CE-12
2/26/15

CONSOLIDATED RAIL CORPORATION

SPECIFICATIONS FOR DESIGN AND CONSTRUCTION

OF

UNDERGRADE RAILROAD BRIDGES

FOR

GRADE SEPARATION PROJECTS

APPROVED:

T. C. Tierney
Vice President / Chief Engineer

1.0 GENERAL

1.1 Scope

a. This specification shall apply to the design and construction of all railroad bridges for which Conrail will maintain all or part of the structure. It also covers any structure over which Conrail will operate its equipment.

b. This specification shall be used in conjunction with Conrail's CE-6 specification, "Specific Requirements Of Consolidated Rail Corporation For Work On Its Right Of Way", which covers other aspects and procedures for a grade separation project.

1.2 Definitions

a.	Conrail	- Consolidated Rail Corporation
b.	Undergrade Bridge	- Bridge which carries the railroad over a highway or waterway.
c.	Professional Engineer	- Engineer licensed in the state where the bridge is to be constructed.
d.	Project Engineer	- Engineer for the State, County or other municipality constructing the bridge project.
e.	Contractor	- The individual, firm or corporation undertaking the execution of the work.
f.	AREMA	- American Railway Engineering and Maintenance-of-Way Association manual of recommended practice
g.	AISC	- American Institute of Steel Construction
h.	ASTM	- American Society for Testing and Materials
i.	AWS	- American Welding Society
j.	SSPC	- Steel Structures Painting Council

1.3 Submission of Design Drawings and Specifications

a. Design drawings shall be submitted a minimum of four (4) times during the course of the project design. The submissions shall be as follows:

(1) **Type, Size and Location** - Drawings submitted at this time are to show the type of structure, span lengths, a typical bridge cross section and the layout of the abutments and pier(s). A geotechnical report (see Section 2.1) shall also be included. In addition, the existing and proposed track geometry (track profile and horizontal alignment), with the point of minimum horizontal clearance through the bridge structure, is to be shown.

(2) **60% Submission** - 60% complete drawings with preliminary design computations are to be submitted. Preliminary project specifications are to be submitted at this time.

(3) **90% Submission** - 90% complete drawings with final design computations and project specifications **must** be submitted at this time.

(4) **Final Submission (Contract Drawings & Specifications)** - These drawings and specifications shall include all Conrail design requirements and address all the Conrail comments raised during the design phase of the project. Once approved by Conrail, these drawings and specifications will become the Contract Documents.

b. The final drawings and computations must be prepared by, and bear the seal of, a Professional Engineer.

1.4 Maintaining Railroad Operations During Construction

a. The project is to be designed and constructed so that there will be minimal interference with rail operations. Safe rail operations must be maintained at all times.

b. The new structure shall be designed so that all existing tracks at the site remain operational unless track outages are agreed upon by Conrail's Chief Engineer or his designated representative. Keeping the railroad operational may require shifting existing track(s), installation of sheeting & shoring, construction of a temporary run-around track(s) and/or temporary bridges, etc.

c. A conceptual sequence of construction, showing each phase of the project and how it affects rail operations, shall be shown on the Type, Size and Location drawings.

1.5 As-Built Drawings

a. Upon completion of the project, the Project Engineer shall have the contract drawings marked-up to show all field changes. These drawings shall be dated and signed and sealed by the Project Engineer and will become the "As-Built Drawings". The owner will provide Conrail with one complete set of "As-Built Drawings" in electronic pdf format.

2.0 SOIL INVESTIGATION

2.1 General

a. A geotechnical report shall be submitted with the "Type, Size and Location" submission. The report shall contain boring logs, soil capacity recommendations and foundation design recommendations. The geotechnical report must be prepared by, and bear the seal of, a Professional Engineer.

2.2 Boring Locations

a. A minimum of two borings shall be made at each abutment and pier. The borings shall be located at each end of the abutment or pier.

b. Test boring logs shall be accompanied with a plan, drawn to scale, showing the location of the borings in relation to the track(s) and the proposed undergrade bridge.

2.3 Sampling

a. Test borings shall be made in accordance with current ASTM Specification D 1586 except that sampling must be continuous for the full length unless rock is encountered. Where rock is encountered, it is to be cored using a Series "M" Double Tube Core Barrel, with a diamond bit, capable of retrieving a rock core at least 1 5/8" (41.3 mm) in diameter. Individual core runs shall not exceed 5 feet (1.5 m) in length.

2.4 Boring Logs

a. The format of the test boring logs shall comply with the sample test boring log sheet provided in the Appendix, page A-1. The test boring logs shall clearly indicate **all** of the following:

(1) Boring number as shown on the required boring location plan.

(2) Ground elevation at each boring using the same datum as the bridge construction plans.

(3) Engineering description of soils or rock encountered.

(4) Depth and percent recovery of all soil samples.

(5) Depth from surface for each change in strata.

(6) Number of blows for each 6 inches (152 mm) of penetration for the standard penetration test described in ASTM D 1586. Blows for lesser penetrations should be recorded.

(7) Percent recovery and Rock Quality Designation (RQD) for all rock cores.

(8) Depth to ground water while sampling and when it has stabilized in the bore hole.

b. The bottom of footing elevation shall be superimposed on the boring logs.

c. All borings shall be sealed, for their full depth, with a 4-3-1 bentonite-cement-sand grout after final ground water readings have been taken and recorded.

d. Soil samples taken from auger vanes or return washwater are not acceptable.

2.5 Additional Information

a. When directed by Conrail, additional borings may be required for the purpose of taking undisturbed thin-wall piston samples or Dennison type samples for laboratory testing to determine the index and engineering properties of certain soil strata.

3.0 DESIGN REQUIREMENTS

3.1 General Requirements

3.1.1 Design Standards

a. The design of all elements of the bridge structure shall be in accordance with the current AREMA manual unless otherwise modified herein. The AREMA manual current during the preparation of the 60% submission shall be considered as the current manual.

3.1.2 Type of Bridge Structure

a. All bridges shall be designed as a solid floor, ballasted deck, bridge.

b. All bridge spans shall be simple span structures. Continuous span bridges will not be approved.

3.1.3 Typical Details

a. The steel deck plate of the bridge shall be continuously welded to the girders or floor beams.

b. Ballasted deck bridges shall be designed to provide 8 inches (219 mm) of ballast under the ties. Where conditions (clearance restrictions, etc.) require less ballast depth, a minimum of 6 inches (152 mm) of ballast may be used when approved by the Chief Engineer.

3.1.4 Clearances

a. Level Tangent Track - The horizontal clearance on level tangent track shall be 9'-0" (2.74 m) from centerline track, taken at the top of rail elevation.

b. Curved Track - For curved track, the outside and inside clearances shall be measured radially and horizontally and increased by 1 inch (2.54 mm) per degree of curvature over that indicated for tangent track. In addition, the inside clearance for superelevated track shall be further increased by 1 inch (2.54 mm) per inch (2.54 mm) of superelevation for each 5 feet (1.52 m) of height above the top of low rail.

3.1.5 Materials

a. Structural Steel

(1) ASTM A 36 or ASTM A 709, Grade 36.

(2) ASTM A 572, Grade 50 or ASTM A 709, Grade 50

(3) ASTM A 588 or ASTM A 709, Grade 50W

For additional material requirements concerning "Other than Fracture Critical Members" see AREMA Chapter 15, Table 1-2.

For additional material requirements concerning "Fracture Critical Members" see AREMA Chapter 15, Table 1-14.

b. All bolted connections shall be made with high strength bolts with a minimum bolt diameter of 7/8 inch (22.2 mm) with 15/16 inch (23.8 mm) diameter open holes. The high strength bolt, nut and washer material shall be Type III in accordance with ASTM A 325.

3.1.6 Thickness of Material

a. All structural steel members (girders and floorbeams) shall have a minimum material thickness of ½ inch (12.7 mm), except as noted below.

b. Steel deck plates shall have a minimum thickness of 5/8 inch (15.9 mm). All other plates shall have a minimum thickness of ½ inch (12.7 mm).

c. Bearing stiffeners shall have a minimum thickness of 1".

3.1.7 Fracture Critical Members

a. All steel members shall meet the Fracture Critical Member requirements provided in AREMA Chapter 15, Part 1, Section 1.14.

3.1.8 Welding

a. All field welds shall be made with E-70XX low hydrogen electrode with on-site protection and use of electrode heating units per current AWS specifications.

b. The weld between the flange and web, of a plate girder member, is to be a complete penetration double bevel groove weld (TC-U5S).

3.1.9 Drainage

a. The bridge deck shall be sloped, in the longitudinal direction, a minimum of 0.5% to allow for drainage.

b. At the low end of the bridge a collection system (perforated pipe with granular material or other approved method) shall be provided. The collection pipe(s) shall be routed behind the abutment and discharge into a storm sewer system.

3.1.10 Handrail

a. Longitudinal beam bridges shall have handrails provided on both sides of the bridge. The horizontal clearance from the face of the handrail to the centerline of the adjacent track is to be a minimum of 9'-0" (2.74 m) for tangent track. See Section 3.1.4 b. for curved track requirements.

b. Through girder bridges will not require handrails provided the distance from top of rail to top of the girder flange plate is a minimum of 3'-6" (1.07 m). A handrail, attached to the top flange of the girders shall be provided when the top of rail to top of flange distance is less than 3'-6" (1.07 m). A walkway and handrail shall is not permissable on the outside face of through girder bridges.

3.2 Design Loads and Stresses

3.2.1 Dead Load

a. All structural members of the bridge shall be designed to accommodate 18 inches (457 mm) of additional ballast. This additional loading is to account for future track raises.

3.2.2 Live Load

a. Structural steel members shall be design for a Cooper E 80 load or the Alternate Live Load. The member under consideration shall be designed for the loading which produces the greater stress. Note: different members of the bridge may be controlled by different loadings (i.e. - the E 80 load may govern the girder design while the Alternate Live Load may govern the floorbeam design).

Concrete structures shall be designed in accordance with the AREMA Manual Chapters 7 and 8 respectively.

Timber structures shall only be used on a temporary basis when approved by Chief Engineer Conrail. When used they shall be designed in accordance with the AREMA Manual Chapters 7 and 8 respectively.

3.2.3 Fatigue

a. The allowable fatigue stress range shall be in accordance with AREMA Chapter 15, Table 1-10.

3.3 Seismic Design

a. The structure shall be designed in accordance with the guidelines presented in AREMA Chapter 9, "Seismic Design for Railway Structures".

b. Hold-down devices shall be provided between the superstructure and substructure.

c. The distance from the edge of the superstructure bearings to the edge of the substructure shall be a minimum of 9 inches (229 mm).

3.4 Bearings

a. Bearings shall be designed and constructed in accordance with AREMA Chapter 15, Part 5.

b. Bronze plates shall be "Hi Tin Bronze" in accordance with ASTM B 22, Copper Alloy UNS No. C91100, with graphite inserts. The bronze plate shall have a minimum thickness of ¾ inch (19.1 mm).

c. Pins used for hinged bearings shall be finished carbon steel shafting in accordance with ASTM A 108, Grade 1018. Pins shall have a minimum diameter of 5 inches (127 mm).

d. Other types of bearings which adequately provide for thermal expansion and contraction, rotation, camber changes, and creep and shrinkage of the structural members will be allowed provided approval is given by the Chief Engineer.

3.5 Concrete Structures and Foundations

3.5.1 General Requirements

a. Concrete structures and foundations shall be in accordance with AREMA Chapter 8, unless otherwise modified herein.

b. Backs of all walls, which shall be in permanent contact with the earth, shall receive two (2) coats of approved dampproofing as per AREMA Chapter 29, Part 3.

c. Cast-in-place concrete shall have a minimum 28 day compressive strength of 4,000 psi (27.6 MPa) and precast concrete shall have a minimum 28 day compressive strength of 6,000 psi (41.4 MPa).

d. All structural concrete shall be air entrained.

e. All reinforcing steel shall be in accordance with ASTM A615, Grade 60.

f. All reinforcing steel shall be epoxy-coated and conform to ASTM A775.

g. Concrete mix designs shall be submitted to the Project Engineer for approval.

h. Reinforcing bar placing (shop) drawings shall be submitted to the Project Engineer for approval. One complete set of the final approved shop drawings, with a copy in pdf format, shall be included with the "As-Built Drawings" (see Section 1.5 a.).

i. The factor of safety against overturning for abutments and walls shall be 2.0. The factor of safety against sliding for abutments and walls shall be 1.5.

3.5.2 Abutments

a. Abutments shall be designed in accordance with AREMA Chapter 8, Part 5, unless otherwise modified herein.

b. Abutments shall be cast in place concrete structures unless approved by the Chief Engineer.

c. The backface of the abutment stem must be at or behind the backface of the abutment backwall. Placing a haunch in the abutment stem, below the backwall is not acceptable.

d. Mechanically stabilized earth systems will not be accepted for use as abutments.

3.5.3 Retaining Walls

a. Mechanically stabilized earth systems shall not be used where the retaining wall is supporting a track.

b. Steel sheet piling or metal crib walls shall not be used for permanent construction.

c. Soil anchors or rock anchors shall not be used in the design and construction of any type of permanent retaining structure.

d. The Boussinesq analysis shall be used for the railroad live load when designing walls supporting a track. The following procedure shall be used:

(1) The load on the track shall be taken as a strip load with a width equal to the length of the ties, 8½ feet (2.6 m). The vertical surcharge, q (psf), caused by each axle, shall be uniform and equal to the axle load divided by the tie length and the axle spacing, 5 feet (1.5 m). For an E-80 loading, this results in;

$q = 80{,}000 / (8.5 \times 5) = 1882$ psf. $\quad (q = 356 / (2.591 \times 1.524) = 90.1$ kPa$)$

(2) The horizontal pressure due to the live load surcharge at any point on the wall is p_h and can be calculated by the following:

$p_h = (2q/\pi)(\beta - \sin\beta(\cos 2\alpha))$ (See Appendix, page A-2)

The vertical and horizontal pressures given above shall be used unless an alternate design method is approved by the Chief Engineer. Proposals to use an alternate design method must include acceptable references and a statement explaining the justification for choosing the alternate method.

3.5.4 Footings

a. When designing footings or walls to resist lateral load, passive pressure shall be neglected.

3.5.5 Pile Foundations

a. Pile foundations shall be in accordance with AREMA Chapter 8, Part 4, unless otherwise modified herein.

b. Timber piles shall only be used for temporary structures.

3.6 Deck Waterproofing

3.6.1 General Requirements

a. The top surface of steel or concrete ballasted deck bridges and the side curb plates or concrete curbs are to be protected with a cold liquid-applied elastomeric membrane. The "Eliminator" waterproofing system as manufactured by Stirling Lloyd Products (203) 230-9448, or an approved equal, shall be used.

3.6.2 Primer

a. Prior to the application of the membrane on steel surfaces, the surface to receive the membrane shall be given one coat of "MR6" primer as manufactured by Stirling Lloyd Products, or an approved equal.

b. Prior to the application of the membrane on concrete surfaces, the surface to receive the membrane shall be given one coat of "PAR1" primer as manufactured by Stirling Lloyd Products, or an approved equal.

3.6.3 Membrane

a. The membrane shall be "Eliminator HM" as manufactured by Stirling Lloyd Products, or an approved equal. Touch-ups in the field shall be performed with "Eliminator HG" as manufactured by Stirling Lloyd Products, or an approved equal.

b. The membrane shall be a 100% reactive spray-applied material

(1) Performance Requirements, Properties:

Property	Requirements	Test Method
Membrane Thickness	Steel - 100 mils (2.5 mm), min. Concrete - 120 mils (3.0 mm), min.	
Percent Reactive	100%	
Water Vapor Transmission Registered method used Desiccant method	6.6 grains/mm^2/24 h	ASTM E 96-93
Minimum Elongation at Break	80%	ASTM D 638-91
Minimum Tensile Strength	930 psi (6.4 MPa)	ASTM D 638-91
Adhesion to Steel	290 psi (2.0 MPa)	ASTM D 4541-89
Adhesion to Concrete	100 psi (0.7 MPa)	ASTM D 4541-89
Crack Bridging	Pass @ 25 cycles 0.0625 inch (1.6 mm) -15° F (-26° C)	ASTM C 836-89
Ballast Impact	No Damage	Test method as described in subparagraph 2.

(2) Ballast Impact Test:

(a) The waterproofing is placed on a deck on which a 23.5 inch (600 mm) diameter metal cylinder is placed. Ballast is put in the interior of the cylinder in direct contact with the membrane.

(b) A metal plate 12 x 12 x 2 inch (300 x 300 x 50 mm) which transmits a movement of 160 mils (4 mm) and a cycle force of 9.2 to 28.1 Kips (41 to 125 kN) corresponding to a 27.5 ton (25 tonne) axle load is placed on the ballast.

(c) The test is carried out for 2 million cycles.

(d) If no damage to the membrane is evident after completion of the test the sample has passed. If there is damage to the membrane after the test, the sample has failed, protective cover shall be installed before ballast is placed.

(3) Certification - Manufacturer shall furnish certification that the material meets specification requirements.

3.6.4 Construction

a. The membrane shall only be applied by approved applicators.

b. Surfaces to be protected with the membrane shall be given one coat of primer prior to the application of the membrane. The primer shall be installed in the fabrication shop. The primer shall be applied to the entire surface to be waterproofed, except for areas within 3 inches of field welds. The primer shall be applied by spray, brush, roller or a method as approved by the manufacturer.

c. The membrane shall be applied when substrate temperatures are in the range of 32° - 104° F (0° - 40° C) providing that the substrate is above the dew point. The condition of the substrate shall meet the manufacturer's recommendations. Material shall be sprayed on horizontal or vertical surfaces up to, around or into details.

d. Surface Preparation:

(1) All concrete surfaces shall be cured for a minimum of seven days and shall be surface dry. Surfaces to be waterproofed shall be clean, smooth, dry and free of oil, grease and loose or foreign material.

(2) The surface preparation shall be performed by means approved by the Project Engineer. The surface profile is not to exceed ¼ inch (6.3 mm) peak to valley. Test method ASTM D 4541 shall be used to verify that the surface preparation meets the required adhesion/pull off values of 100 psi (0.7 MPa) for concrete and 290 psi (2.0 MPa) for steel surfaces.

(3) Steel substrates shall be cleaned to a near white SSPC SP-10 specification or to a condition that exceeds the manufacturer's minimum requirements. Special attention shall be given to welds, bolts, rivets, etc. so that preparation complies with manufacturer's recommendations. Primer is to be applied within 4 hours of preparation.

(4) Other methods of surface preparation recommended by the manufacturer may be used as approved by the Project Engineer.

e. Application Procedures:

(1) Immediately prior to the application of any component of the system, the surface shall be dry. Any remaining dust or loose particles shall be removed using a vacuum or clean, dry, oil-free compressed air.

(2) Where the area to be waterproofed is vertical, the system shall be capable of being sprayed at the specified thickness.

(3) The membrane shall be carefully sprayed around and into drainage fittings to ensure proper runoff of water. Special care shall be taken with the spraying of the system to get full coverage over welds, bolts, etc.

(4) Where the membrane is to be joined to existing cured material the new application shall overlap the existing material by at least 4 inches (100 mm). No preparation shall be

necessary unless the existing materials are dirty or contaminated in which case the overlap area shall be wiped with solvent (e.g. acetone).

(5) The membrane shall be applied in a methodical manner to ensure proper coverage. Wet film thickness shall be checked once every 100 SF (9 m^2).

(6) If required by site conditions, application to small areas, or touch-up the membrane can be applied, by the contractor, by brush or trowel in accordance with manufacture's recommendations.

(7) The membrane shall be fully cured before it is covered. Membrane shall be inspected prior to covering and surface defects or damage shall be repaired in accordance with manufacture's recommendations.

(8) Protective cover in accordance with AREMA Chapter 29, Part 2, Subarticle 2.9.4.1 (c), 2 shall be installed prior to placing ballast if the membrane does not pass the Ballast Impact Test or if recommended by the manufacturer.

(9) Other application procedures may be used as recommended by the manufacturer and approved by the Project Engineer.

3.7 Temporary Run-around Bridge

a. A temporary run-around railroad bridge may be used where temporary track relocation, over a street or stream, is required to construct the permanent structure. The temporary bridge may be open deck with details in accordance with Conrail's Standard Steel Trestle.

3.8 Removal of Abandoned Structures

a. Abandoned abutments, piers and other structures shall be removed to a minimum depth of two feet (0.6 m) below finished ground line.

4.0 FABRICATION OF STRUCTURAL STEEL

4.1 General

a. All structural steel shall be fabricated in accordance with AREMA Chapter 15, unless otherwise modified herein.

b. Steel for flange plates, web plates and stiffeners of welded main load carrying members shall be fully killed fine grain practice and shall satisfy the impact requirements in accordance with Charpy V-Notch (CVN) tests as governed by ASTM A 673 for frequency of testing H, with minimum average energy of 15 ft.-lbs. at 40 degrees Fahrenheit (Zone 2). Flange plates shall be universal mill; if flange plates with flame cut edges are used, they shall be free of nicks and notches and shall have all edges ground to a 1/16 inch (1.6 mm) radius.

c. Flange splice welds are prohibited, except where called for on the contract drawings.

4.2 Quality of Workmanship

a. Structural steel fabricators shall be certified under the AISC Quality Certification Program, Category III, Major Steel Bridges.

b. Structural steel fabricators of Fracture Critical Members shall also meet the additional requirements for Fracture Critical Members as specified in the AREMA, Chapter 15, Part 1, Section 1.14.

c. Evidence of certification shall be submitted to the Chief Engineer for approval before beginning any work.

d. Welding Qualifications

(1) Welds shall be made only by welders, welding operators and track welders who have been previously qualified by tests as prescribed by AWS D1.5 and AWS D1.1 to perform the type of work required. Certification shall be provided by the fabricator for each welder, welding operator and track welder involved that shows that each has been thus qualified within the previous 12 months.

(2) The AWS D1.5 shall be used for all requirements not specifically covered herein.

(3) Welding of Fracture Critical Members shall be in accordance with the requirements of AREMA Chapter 15, Part 1, Section 1.14.

4.3 Welding Processes and Requirements

a. All welds connecting flange plate to web plate shall be made by automatic submerged arc welding. Mill scale shall be removed from flange plates at web to flange weld. Fifty percent of web to flange weld shall be subject to ultrasonic testing in accordance with AWS Structural Welding Code.

b. All splice welds in flange plates and webs are to be 100% radiographed.

c. Transverse tack welds must not be used on tension flange plates.

d. All grinding shall be done in the direction of applied stresses. Undercutting by grinding is prohibited.

e. The bottom flange plate of welded plate girders must be perpendicular to the web plate at the bearings. The maximum tolerance is 0.03 inch (0.76 mm).

4.4 Shop Drawings

a. The shop drawings shall be submitted to the Project Engineer for approval. It is the responsibility of the Project Engineer to review the drawings to ensure they comply with the Contract Drawings & Specifications. Shop drawings which do not comply with the Contract Drawings & Specifications shall not be submitted to Conrail for review.

b. If the fabricator requests a change to the Contract Drawings & Specifications, he shall submit a drawing or written request, indicating the change, to the Project Engineer. The Project Engineer shall review the change and, if acceptable, stamp the submission "Approved" and forward to Conrail for review. Change requests, which the Project Engineer determines as unacceptable, shall be returned to the fabricator.

c. Change requests, approved by the Project Engineer and forwarded to Conrail, will be reviewed and, if acceptable, stamped "Approved". Change requests which are not acceptable will be stamped "Returned For Correction" or denied with an explanation provided. Conrail will return all change requests to the Project Engineer for handling with the fabricator.

d. One complete set of the final approved shop drawings, in pdf format, shall be included with the "As-Built Drawings" (see Section 1.5 a.).

4.5 Inspection

a. All fabricated steel shall be inspected and tested by Conrail's Quality Control before it is painted and shipped.

b. Mill inspection of structural steel shall comply with the requirements of the applicable ASTM Specifications. Mill inspection of structural steel will be waived provided the fabricator furnishes certified copies of the mill's report on the physical properties of the steel used.

4.6 Painting Metal Structures

4.6.1 General Requirements

a. All painting work shall be performed in accordance with the Steel Structures Painting Council (SSPC) Painting Manual, latest edition.

b. Surfaces of the steel deck plates and side plates, which are to be coated with the "Eliminator" waterproofing system (see Section 3.7), shall not be shop or field painted.

4.6.2 Atmospheric Conditions

a. Coatings shall be applied during good painting weather. Air and surface temperatures shall be within limits prescribed by the manufacturer for the coating being applied and work areas shall be reasonably free of airborne dust at the time of application and while the coating is drying.

b. Do not apply paint in rain, fog or mist, or when the relative humidity exceeds 85%, or to damp or wet surfaces, unless otherwise permitted by the paint manufacturer's printed instructions.

4.6.3 Surface Preparation and Painting

a. All steel surfaces, which are to be painted, shall be thoroughly cleaned as per NACE No. 2 / SSPC - SP 10 and shop painted with one (1) coatof Carbo Zinc 11 HS self curing, inorganic zinc primer, one (1) intermediate coat of Carboguard No. 893 and one (1) finish coat of Carbothane No. 133 LV as manufactured by the Carboline Company, 350 Hanley Industrial Court, St. Louis, MO 63144-1000, (314) 644-1000, or an approved equal.

b. The finish coat color, used to paint weathering steel, shall be Corten Brown (Color Number 2248) to match the color of the weathering steel. The finish coat color, used to paint non-weathering steel, shall be in accordance with the State DOT requirements.

c. The mil thickness of the primer and finish coat shall conform to the paint manufacturer's requirements.

d. No paint is to be applied within 3 inches (89 mm) of areas to be field welded. The intermediate and finish coats shall not be applied within 2 inches (57 mm) of any open holes.

4.7 Assembly

a. To insure proper field fit, all spans shall be completely shop assembled. They shall be shipped assembled, or match marked and disassembled for shipping, as indicated on the drawings.

APPENDIX

TEST BORING LOG

PROJECT

LOCATION

DATE STARTED DATE COMPLETED

HOLE NO.

SURFACE EL.

JOB NO.

GROUND WATER DEPTH WHILE DRILLING"

BEFORE CASING REMOVED

AFTER CASING REMOVED

N - NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" - ASTM D-1586, STANDARD PENETRATION TEST

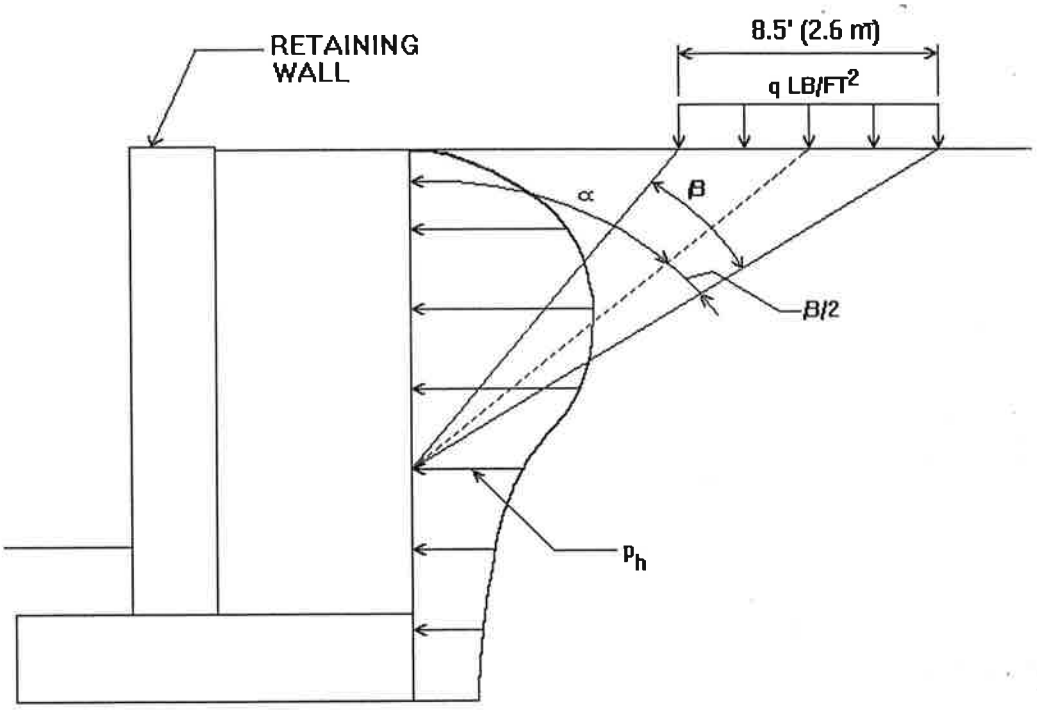
C - NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR - % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 1 OF 1

DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
	0.0'-	1		6/14		Brown moist medium dense fine to	
	2.0			14/19	28	coarse SAND and fine to medium	
	2.0'-	2		9/15		GRAVEL, little silt	
	4.0'			15/23	30		
5.0	4.0'-	3		17/18			
	6.0'			11/21	29		6.0'
	6.0'-	4		9/6		Brown moist stiff SILT	
	8.0'			5/7	11		
	8.0'-	5		10/12			8.5'
10.0	10.0'			11/11	23	Brown moist very stiff SILT, little	
	10.0'-	6		12/11		fine to course sand, little fine gravel	
	11.3'			50 -.3'			
							12.5'
						Gray dry hard silty weathered SHALE	
15.0						Top of Rock	15.0'
	15.0'-	R-1	Rec	BX Core		Gray weathered steeply bedded SHALE	
	20.0'		46"	77%			
20.0							
						Bottom of Boring	20.0'

Lateral Pressure Diagram



ELEVATION

$$p_h = (2q/\pi)(\beta - \sin\beta(\cos 2\alpha))$$

p_h = Pressure at any given point
q = Strip load surcharge
α = Angle in degrees
β = Angle in radians

Lateral Pressure Due To Strip Load