.3 Longitudinal beams, or deck plate girders where four (4) or more girders are used per track, shall have diaphragms at the ends and intermediate points. To obtain lateral distribution of the load on spans with ballast floors, the intermediate diaphragms shall be placed not more than 8 ft (2.44 m) apart. The diaphragms shall be as deep as the depth of the beam will permit, and be rigidly connected to the web of the beam or girder. If it is so required for adequate transverse load distribution, double angle connections shall be used.

.4 At all end diaphragms; special connection details or access holes must be provided due to space constraints from the backwall.

10. TRACTION BRACING

.1 For bridges with transverse floor beam systems such as TPG, TT or DT; provide traction bracing to transfer the longitudinal forces to the main girders or trusses.

.2 For spans exceeding 50 ft (15.25 m), the traction bracing shall preferably be located at both ends of the bridge span but final location shall be determined by the configuration and type of the steel spans.
For spans shorter than 50 ft (15.25 m), traction bracing shall be installed only at the fixed end of the span.

.3 Traction bracings shall be sized to be the same depth or as close as possible to the member being braced.

.4 The load transfer path for the longitudinal forces shall be determined, and analysis shall be carried out to determine the percentage of the load sharing to the other members of the floor system.

.5 Allowable stresses for members designed for longitudinal forces are permitted to be increased by 25 %.

CHAPTER 15 - PART 8

11. WALKWAYS AND HANDRAILS ON BRIDGES – LOADS (Article 8.5.3.2)

Walkways and inspection catwalks shall be designed to support a uniformly distributed live load of not less than 100 lb per sq. ft (4.8 KN / m^2)

---------- END OF DESIGN GUIDELINES FOR STEEL BRIDGES----------

FABRICATION GUIDELINES FOR STEEL BRIDGES

PART 2B

REVISION JANUARY 2006

OFFICE OF CHIEF ENGINEER
CANADIAN NATIONAL RAILWAY
Edmonton, Alberta

PART 2B - FABRICATION GUIDELINES FOR STEEL BRIDGES

PURPOSE AND SCOPE

These guidelines modify and supplement the applicable sections of the American Railway Engineering and Maintenance Association Manual for Railway Engineering recommendations for Steel Structures, Chapter 15, Part 3 and shall apply to all work pertaining to the fabrication of steel railway bridges.

CHAPTER 15 - PART 3

1. SHOP DRAWINGS (General)

.1 The Fabricator's attention is called to the requirements for shop drawings, Chapter 15, Article 1.1.3 Shop Drawings, AREMA Manual. Standard size of drawings is 24 in x 36 in (610 mm x 915 mm).

.2 The Fabricator shall furnish three (3) complete sets of detailed shop drawings or as called for in the tender documents; to the Railway for approval prior to starting fabrication. Unchecked drawings shall not be submitted for approval. After approval of shop drawings, the Fabricator shall supply the Railway with three (3) additional sets of the shop drawings or as called for in the tender documents.

.3 The rejection of or the procedure for the correction of shop drawings will not be considered as cause for delay.

.4 As-built shop drawings shall be furnished to the Railway at the completion of the contract in electronic format AUTOCAD "DWG" and ADOBE ACROBAT "PDF", to the attention of:-

Canadian National Railway
Head Office
Senior Engineer
10004 – 104th Avenue
Edmonton, Alberta
T5J 0K2
(See Appendix B for details)

.5 Correctness of shop drawings irrespective of any review and approval by the Engineer shall be the responsibility of the Fabricator.

2. MATERIALS (General)

.1 Mill test reports will be required for all steel plates and rolled sections supplied by the Fabricator.

.2 Bolts, nuts and washers shall meet the current requirements of ASTM for high strength bolts. Bolts designated A325 will be used except when noted otherwise on plans. All bolts, nuts and washers will be supplied from a single source with documentation of their source and quality certification.

.3 All high strength connection bolts and nuts may be used only once and then discarded and replaced with new.

3. GENERAL (Section 3.1)

.1 DIMENSIONAL TOLERANCES FOR STRUCTURAL MEMBERS (Article 3.1.7)

.1 Deck Spans
The top flanges of all beams and girders supporting a steel plate or timber deck shall not vary more than 1/8 in (3 mm) from a straight edge placed at any line across two adjacent beams, and not more than ¼ in (6 mm) across all beams.

.2 Through Plate Girder Spans
The top flanges of all transverse floor beams supporting a steel plate or timber deck shall be in the same plane.

.2 FIT OF STIFFENERS (Article 3.1.10)

.1 Bearing Stiffeners
Top and bottom ends shall be welded to the outstanding portion of the flanges with full penetration, double bevel groove weld.

.2 Intermediate Stiffeners
Top ends shall be welded with fillet weld while the bottom shall be milled to bear.

4. RIVETED AND BOLTED CONSTRUCTION - PREPARATION OF HOLES FOR FASTENERS (Article 3.2.6 and 3.2.7)

.1 Deck Spans

.1 The beams or girders in each shop-assembled set shall be assembled with the top of the top flanges of adjacent beams in a true horizontal plane to ensure that all floor plates will fit properly. Holes for the diaphragm connections shall be match-marked and drilled.

.2 Holes for field-connections of diaphragms and walkway brackets shall be reamed to size while adjacent girder sets are shop-assembled in a true horizontal plane as specified for shop-connected diaphragms, and the field connections match-marked.

.2 Through Plate Girder Spans

.1 Holes for field connections of floorbeams, floorbeam brackets, and members to which they connect shall be subpunched or subdrilled and reamed to size with parts assembled or drilled full size from the solid while assembled as required by Article 3.2.6 of the AREMA Manual.

.2 Floorbeams and connection angles shall be assembled in suitable frames and holes match-marked prior to drilling so that the connection angles will be square with the beam and true to dimensions.

5. WELDED CONSTRUCTION (Section 3.3)

.1 GENERAL (Article 3.3.1)

.1 All welding must be done with shielded metal-arc or submerged arc processes. All flange-to-web "T-Joint" welds and shop welded splices in flanges or webs shall be by approved continuous automatic feed and travel submerged arc weld. Electro-slag, electro-gas and gas metal-arc processes will not be permitted.

.2 Preheating is required prior to flame cutting or welding:

Material thickness	Temperature
>1 ½ in (40 mm) to 2 3/8 in (60 mm)	150^0 F (65^0 C)
> 2 3/8 in (60 mm)	225^0 F (107^0 C)

.2 Welding Procedures

.1 Welding procedures shall be submitted for the Engineer's review and approval before commencing any fabrication work.

.2 Welding procedures shall be prepared in accordance with the applicable requirements of CSA Standard W59-1989, Section 5 of the current Welded Steel Construction AWS D1.5 and AREMA Manual except as modified herein.

.3 Welding procedures shall indicate the following information:-

.1 joint preparation
.2 fit-up
.3 electrode specification and diameter
.4 welding position
.5 flux, polarity and amperage
.6 number of passes
.7 preheat interpass temperatures
.8 sequence of welding, any procedure changes from one pass to the next in the same weld
.9 maximum thickness in weldment layer

These requirements apply to each type of weld, pre-qualified or other.

.4 Welding procedures for joining FCMs which are not pre-qualified shall be qualified by test as outlined in Section 12 of the current AWS D1.5 and Section 5 of CSA Standard W59-1989.

6. INSPECTION (Section 3.5)

.1 The Railway shall engage an independent inspection consultant to carry out shop inspection of the fabrication including non-destructive testing of the welds such as radiographic, ultrasonic or magnetic particle tests and any other tests deem necessary to complete the inspection. This will be in addition to the Fabricator's Quality Assurance Program.

.2 The Fabricator shall submit detailed fabrication schedule in increments of not more than one week. The detailed schedule shall be in clear, concise, bar charts form and shall clearly indicate the fabrication periods and sequences of operations of each item of work in sufficient detail so that the Engineer or the appointed inspector can determine the feasibility of the work schedule and monitor the progress of the work.
Interim reviews of work progress based on the schedule submitted by the Fabricator shall be conducted every 2 weeks by the Fabricator or at closer interval when requested by the Engineer.

.3 The Fabricator shall give two weeks notice to the Engineer at the beginning of work in the shops so inspection may be provided. No work in the shop shall be done until the Engineer has been notified.

.4 The following inspections shall be carried out:-

.1 Geometric Control
- i) Plate and Shape Sizes
- ii) Dimensions
- iii) Alignment
- iv) Tolerances

.2 Quality of Welds
- i) Visual Examination - 100% of all welds
- ii) Radiograph Test Method - 100% of butt joint groove welds at flange and web splices. For bottom flanges, test to be carried out after heat treatment.
- iii) Ultrasonic Test Method - 100% at flange to bearing stiffeners butt groove weld, 100% of flange to web plate butt groove weld of FCM members, 100% in the tension zone and 10% in the compression zone of flanges and web splices of non-FCM members butt groove welds.
- iv) Magnetic Particle Test Method – 100% of fillet welds for main members and 50% of fillet welds for secondary members.

3. High Strength Bolts
- i) Turn of the nut method or by torque wrench - 100% sampling of installed bolts (site installed bolts are not included)

.4 Surface Finishes
- i) Cleaning
- ii) Galvanizing
- iii) Metalizing

.5 All joints to be radiograph inspected shall be ground flush on both sides, and shall be free of paint, scale and grease. The direction of grinding shall be perpendicular to the length of the weld.

STEEL FABRICATION (Cont'd)

.6 Welds requiring repairs shall be retested after repairs are made, and the cost for retesting shall be the Fabricator's expense.

---------- END OF STEEL FABRICATION FOR STEEL BRIDGES----------

DESIGN GUIDELINES FOR CONCRETE BRIDGES

PART 3

REVISION JANUARY 2006

OFFICE OF CHIEF ENGINEER
CANADIAN NATIONAL RAILWAY
Edmonton, Alberta

PART 3 - DESIGN GUIDELINES FOR CONCRETE BRIDGES

PURPOSE AND SCOPE

These guidelines modify and supplement the applicable sections of the American Railway Engineering and Maintenance Association Manual for Railway Engineering recommendations for Concrete Structures and Foundations Chapter 8, Part 1, 2, 3, 4, 5, 16, 20 and 28.

CHAPTER 8 - PART 1

1. GENERAL

.1 TYPE OF SUPERSTRUCTURES

The recommended types of superstructures are:

.1 Precast normally reinforced and prestressed concrete simple spans.

.2 Cast-in-place, conventionally reinforced rigid frames.

.2 CLEARANCES

In general, new construction in Canada and US, the bridge span layout shall meet AREMA Clearance Diagram (see Drg. K1U-10.1 in Appendix A) with the exception of bridges in the State of Wisconsin where the minimum vertical clearance is 24 ft (7.315 m).

For retrofit construction or branchline locations, a reduction in clearances may be allowed only with the written approval of the Senior Engineer.

.3 SHOP DRAWINGS

.1 Standard size of drawings is 24 in x 36 in (610 mm x 915 mm).

.2 The Fabricator shall furnish three (3) complete sets of detailed shop drawings or as called for in the tender documents; to the Railway for approval prior to starting fabrication. Unchecked drawings shall not be submitted for approval. After approval of shop drawings, the Fabricator shall supply the Railway with three (3) additional sets of the shop drawings or as called for in the tender documents.

.3 The rejection of or the procedure for the correction of shop drawings will not be considered as cause for delay.

.4 As-built shop drawings shall be furnished to the Railway at the completion of the contract in electronic format AUTOCAD "DWG" and ADOBE ACROBAT "PDF", to the attention of:-

Canadian National Railway
Head Office
Senior Engineer
10004 – 104th Avenue
Edmonton, Alberta
T5J 0K2
(See Appendix B for details)

.5 Correctness of shop drawings irrespective of any review and approval by the Engineer shall be the responsibility of the Fabricator.

2. CEMENT – SPECIFICATIONS (Article 1.2.2)

.1 The cement used in the concrete for all grade separations shall be low alkali cement. The Contractor shall obtain and furnish to CN, a statement signed by an officer or chemist of the cement manufacturer, certifying that the cement furnished does not exceed 0.6 percent alkali equivalent, as measured by the percent of sodium oxide plus 0.658 times the percent of potassium oxide.

.2 If the above cement type is proven to be unavailable, alternative cement proposed must be tested for alkali aggregate reactivity utilizing mortar bar accelerated expansion test or other acceptable tests. The concrete to be tested shall be based on the proposed design concrete mix and source of aggregates, which is project specific. The Senior Engineer must approve the acceptance of the cement.

3. AGGREGATES - NORMAL WEIGHT COARSE AGGREGATE (Article 1.3.3)

Delete all references to blast furnace slag coarse aggregate. Blast furnace slag coarse aggregate will not be allowed.

4. REINFORCEMENT - WELDING (Article 1.5.2)

Delete all references to welding of reinforcing bars. Rebar welding is not allowed.

5. DETAILS OF REINFORCEMENT - PLACING OF REINFORCEMENT – GENERAL (Article 1.9.4.1)

The use of epoxy coated reinforcing steel must be approved by the Senior Engineer and shall be limited to structures that are subject to attack by de-icing chemicals or other aggressive agents. Epoxy coated reinforcing steel shall be fabricated by a fabricator approved by the CRSI Voluntary Certification Program. The Engineer shall be responsible to ensure that all precautions indicated in the specifications concerning fabrication, handling, storage, installation and pouring be tightly adhered to.

6. PROPORTIONING – FIELD TESTS (Article 1.11.9)

.1 Modify paragraph (b) to require a minimum of four (4) cylinders be made for each 50 cubic yards (38 cubic metres) or portion thereof for each class of concrete per day.

.2 Modify paragraph (d) to require that air content be checked at least twice for each 50 cubic yards (38 cubic metres) or portion thereof for each class of concrete for each day.

CONCRETE DESIGN (Cont'd)

.3 A minimum of 2 determinations for slump shall be made for each 50 cubic yards (38 cubic metres) or portion thereof for each class of concrete per day.

7. DEPOSITING CONCRETE (Section 1.13)

Chutes, pipelines or baffles made of aluminium or aluminium alloy components shall not be used.

8. CURING – GENERAL (Article 1.17.1)

.1 Concrete shall be protected from freezing, abnormally high temperatures, premature drying and moisture loss.

.2 All concrete surfaces shall be moist cured for a minimum of 7 consecutive days at a minimum of 50 deg. F (10 deg. C) or for the time necessary to attain 70% of the specified 28 day compressive strength.

.3 The use of curing compounds will not be permitted unless approved by the Senior Engineer.

CHAPTER 8 – PART 2

9. NOTATIONS, DEFINITIONS AND DESIGN LOADS (Section 2.2)

.1 DEAD LOADS (Article 2.2.3.b.1)

The dead load on ballast bridges shall be minimum 16 in (405 mm) of ballast to top of tie plus 12 in (305 mm) of ballast for future track surfacing. For track on a curve, the minimum ballast to the top of tie shall be 16 in (405 mm) at the low end of the crossties.

.2 LIVE LOADS (Article 2.2.3.c)

.1 Article 2.2.3.c.1
Bridge spans to be designed to Cooper E90 loading.

.2 Article 2.2.3.c.3
Revise this Article to read as follows:
Live load from a single track acting on the top surface of a structure with ballasted deck or under fills shall be assumed to have uniform lateral distribution over a width equal to the length of track tie plus the depth of ballast and fill below the bottom of the tie, plus twice the effective depth of slab; limited, however, by the extent of the structure.

.3 IMPACT LOAD (Article 2.2.3.d.2)
The formula for Impact Load shall be:-
.1 For span length < 14 ft
$I = 60\%$

.2 For span length 14 ft < L < 127 ft

$$I = \frac{225}{\sqrt{S}}$$

.3 For span length > 127 ft

$$I = 20\%$$

where I = % increase of live load for impact
S = Span length (ft)

.4 Impact shall not be used where the live load is allowed to dissipate either by soil or massive concrete. This is usually the case for earth retaining structures such as abutments, retaining wall, shoring walls, shallow foundations and pile foundations with massive cap.

10. MATERIALS – CONCRETE (Article 2.3.1)

.1 Minimum 28 days concrete strength of members shall be as follows:

.1	Precast prestressed elements	7000 psi (50 MPa)
.2	Normally reinforced concrete deck and substructures	5000 psi (35 MPa)
.3	Normally reinforced precast or other minor concrete elements	5000 psi (35 MPa)
.4	Post-tensioned deck	5800 psi (40 Mpa)
.5	Post-tensioned element	7000 psi (50 Mpa)

.2 Minimum 24 hours concrete strength at release for prestressed concrete members shall be 5000 psi (35 MPa)

11. MATERIALS – REINFORCEMENT (Article 2.3.2)

Delete all references to welding of reinforcement bars. Rebar welding is not allowed.

12. CONCRETE PROTECTION FOR REINFORCEMENT – MINIMUM CONCRETE COVER (Article 2.6.1)

.1 Delete this Article and substitute the following table:

Exposure Conditions	**Min. Cover**
Concrete cast against and permanently exposed to earth	3 in (75 mm)
Concrete not submerged or exposed to earth or de-icing chemicals: • Principle reinforcing bars • Stirrups elsewhere, ties and spirals	 2 in (50 mm) 2 in (50 mm)
Concrete submerged or exposed to earth in non-aggressive environments: • Principle reinforcing bars • Stirrups elsewhere, ties and spirals	 2 in (50 mm) 2 in (50 mm)
Concrete subjected to de-icing chemicals or other aggressive environments: • Principle reinforcing bars • Stirrups elsewhere, ties and spirals	 2 ½ in (65 mm) 2 ½ in (65 mm)
Soffit of slabs over roadways • Principle reinforcing bars	 2 in (50 mm)

.2 If the above cover cannot practically be attained, they may be reduced as necessary, subject to the approval of the Senior Engineer, but in no case shall the cover be less than 2 in (50 mm) for normal reinforced concrete or 1½ in (40 mm) for precast prestressed concrete members.

13. SHRINKAGE AND TEMPERATURE REINFORCEMENT (Section 2.12)

In the last line, change "18 inches" (455 mm) to "12 inches" (305 mm).

14. SPLICES OF REINFORCEMENT – WELDED SPLICES AND MECHANICAL CONNECTIONS (Section 2.22.2)

Delete all references to welding of reinforcement bars. Rebar welding is not allowed.

CONCRETE DESIGN (Cont'd)

15. ALLOWABLE SERVICE LOAD STRESSES – CONCRETE (Article 2.26.1.c)

Delete the last line and substitute the following:
Minimum edge distance on concrete shall be as follows:

- Steel plates continuous under two or more rolled beams 6 in (150 mm)
- Slab type shoes 9 in (230 mm)
- Shoes for truss spans and spans longer than 100 ft (30.5 m) 12 in (305 mm)

CHAPTER 8 – PART 3

16. FIELD CONDITIONS – REINFORCEMENT (Article 3.7.2)

If the concrete is placed against a seal coat or against steel sheeting that is to remain in place, the cover shall not be less than 2-1/2 in (65 mm).

CHAPTER 8 – PART 4

17. ALLOWABLE LOAD ON PILES – PILE LENGTH DETERMINATION (Section 4.3.5)

Add the following:
Piles supporting concrete foundation caps, pier caps or abutments shall have their tops embedded at least 12 in (305 mm) into the concrete.

18. ALLOWABLE LOAD ON PILES – PILE DRIVING FORMULAS (Article 4.3.5.4)

Add the following:
One of the following criteria must be satisfied for piles to be driven to practical refusal:

.1 With Pile Dynamics Test
Pile shall be driven to a minimum allowable load capacity 50% greater than the design loading. The required blow counts for the 150% of design loading shall be verified by pile dynamics test.

.2 Without Pile Dynamics Test
Pile shall be driven to a minimum allowable load capacity 100% greater than the design loading. The required blow counts for the 200% of design loading shall be determined by the Geotechnical Engineer.

CHAPTER 8 – PART 5

19. COMPUTATION OF APPLIED FORCES – LOADS EXCLUSIVE OF EARTH PRESSURE (Article 5.3.1.b)

.1 Delete this Article and substitute the following:
In calculating the surcharge due to track loading, the entire live load shall be assumed to be uniformly distributed as follows:

- Longitudinal - A length of 3 ft (915 mm) plus the depth of ballast and fill under the tie; limited, however, by the axle spacing.

- Lateral - For load from a single track, and for structures at which the nature of the structure does not provide for practical extension of future tracks, the lateral distribution may be made over a width equal to the length of tie plus the depth of ballast and fill under the tie down to the elevation of the section under investigation; limited, however, by the extent of the structure. The lateral distribution of load from multiple tracks shall be as specified for single tracks and further limited so as not to exceed the distance between centers of adjacent tracks. At abutments, the above distribution shall be limited to the abutment shaft only.

  In no case shall the resulting surcharge be less than 600 lbs. per sq. ft (28.73 KN/m^2).

  For retaining walls where a track runs approximately parallel to the back of the wall, the surcharge as calculated by the above distribution shall be considered to act only below a point of intersection of the back of the wall and a line sloping 1 vertical to 2 horizontal downward from the ends of the ties.

.2 Active pressure coefficients shall be used for the design of abutments and other permanent earth retaining structures unless its stiffness prevents the mobilization of active pressure. Active pressure coefficient is to be determined by the Geotechnical Engineer but shall not be less than 0.33.

20. DETAILS OF DESIGN AND CONSTRUCTION FOR ABUTMENTS AND RETAINING WALLS – GENERAL Article (5.7.1.b)

Revise this Article to read as follows:
The width of the stem of a semi-gravity wall at the level of the top of the footing shall be at least one-fourth of its height for wingwalls and retaining walls, and three-tenths of its height to base of rail for abutments.

CHAPTER 8 – PART 16

21. DESIGN AND CONSTRUCTION OF REINFORCED CONCRETE BOX CULVERTS

The dry cast method will not be allowed. All precast concrete box culverts shall be air-entrained and wet cast.

CHAPTER 8 – PART 28

22. TEMPORARY STRUCTURES FOR CONSTRUCTION – DESIGN OF SHORING SYSTEMS (Section 28.5)

.1 Active pressure coefficients can be used for the design of shoring unless its stiffness prevents the mobilization of active pressure. Active pressure coefficient is to be determined by the Geotechnical Engineer but shall not be less than 0.33.

.2 All excavations deeper than 5 ft (1.525 m) must be tied-back with soil or deadman anchors. The use of struts or rakers will not be permitted unless approved by Railway.

.3 Timber lagging must be designed, taking into consideration soil and water conditions as well as train surcharge using the Theory of Elastic Analysis. Design calculations are to be included in design notes.

.4 If there is risk of groundwater building up behind a lagged wall, or of washing in of soil particles, gaps should be left between the boards to allow drainage, and these should be packed with straw or synthetic filter material to prevent loss of soil.

CHAPTER 8 – PART 20 AND 25

23. FLEXIBLE SHEET PILE BULKHEADS
SLURRY WALL CONSTRUCTION

Permanent flexible sheet pile walls and permanent slurry walls subjected to railroad surcharge will not be allowed without written approval of the Senior Engineer.

----------END OF DESIGN GUIDELINES FOR CONCRETE STRUCTURES----------

DESIGN GUIDELINES FOR BEARINGS

PART 4

REVISION JANUARY 2006

OFFICE OF CHIEF ENGINEER
CANADIAN NATIONAL RAILWAY
Edmonton, Alberta

PART 4 - DESIGN GUIDELINES FOR BEARINGS

PURPOSE AND SCOPE

These guidelines modify and supplement the applicable sections of the American Railway Engineering and Maintenance Association Manual for Railway Engineering recommendations for Bridge Bearings Chapter 19, Part 1.

CHAPTER 19 – PART 1

1. GENERAL REQUIREMENTS (Article 1.1.2)

.1 Elastomeric Bearing Pads
Minimum thickness shall not be less than ½ in (13 mm).

.2 Bearing Levelling Pads
Minimum thickness shall not be less than ¼ in (6 mm).
Levelling pads shall be laminated fabric rubber such as Fabreeka, Sorbtex or equivalent.

2. BEARING SELECTION CRITERIA (Article 1.1.5)

Add the following clauses:

.1 For steel spans
The preferred bearing types are as follows:
- .1 Bridge spans of length < 30 ft (9.15 metres)
  - Sliding Plates Bearing
  - Elastomeric Bearing
- .2 Bridge spans of length 30 ft (9.15 m) < L < 55 ft (16.75 m)
  - Elastomeric Bearing
- .3 Bridge spans of length > 55 ft (16.75 m)
  - Spherical Bronze Alloy (TPGs, DPGs and skew spans)
  - Radial Bronze Alloy (DPGs)

.2 For concrete spans
The preferred bearings types are as follows:-
- .1 Bridge spans of length < = 28 ft (8.5 m)
  - 3/8 in (10 mm) thick Rubber, Fabreeka or Sortex pads
- .1 Bridge spans of length >28 ft (8.5 m) to < 48 ft (14.6 m)
  - Elastomeric bearings (strip)
- .2 Bridge spans of length > 48 ft (14.6 m)
  - To be approved by CN

.3 For details of bearings, see Appendix A - Standard Drawings S15, S16 and S17 for steel spans and C9 for concrete spans.

BEARING DESIGN (Cont'd)

3. BASIC ALLOWABLE STRESSES – BRONZE OR COPPER ALLOY PLATES (Article 1.2.3)

   Allowable bearing pressure on bronze bearing plates shall be limited to 1,600 psi (11.0 MPa) on the net area and 2,000 psi (13.8 MPa) on the gross area; except for UNS C86300 grade whereby the allowable bearing pressure is 3,000 psi (20.7 MPa).

4. STEEL BEARING COMPONENTS – ANCHOR BOLTS AND RODS (Article 1.3.7)

   Add the following clauses:-

   .1 Anchor bolts shall meet the requirements of ASTM F1554, hot dip galvanized or shall be corrosion resistant, low alloy structural steel, conforming to the requirements of ASTM Specification A588 or ASTM A276, Type 410, annealed.

   .2 Anchor bolts shall be grouted with fast setting, low shrinkage grout such as SIKA 212 or equivalent.

----------END OF DESIGN GUIDELINES FOR BEARINGS----------

WATERPROOFING GUIDELINES FOR RAILWAY BRIDGES

PART 5

REVISION JANUARY 2006

OFFICE OF CHIEF ENGINEER
CANADIAN NATIONAL RAILWAY
Edmonton, Alberta

PART 5 - WATERPROOFING GUIDELINES FOR RAILWAY BRIDGES

PURPOSE AND SCOPE

These guidelines modify and supplement the applicable sections of the American Railway Engineering and Maintenance Association Manual for Railway Engineering recommendations for Waterproofing Chapter 29, Part 1 and 2.

CHAPTER 29 – PART 1

1. GENERAL (Section 1.1)

.1 All steel and concrete decks, except for concrete decks located at bridge sites where the climate is mild with infrequent freeze thaw cycles (generally areas south of Ohio River); shall be waterproofed.

.2 Unless otherwise approved in writing by the Senior Engineer, the waterproofing membrane shall be as follows:

.1 Precast and Cast-In-Place Concrete Deck

- one layer of 0.09 in (2.3 mm) thick butyl rubber, secured with an approved adhesive.
- 0.16 in (4 mm) thick, SBS modified bitumen membrane reinforced with non-woven polyester mesh. Approved systems are:-
  - .1 Torchflex TP-250-FF as manufactured by IKO Industries
  - .2 Sopralene Flame 250 as manufactured by Soprema.
- Seamless spray applied system
  - .1 two–component elastomer membrane such as bridge deck membrane as manufactured by Bridge Preservation.
  - .2 two–component methyl methacrylate resin membrane as manufactured by Stirling Lloyd.

.2 Steel Deck

- one layer of 0.09 in (2.3 mm) thick butyl rubber, secured with an approved adhesive.
- Seamless spray applied system
  - .1 two–component elastomer membrane such as bridge deck membrane as manufactured by Bridge Preservation.
  - .2 two–component methyl methacrylate resin membrane as manufactured by Stirling Lloyd.

WATERPROOFING (Con'd)

.3 General Requirements

- All waterproofing system should be applied in accordance to the manufacturers' specification.
- Surface preparation of members to be waterproofed shall be carried out in accordance to the waterproofing manufacturers' requirement.
- Steel deck to be waterproofed shall be detailed with countersunk bolt connections.

.3 All deck or bridge joints shall be sealed against egress of water dripping onto bridge seats or roadways below.

CHAPTER 29 – PART 2

2. MEMBRANE PROTECTION – ASPHALTIC PANELS (Article 2.4.3)

Asphaltic panels of minimum thickness 3/8 in (10 mm) laid in two layers with staggered joints shall be used for membrane protection. Alternates must be submitted to the Railway for review, and must be approved in writing by the Senior Engineer.

----------END OF WATERPROOFING GUIDELINES FOR RAILWAY BRIDGES---------

APPENDIX A

STANDARD DRAWINGS
REVISION JANUARY 2006

OFFICE OF CHIEF ENGINEER
CANADIAN NATIONAL RAILWAY
Edmonton, Alberta

APPENDIX A
STANDARD DRAWINGS – IMPERIAL

Dwg. No.	Rev.	Description
C1i	A	Cast-in-place Concrete Bridge Deck Details
C2i	A	Cast-in-place Concrete Bridge Deck Details
C3i	A	Cast-in-place Concrete Bridge Deck Waterproofing Details
C4i	-	Cast-in-place Concrete Bridge Approach Slab (DPG Span)
C5i	-	Cast-in-place Concrete Bridge Approach Slab (TPG Span)
C6i	A	Refuge Bays
C7i	B	Standard Bar List and Bar Shapes
C9i	B	Bronze Bearings - Example of Expansion Bearings for a Concrete Span Bridge
C10i	A	Concrete Slab - Joint Details
C11i	-	Protection Board & Waterproofing Details At Joints Between Slabs
C12i	-	Protection Board & Waterproofing Details At Joints Between DVBs
F1i	A	Example of Typical Temporary Shoring Wall
F2i	B	Typical Tied-Back Wall Details Shoring Wall
F3i	A	Typical Tied Back Wall Notes
K1U-10.1i	C	AREMA Standard Clearance Diagram for All New Railway Bridges
K1U-10.2i	-	Protection and Minimum Clearances for Overhead Bridges
K1U-10.3i	-	Protection Wall Requirements for Reinforced Earth (or Equiv.) Walls for Overhead Bridges
K1U-10.4i	-	Clearance Diagram Requirements for Prefabricated Tunnels
S1i	B	Submerged Arc Welded Joints for Flanges, Webs, Stiffeners and Gusset Plates
S2i	A	Stiffeners
S3i	C	Anchor bolt
S4i	-	Floor Beam Connections
S5i	-	Stringer to Floor Beam Connection Open Deck Only
S6i	-	Beam Copes
S7i	-	Lateral Bracing for DPG Spans
S8i	A	Attachment of Deck Plate by Bolting in Shop or Field
S9i	-	Type H-3 Saddle Clip for 38-H-4 Heavy Duty Grating
S10i	A	Attachment of Deck Plate by Bolting in Shop or Field (for square spans 12M & over and all Skewed Spans)
S12i	A	HP12 & 14 Pile Splice
S13i	-	Tubular Pile Splice
S14i	A	Pile Splice Detail For Driving Through Template
S15i	B	Standard Bearings for DPG & TPG Steel Spans (Sheet 1)
S16i	A	Standard Bearings for DPG & TPG Steel Spans (Sheet 2)
S17i	A	Steel Trestle - Bearings

STANDARD DRAWINGS - IMPERIAL (cont'd)

Dwg. No.	Rev.	Description
S18i	A	Typical Notes for Steel Spans
S19i	A	Template for Pile Driving
S20i	-	Metallizing Area for Beam Spans, D.P.G. & T.P.G. Spans
R1S-1i	A	Instruction for Dating Concrete Structures
TD-05-L-1i	C	Location for Bridge Name Plate

APPENDIX A
STANDARD DRAWINGS – METRIC

Dwg. No.	Rev.	Description
C1m	A	Cast-In-Place Concrete Bridge Deck Details
C2m	A	Cast-In-Place Concrete Bridge Deck Details
C3m	-	Cast-In-Place Concrete Bridge Deck Waterproofing Details
C4m	A	Cast-In-Place Concrete Bridge Approach Slab (DPG Span)
C5m	A	Cast-In-Place Concrete Bridge Approach Slab (TPG Span)
C6m	A	Refuge Bays
C7m	B	Standard Bar List and Bar Shapes
C9m	B	Bronze Bearings - Example of an Expansion Bearings for a Concrete Span Bridge
C10m	A	Concrete Slab - Joint Details
C11m	-	Protection Board & Waterproofing Details at Joints Between Slabs
C12m	-	Protection Board & Waterproofing Details at Joints Between DVBs
F1m	A	Example of Typical Temporary Shoring Wall
F2m	A	Typical Tied-Back Wall Details Shoring Wall
F3m	A	Typical Tied Back Wall Notes
K1U-10.1m	E	AREMA Standard Clearance Diagram for All New Railway Bridges
K1U-10.2m	A	Protection and Minimum Clearances for Overhead Bridges
K1U-10.3m	A	Protection Wall Requirements for Reinforced Earth (or Equiv.) Walls for Overhead Bridges
K1U-10.4m	-	Clearance Diagram Requirements for Prefabricated Tunnels
S1m	C	Submerged Arc Welded Joints for Flanges, Webs, Stiffeners and Gusset Plates
S2m	B	Stiffeners
S3m	D	Anchor Bolt
S4m	-	Floor Beam Connections
S5m	-	Stringer to Floor Beam Connection Open Deck Only
S6m	-	Beam Copes
S7m	-	Lateral Bracing for DPG Spans
S8m	B	Attachment of Deck Plate by Bolting in Shop or Field
S9m	A	Type H-3 Saddle Clip for 38-H-4 Heavy Duty Grating
S10m	A	Attachment of Deck Plate by Bolting in Shop or Field (for square spans 12M & over and all Skewed Spans)
S12m	A	HP310 & 360 Pile Splice
S13m	A	Tubular Pile Splice
S14m	B	Pile Splice Detail For Driving Through Template
S15m	C	Standard Bearings for DPG & TPG Steel Spans (Sheet 1)
S16m	A	Standard Bearings for DPG & TPG Steel Spans (Sheet 2)
S17m	A	Steel Trestle - Bearings

STANDARD DRAWINGS – METRIC (cont'd)

Dwg. No.	Rev.	Description
S18m	A	Typical Notes for Steel Spans
S19m	A	Template for Pile Driving
S20m	-	Metallizing Area for Beam Spans, DPG & TPG Spans
R1S-1m	A	Standard Instruction for Dating Concrete Structures
TD-05-L-1m	C	Location for Bridge Name Plate

APPENDIX B

Alan S. Craine

CN

Manager Structures

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Chad A Anderson

CN

Region Chief Engineer

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EXHIBIT D

WCL'S FORCE ACCOUNT ESTIMATE

Item Description

Construction:

- Realign Main for Shoofly
- Realign Main to Original Alignment
- Railroad Signal Work
- Reinstall Railroad Utilities and Related Appurtenances
- Install and remove the temporary full depth rubber crossing along the main.

Engineering

- Design Engineering
- Plan Review
- Construction Engineering – Bridge and Track Inspection

Note: QA Structural Steel Shop Inspection during Fabrication will be performed by IDOT

CN

www.cn.ca

Southern Region

Patrick Jones
Manager Public Works

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September 6, 2011

Mr. Martin G. Buehler
Director of Transportation/ County Engineer for Lake County
600 West Winchester Road
Libertyville, Illinois 60048-1381

Re: Washington Street Grade Separation Project
Rollins Road Grade Separation Project

Dear Mr. Buehler:

We are writing in response to your letter dated March 10, 2011 in regards to the grade separation project at Washington Street and your letter dated March 18th, 2011 in regards to grade separation project at Rollins Road. In your letters you advised that the substructure at each location could be constructed to accommodate the installation of a second track, but that the plans for each location currently include the superstructure for only a single track. The cost estimates for modification of the substructures to accommodate a second track were included, and CN was asked if it would be interested in participating in the additional cost for the second substructures. The cost participation for the Washington Street project would be $1.5 million and the cost participation for the Rollins Road project would be $1.1 million.

After much consideration, we have determined that we would like to participate in the projects to have the additional substructures constructed to allow for a future second track at both locations. We will want to be involved in determining the side for the future second track, bridge construction details, and clearances. Please forward all plans and specifications to CN for review and approval.

If you have any questions or require additional information, please feel free to contact me at (708)332-3557.

Sincerely,

Patrick Jones

cc: Chuck Gleason, Project Manager, LCDOT
Curt Holman, Senior Manager Technical Services
Tom Healey, Regulatory Council
Shane Zazubek, Senior Financial Partner
Ryan Thady, Alfred Benesch & Company
Jarrod Cebulski, Patrick Engineering