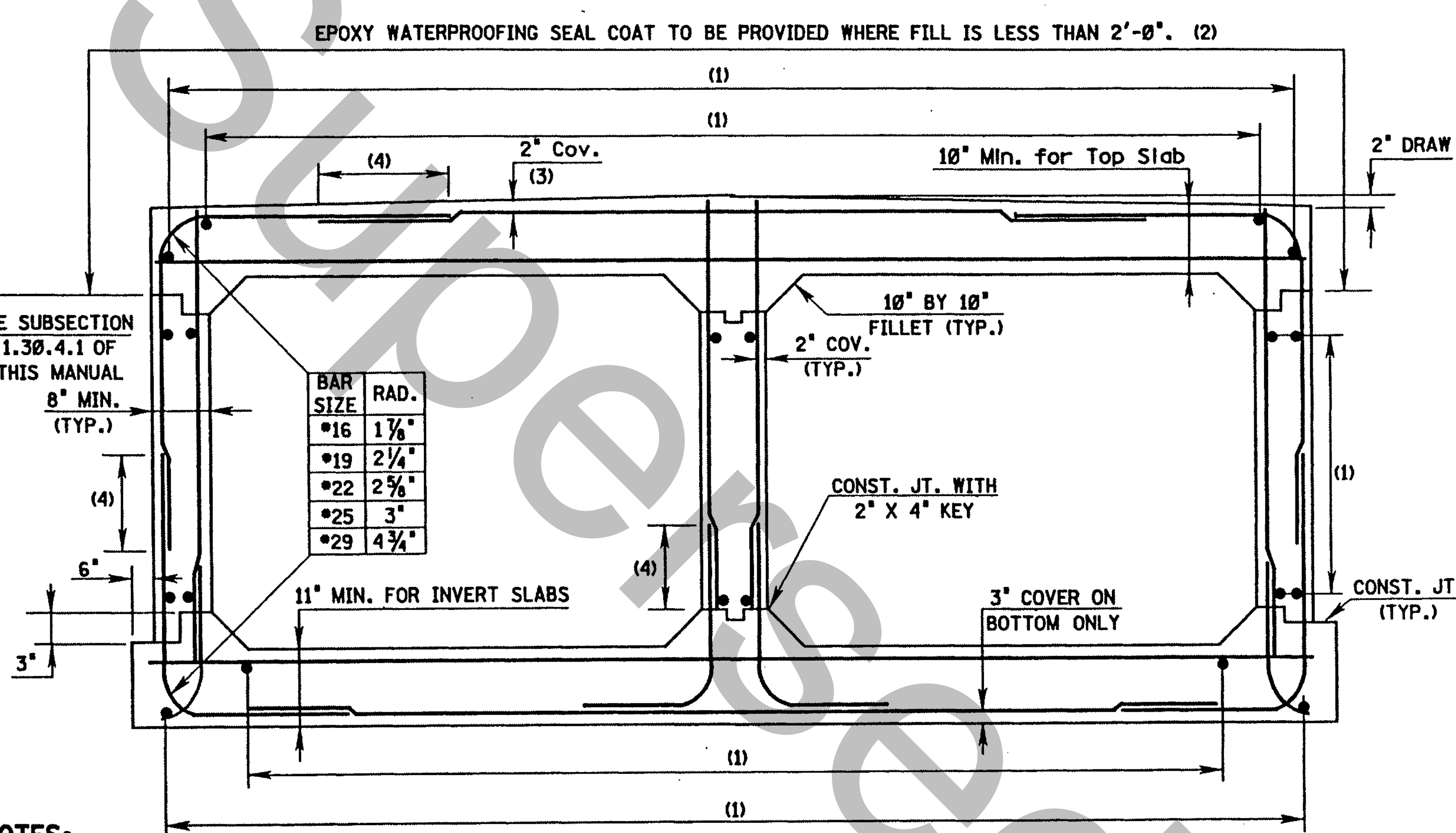
5. MINIMUM COVER SHALL BE 2½" IF CULVERT IS AT GRADE. ½" SHALL BE DEDUCTED FROM THE TOP SLAB THICKNESS IN THE DESIGN CALCULATIONS AS AN ALLOWANCE FOR THE DEPTH OF SAWCUT GROOVED FINISH AND WEAR.

6. FOR BEVEL INFORMATION SEE SECTION 1.30.4.8 OF THIS MANUAL.

TWIN CELL BOX CULVERT, CAST-IN-PLACE

ISSUED: 2002
REV:

PLATE 3.12-2

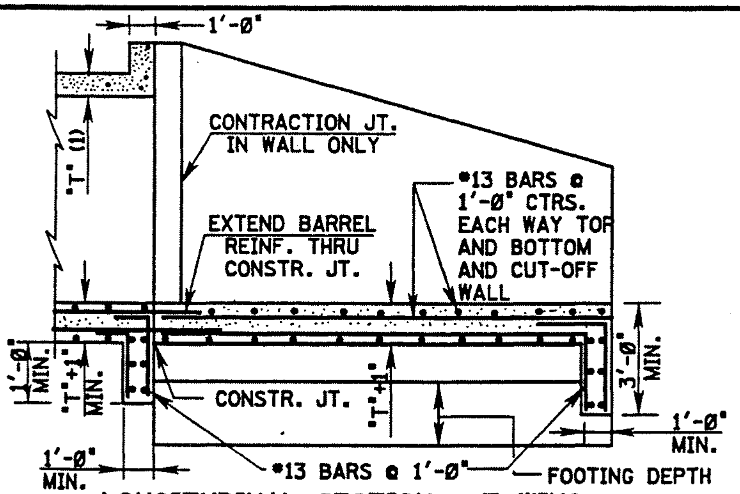


BAR SIZE	RAD.
#16	1 7/8"
#19	2 1/4"
#22	2 5/8"
#25	3"
#29	4 3/4"

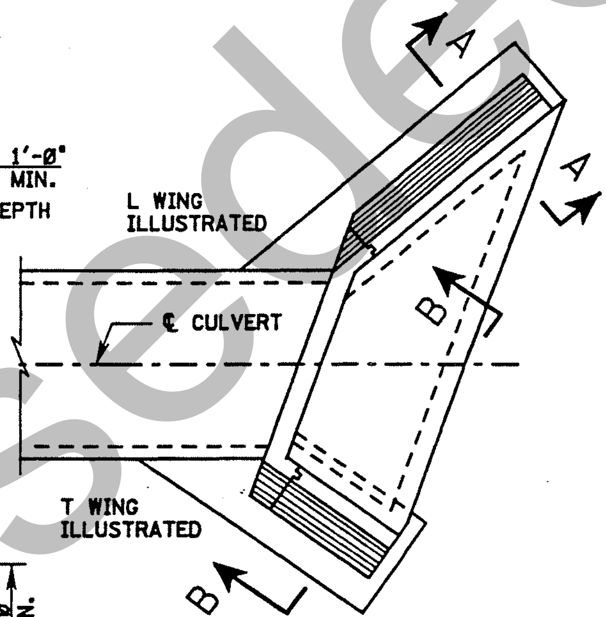
NOTES:

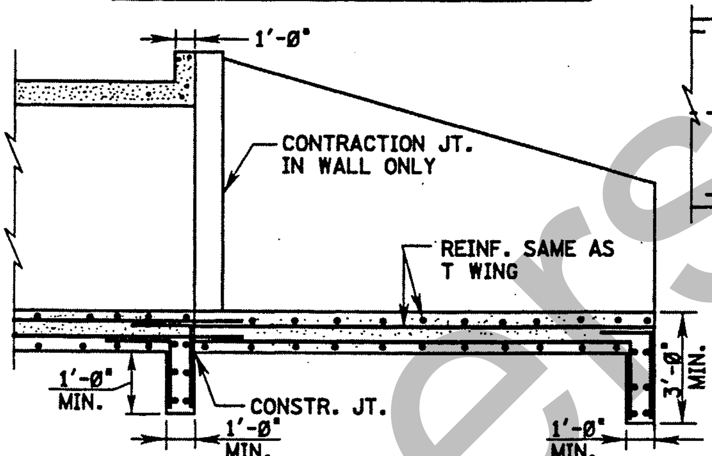
1. SIZE AND SPACING OF REBARS NOT DESIGNATED SHALL BE DETERMINED BY DESIGN.
2. DO NOT APPLY SEAL COAT TO CULVERTS AT GRADE. TOP MAT REINFORCING IN THE TOP SLAB SHALL BE EPOXY COATED IF THE FILL OVER THE CULVERT IS LESS THAN 2'-0".
3. MINIMUM COVER SHALL BE 2 1/2" IF CULVERT IS AT GRADE. 1/2" SHALL BE DEDUCTED FROM THE TOP SLAB THICKNESS IN THE DESIGN CALCULATION AS AN ALLOWANCE FOR THE DEPTH OF SAWCUT GROOVED FINISH AND WEAR.
4. LAP SPLICE AND DEVELOPMENT LENGTHS SHALL BE DETERMINED BY THE DESIGNER IN ACCORDANCE WITH CURRENT AASHTO DESIGN CRITERIA.
5. WALL AND SLAB THICKNESSES SHOWN ABOVE ARE BASED ON AN 8'-0" WIDE BY 4'-0" HEIGHT FOR EACH CELL. INVERT SLAB THICKNESS IS EQUAL TO TOP SLAB THICKNESS PLUS 1".
6. FOR BEVEL INFORMATION SEE SECTION 1.30.4.8.

PAVED APRONS FOR BOX CULVERTS	ISSUED: 2002 REV:	PLATE 3.12-3

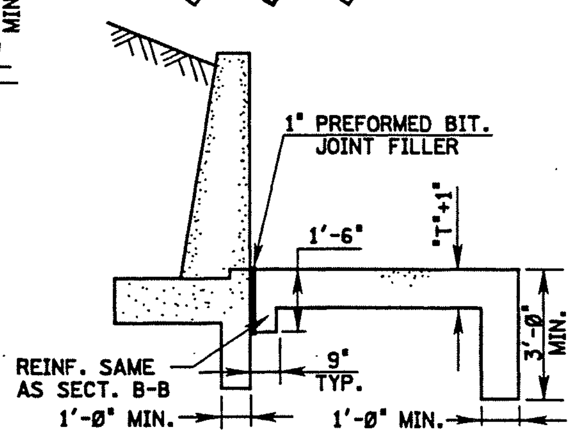


LONGITUDINAL SECTION - T WING

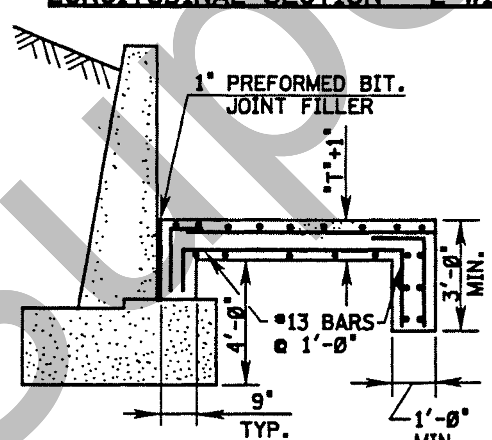




LONGITUDINAL SECTION - L WING



SECTION A-A

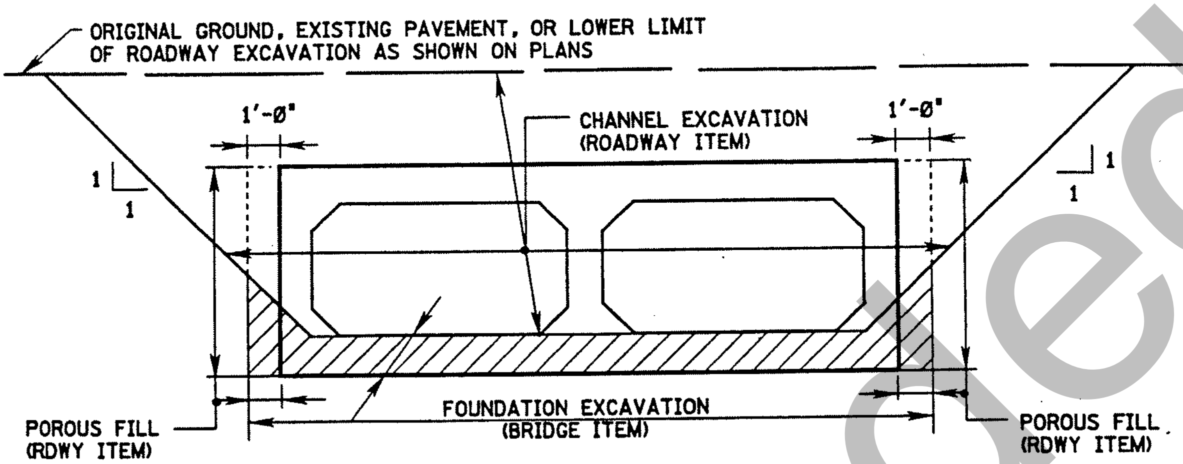


SECTION B-B

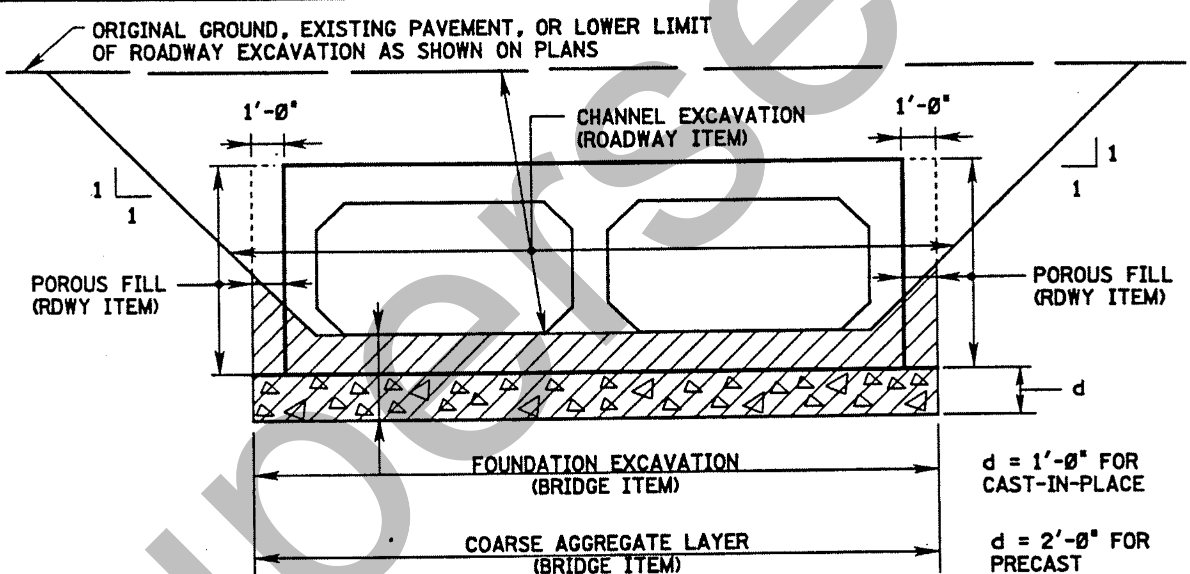
NOTES:

1. "T" IS EQUAL TO THE TOP SLAB THICKNESS.
2. A MINIMUM 3'-Ø" DEEP CUT OFF WALL (CURTAIN WALL) IS REQUIRED WHEN CULVERT DOES NOT HAVE A PAVED APRON.
3. A WATER STOP SHALL BE PROVIDED IN THE CONTRACTION JOINT IN THE RETAINING WALL.

PAYMENT LIMITS FOR EXCAVATION AT CULVERT	ISSUED: 2002 REV:	PLATE 3.12-4



CONDITION 1 : NO REMOVAL OF UNSUITABLE MATERIAL REQUIRED FOR CULVERT FOUNDATION (AS DETERMINED BY SOILS ENGINEER)



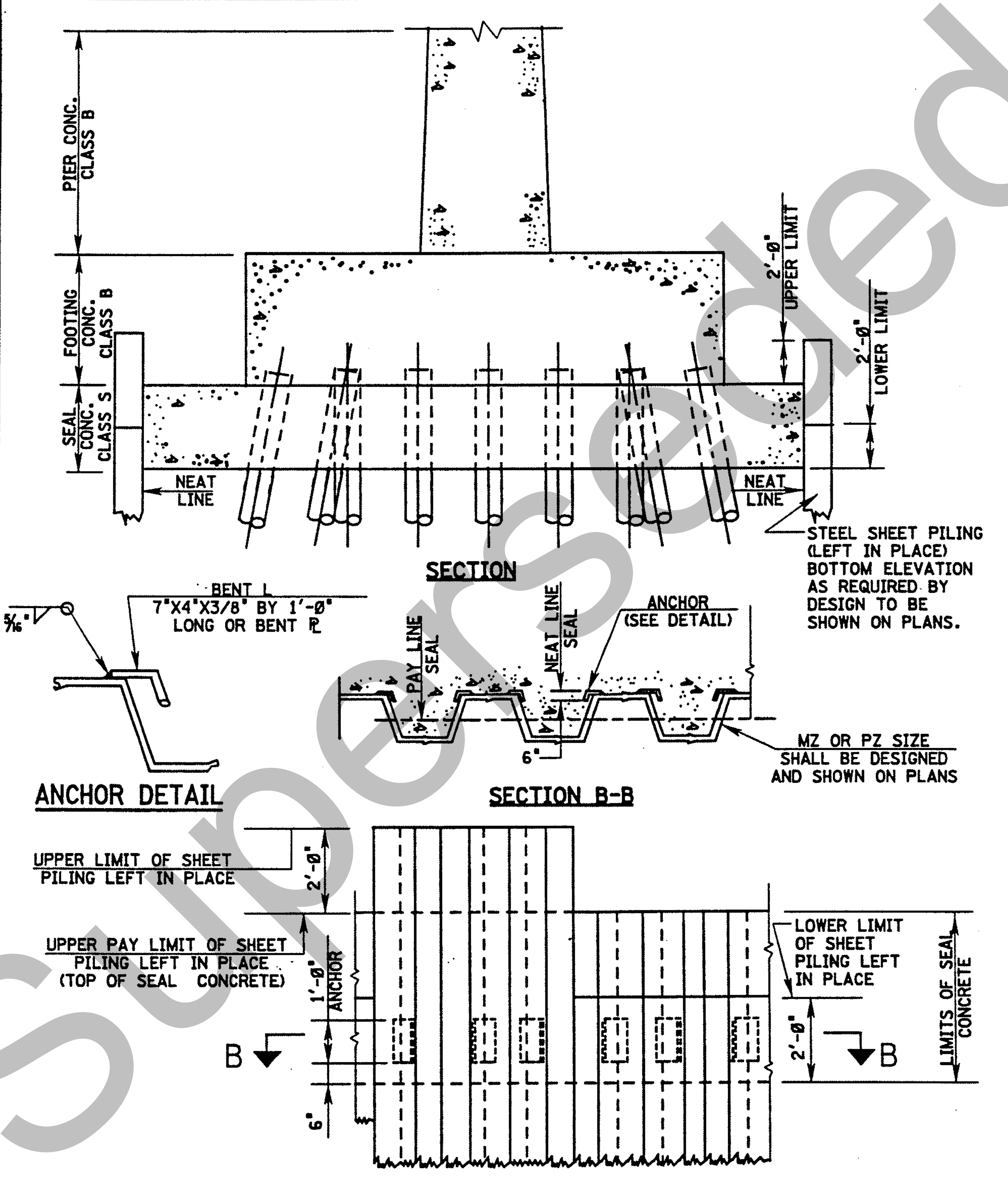
CONDITION 2 : NO REMOVAL OF UNSUITABLE MATERIAL REQUIRED; HOWEVER COARSE AGGREGATE LAYER REQUIRED FOR WATER PROBLEMS ANTICIPATED DURING CONSTRUCTION (AS DETERMINED BY BRIDGE ENGINEER / SOILS ENGINEER).

CONDITION 3 : NO TYPICAL ILLUSTRATION SHOWN. WHERE SOILS ENGINEER DETERMINES THAT UNSUITABLE MATERIAL MUST BE REMOVED TO AN EXTENT AS NECESSARY FOR ROADWAY AND STRUCTURE DESIGN, IT SHALL BE THE RESPONSIBILITY OF THE BRIDGE ENGINEER TO COORDINATE A MEETING OF ALL PARTIES CONCERNED IN ORDER THAT THE ROADWAY AND BRIDGE PLANS ARE CONSISTENT IN EVERY DETAIL PRIOR TO SUBMISSION OF FINAL PLANS.

NOTE:

THE ABOVE ILLUSTRATIONS ARE INTENDED FOR USE AS GUIDELINES AND NOT AS CONTRACT PLAN STANDARD DETAILS. EACH CONTRACT AND EACH SITUATION SHOULD BE EXAMINED ON AN INDIVIDUAL BASIS.

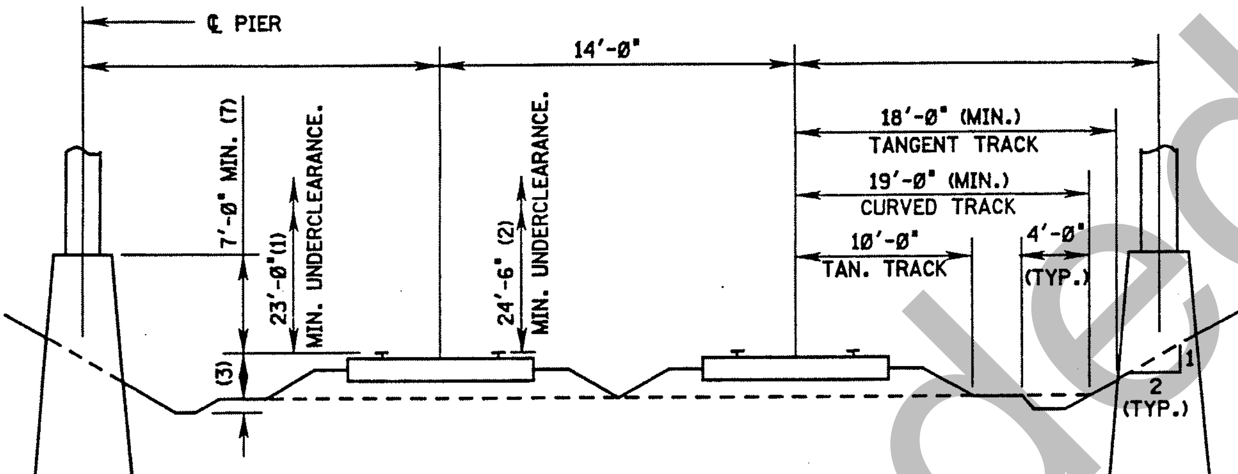
DETAILS FOR SHEET PILING LEFT-IN-PLACE	ISSUED: 2002 REV:	PLATE 3.13-1



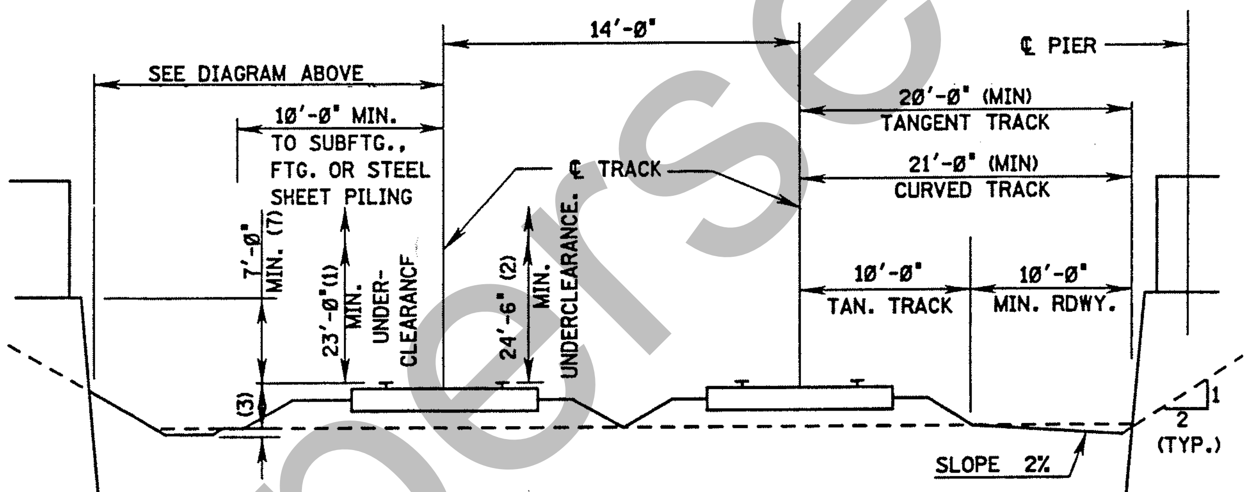
NOTE:

THE DETAILS SHOWN ABOVE ARE FOR GUIDANCE ONLY. DETAILS SHALL BE DEVELOPED TO SUIT ACTUAL SITE CONDITIONS.

RAILROAD SIDE CLEARANCE, DOUBLE TRACK UNDER, NEW CONSTRUCTION	ISSUED: 2002 REV:	PLATE 3.14-1



WITHOUT PROVISION FOR OFF-TRACK MAINTENANCE EQUIPMENT

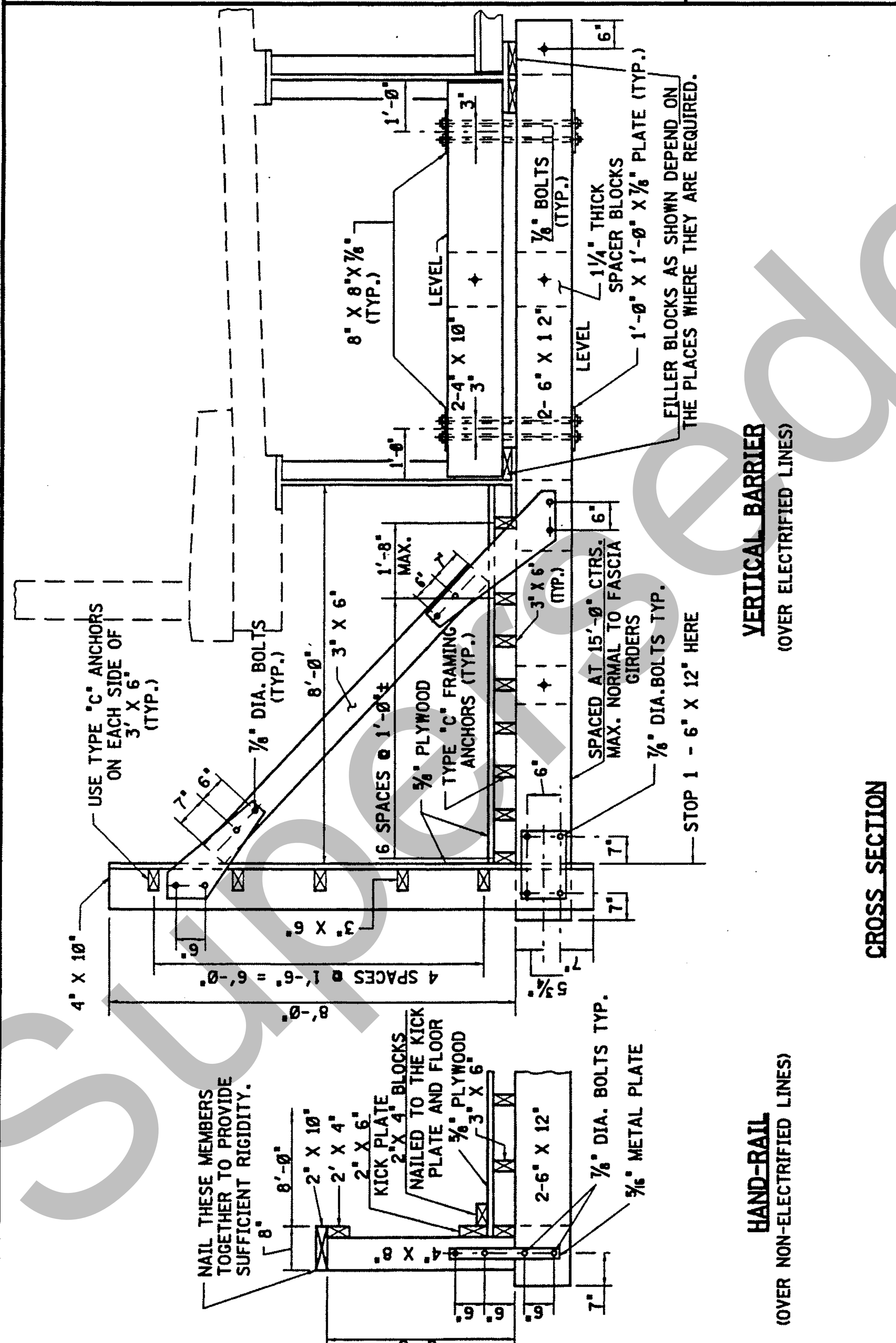


WITH PROVISION FOR OFF-TRACK MAINTENANCE EQUIPMENT

NOTES:

1. MINIMUM VERTICAL UNDERCLEARANCE MEASURED FROM THE TOP OF RAIL FOR NON-ELECTRIFIED TRACKS SHALL BE 23'-0".
2. MINIMUM VERTICAL UNDERCLEARANCE MEASURED FROM THE TOP OF RAIL FOR ELECTRIFIED TRACKS SHALL BE 24'-6".
3. THIS DIMENSION IS VARIABLE.
4. ALL DIMENSIONS SHOWN ARE AT RIGHT ANGLES TO THE TRACK.
5. CLEARANCE FOR RECONSTRUCTION WORK OR FOR ALTERATIONS ARE DEPENDENT ON THE EXISTING PHYSICAL CONDITIONS AND WHERE REASONABLY POSSIBLE SHOULD BE IMPROVED TO MEET THE REQUIREMENTS OF NEW CONSTRUCTION.
6. THE DIAGRAMS ABOVE ILLUSTRATE CONRAIL'S MINIMUM LATERAL CLEARANCE REQUIREMENTS FOR NEW CONSTRUCTION. THE NJDOT UTILITIES & RAILROAD ENGINEERING UNIT SHOULD BE CONTACTED TO VERIFY MINIMUM LATERAL CLEARANCE REQUIREMENTS FOR EACH PROJECT.
7. THE 7'-0" MINIMUM VERTICAL CLEARANCE INCLUDES THE FUTURE BALASTING REQUIREMENTS.

CONSTRUCTION SHIELD OVER ELECTRIFIED TRACKS	ISSUED: 2002 REV:	PLATE 3.14-2



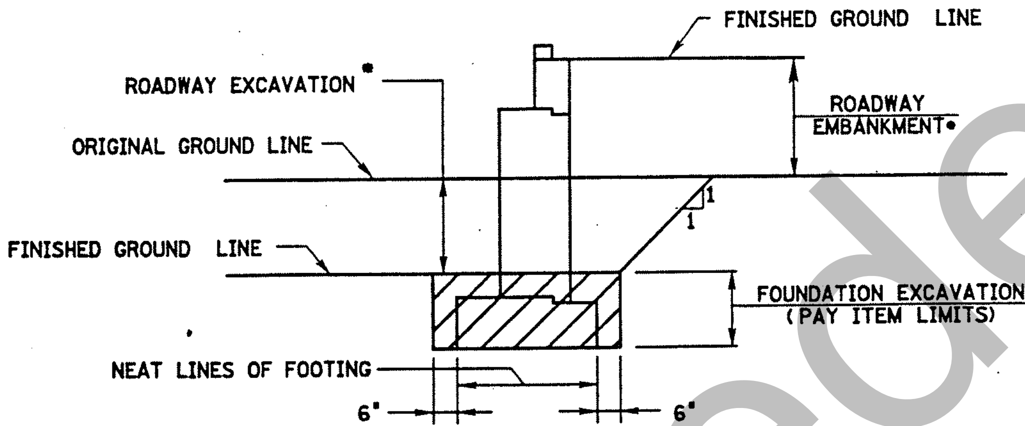
NOTE:

THIS DETAIL PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY. THE DESIGNER SHALL PROVIDE SPECIFIC DETAILS AS REQUIRED IN THE CONTRACT PLANS.

STANDARD CONSTRUCTION SPECIFICATIONS PAYMENT LIMITS FOR EXCAVATION (SHEET 1 OF 5)	ISSUED: 2002 REV:	PLATE 3.15-1

REF: SUBSECTION 206.13 OF THE NJDOT STANDARD SPECIFICATIONS.

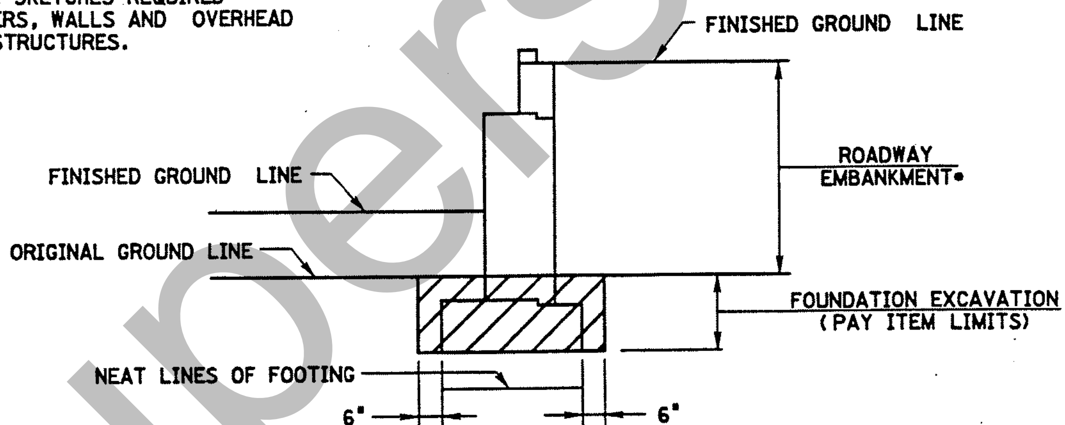
REF: STANDARD CONSTRUCTION DETAILS (ROADWAY)



CASE 1 (PRIOR ROADWAY EXCAVATION SCHEDULED)

NOTE:

HIGH ABUTMENT ILLUSTRATED.
SIMILAR SKETCHES REQUIRED
FOR PIERS, WALLS AND OVERHEAD
SIGN STRUCTURES.



CASE 2 (NO ROADWAY EXCAVATION SCHEDULED)

NOTES:

1. PAY ITEM LIMITS MUST BE SHOWN ON BRIDGE PLANS. THIS CAN BE ACCOMPLISHED BY USING SCHEMATIC DRAWINGS AS SHOWN ABOVE, OR MAY BE INDICATED ON THE DETAIL SECTIONS.

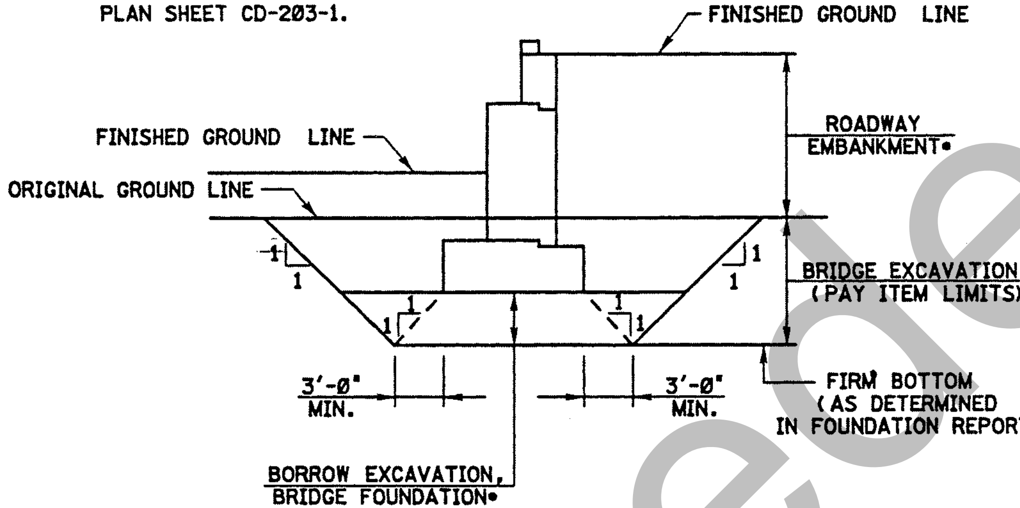
2. THE BRIDGE DESIGN ENGINEER, SHALL REVIEW THE ROADWAY PLANS AND X-SECTIONS PRIOR TO SUBMISSION OF FINAL PLANS TO DETERMINE THAT EXCAVATION PAYMENT LIMITS FOR ROADWAY AND BRIDGE WORK ARE COMPATIBLE.

• INDICATES ROADWAY PAY ITEM OF WORK.

STANDARD CONSTRUCTION SPECIFICATIONS PAYMENT LIMITS FOR EXCAVATION (SHEET 2 OF 5)	ISSUED: 2002 REV:	PLATE 3.15-2

REF: SUBSECTION 206.13 OF THE NJDOT STANDARD SPECIFICATIONS.

REF: STANDARD CONSTRUCTION DETAILS (ROADWAY) PLAN SHEET CD-203-1.

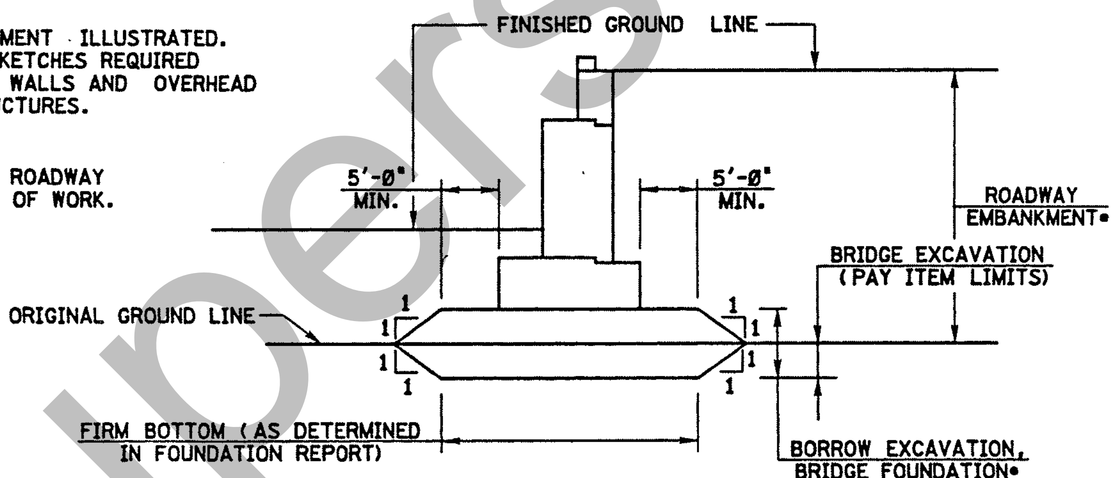


CASE 3 (ORIGINAL GROUND LINE ABOVE FOOTING)

NOTE:

HIGH ABUTMENT ILLUSTRATED. SIMILAR SKETCHES REQUIRED FOR PIERS, WALLS AND OVERHEAD SIGN STRUCTURES.

•INDICATES ROADWAY PAY ITEM OF WORK.



CASE 4 (ORIGINAL GROUND LINE BELOW FOOTING)

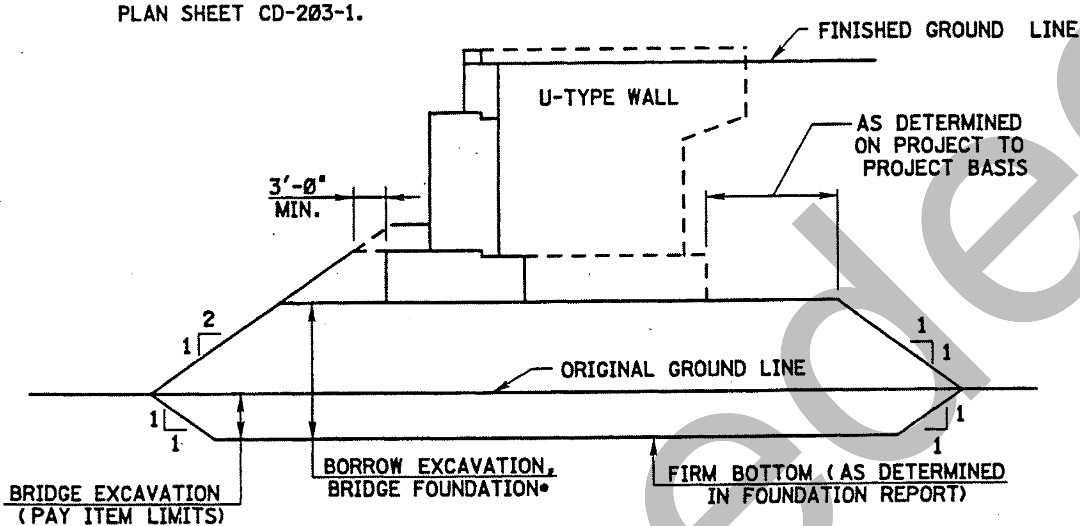
NOTES:

1. SEE GUIDE SHEET PLATE 3.15-1 NOTE 1.
2. SEE GUIDE SHEET PLATE 3.15-1 NOTE 2.
3. BRIDGE EXCAVATON IS CONSIDERED FOR SCHEDULING AS A PAY ITEM, WHERE UNSUITABLE MATERIAL IS NOT BEING REMOVED UNDER ROADWAY EXCAVATION ITEMS OF WORK, DEPTH OF EXCAVATION TO REACH SUITABLE MATERIAL IS MINIMAL, AND PILE FOUNDATONS ARE NOT REQUIRED-AS DETERMINED IN FOUNDATION REPORT.
4. ALSO, SEE GUIDE SHEET PLATE 3.3-3.

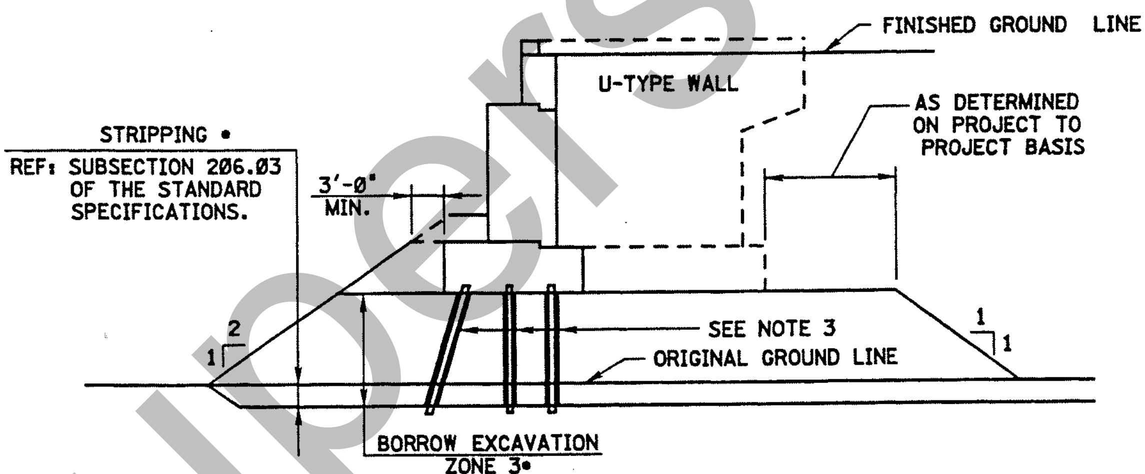
STANDARD CONSTRUCTION SPECIFICATIONS PAYMENT LIMITS FOR EXCAVATION (SHEET 3 OF 5)	ISSUED: 2002 REV:	PLATE 3.15-3

REF: SUBSECTION 206.13 OF THE NJDOT STANDARD SPECIFICATIONS.

REF: STANDARD CONSTRUCTION DETAILS (ROADWAY)
PLAN SHEET CD-203-1.



CASE 5 (STUB ABUTMENT WITHOUT PILES)



CASE 6 (STUB ABUTMENT ON PILES)

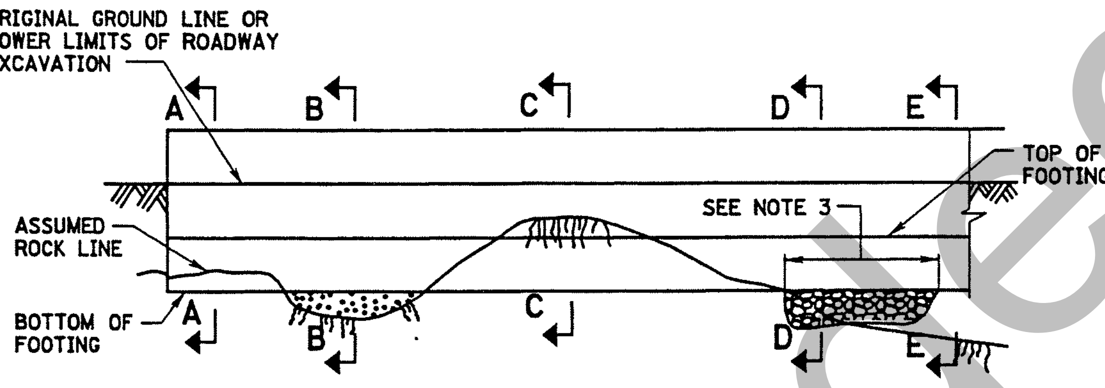
NOTES:

1. SEE GUIDE SHEET PLATE 3.15-1 NOTE 1.
2. SEE GUIDE SHEET PLATE 3.15-1 NOTE 2
3. PREBORED HOLES, WHEN REQUIRED BY FOUNDATION REPORT. SEE SUBSECTION 505.15 AND 505.16 OF THE NJDOT STANDARD SPECIFICATIONS AND SUBSECTION 1.36.3 (A) (2) OF THIS MANUAL.
4. ALSO, SEE GUIDE SHEET PLATE 3.3-3.
5. FOUNDATION EXCAVATION, PAY ITEM NOT TO BE SCHEDULED.

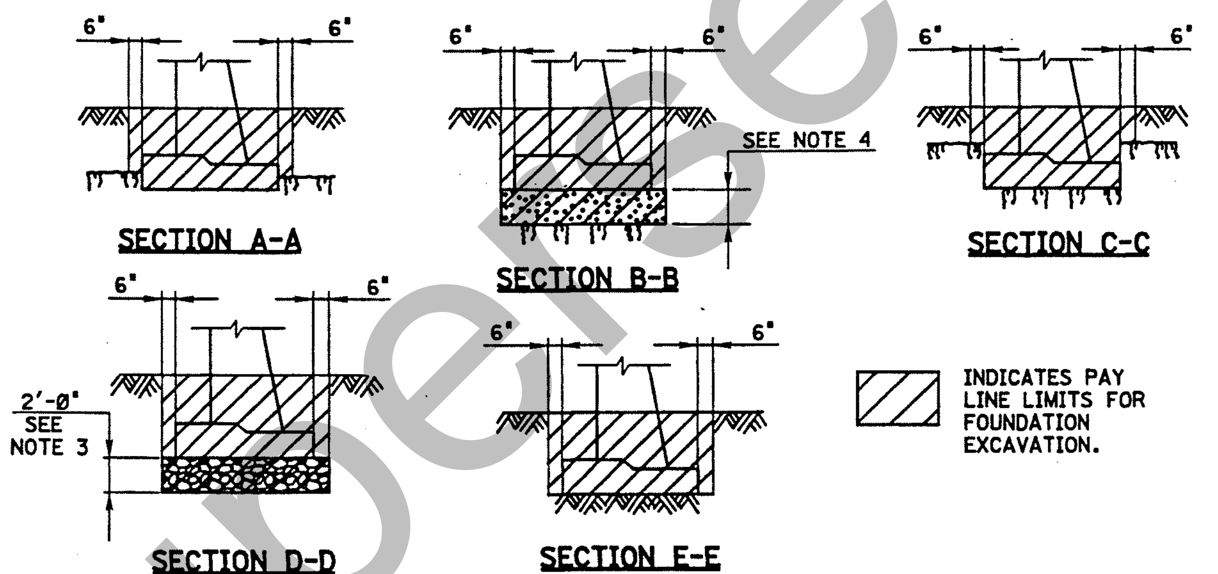
• INDICATES ROADWAY PAY ITEM OF WORK

STANDARD CONSTRUCTION SPECIFICATIONS PAYMENT LIMITS FOR EXCAVATION (SHEET 4 OF 5)	ISSUED: 2002 REV:	PLATE 3.15-4

REF: SUBSECTION 206.13 OF THE NJDOT STANDARD SPECIFICATIONS.



ELEVATION-ABUTMENTS, WALLS, PIERS
(FOOTING PARTLY ON ROCK AND EARTH)



NOTES:

1. SEE GUIDE SHEET PLATE 3.15-1, NOTE 1.

2. SEE GUIDE SHEET PLATE 3.15-1, NOTE 2.

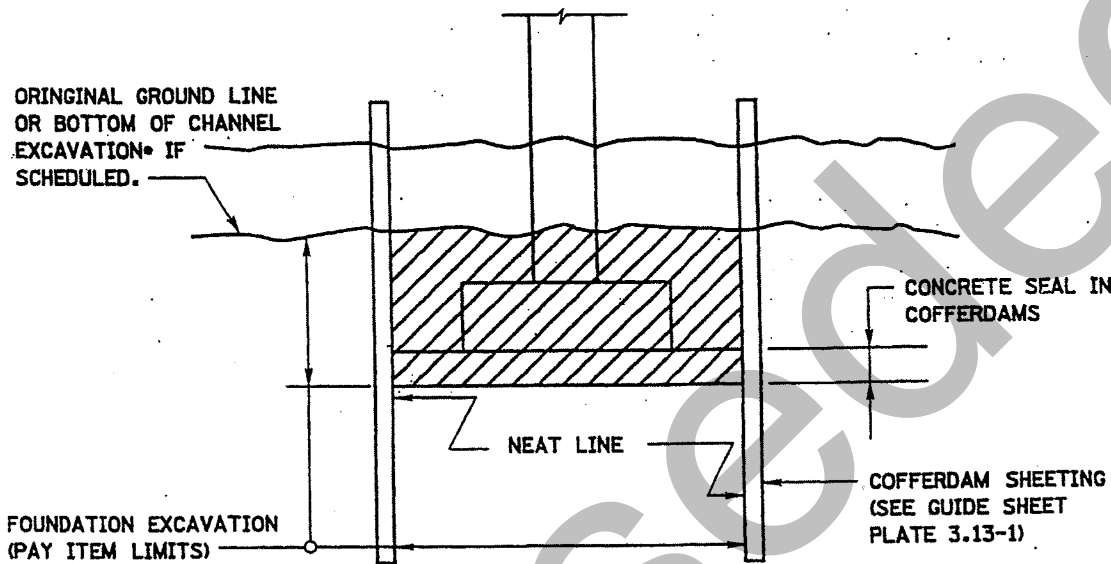
3. EXCAVATE ROCK, BACKFILL AND COMPACT COARSE AGGREGATE LAYER PER NJDOT STANDARD SPECIFICATIONS SUBSECTION 206.07, LENGTH AS DETERMINED ON PROJECT TO PROJECT BASIS.

4. PLACE CLASS B CONCRETE, ADD PARAGRAPH IN SPECIAL PROVISIONS (UNDER SUBSECTION 501.25) THAT THE VOLUME OF CONCRETE WILL BE INCLUDED FOR PAYMENT UNDER CONCRETE IN STUCTURES, FOOTINGS.

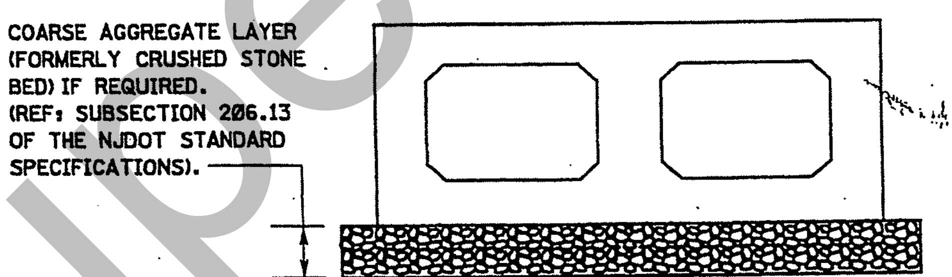
5. IF THE ASSUMED ROCK LINE IS MORE THAN 2'-0" ABOVE OR BELOW THE BOTTOM OF FOOTING, CONSIDER "STEPPING" OF THE FOOTING PER SUBSECTION 1.17.1.4 OF THIS MANUAL, AS AN ALTERNATIVE TO THE ABOVE DETAILS.

STANDARD CONSTRUCTION SPECIFICATIONS PAYMENT LIMITS FOR EXCAVATION (SHEET 5 OF 5)	ISSUED: 2002 REV:	PLATE 3.15-5

REF: SUBSECTION 206.13 OF THE NJDOT STANDARD SPECIFICATIONS.



FOOTINGS IN COFFERDAMS



CULVERTS

(SEE GUIDE SHEET PLATE 3.12-4 FOR EXCAVATION PAY ITEM LIMITS)

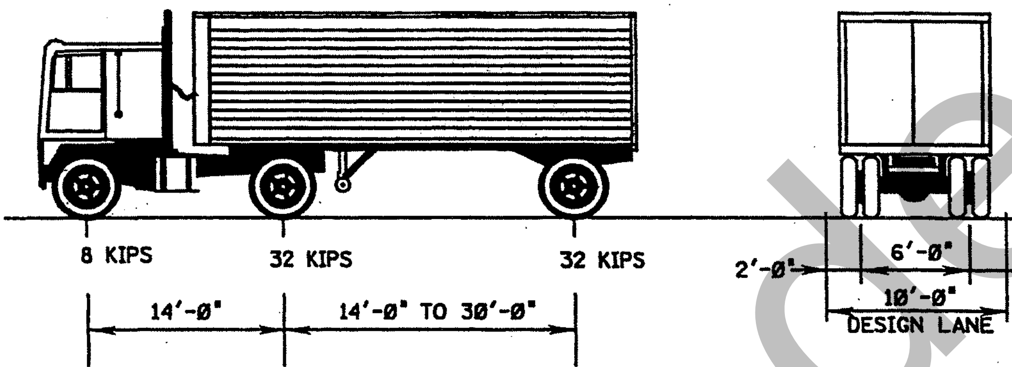
NOTES:

1. SEE GUIDE SHEET PLATE 3.15-1, NOTE 1.

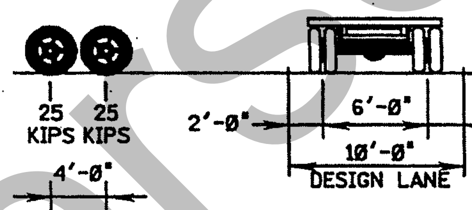
2. SEE GUIDE SHEET PLATE 3.15-1, NOTE 2.

• INDICATES ROADWAY PAY ITEM OF WORK

HL-93 LOADING	ISSUED: 2002 REVISION: BDC04MB-01	PLATE 3.16-1



DESIGN TRUCK



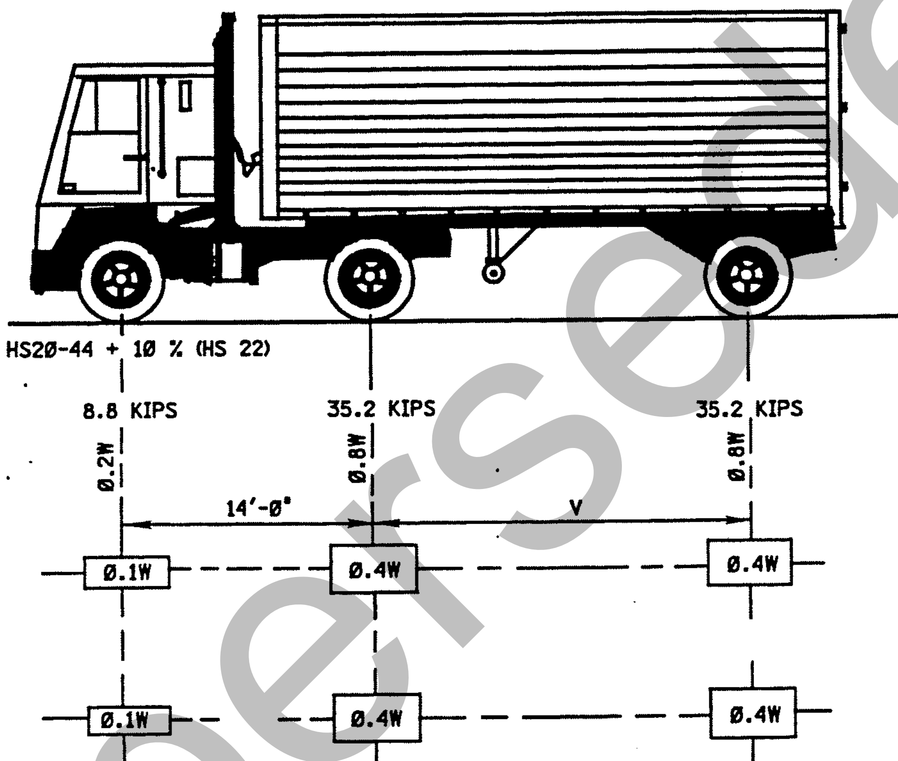
DESIGN TANDEM

DESIGN LANE LOAD

- VARIABLE SPACING - 14'-0" TO 30'-0" INCLUSIVE. SPACING TO BE USED IS THAT WHICH PRODUCES MAXIMUM STRESSES.

HS20-44 + 10% (HS 22)	ISSUED: 2002 REV:	PLATE 3.16-2

THIS NJDOT BRIDGE DESIGN LOADING SHALL BE USED FOR ALL LOCAL AID - OFF SYSTEM BRIDGES WITH ADTT TO 500, AT THE OPTION OF THE OWNER.



W = COMBINED WEIGHT ON THE FIRST TWO AXLES WHICH IS THE SAME AS FOR CORRESPONDING H TRUCK.

V = VARIABLE SPACING - 14'-0" TO 30'-0" INCLUSIVE. SPACING TO BE USED IS THAT WHICH PRODUCES MAXIMUM STRESSES.

GRAPHIC BAR SCALES	ISSUED: 2002 REV:	PLATE 3.17-1