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1.1 Scope

1.1.1 Scope of Code

Add the following paragraphs:

The Canadian Highway Bridge Design Code, CSA S6:19 (CHBDC) applies subject to each of the CHBDC sections specified herein by section number and title, being amended, substituted or modified, as the case may be, in accordance with the amendments, substitutions and modifications described herein as corresponding to each such CHBDC section.

The Canadian Highway Bridge Design Code, CSA S6:19 (CHBDC) shall apply for the design, evaluation, and rehabilitation design of Ministry bridges and other Ministry structure types that are referenced in the scope of CHBDC.

The “BC Ministry of Transportation and Infrastructure Supplement to the Canadian Highway Bridge Design Code, CSA S6:19” (Supplement to CHBDC S6:19) shall also apply for the design, evaluation, rehabilitation design and construction of Ministry bridges and other Ministry structures types that are referenced within the scope of CHBDC.

In the event of inconsistency between the Supplement to CHBDC S6:19 and the CHBDC, the Supplement to CHBDC S6:19 shall take precedence over the CHBDC.

In the event of inconsistency, between Project specific Contracts and Terms of Reference prepared by or on behalf of the Ministry, and the Supplement to CHBDC S6:19 or the CHBDC, the Project specific Contracts and Terms of Reference shall take precedence over the Supplement to CHBDC S6:19 or the CHBDC. In cases where precedence may be unclear, the Ministry Chief Bridge Engineer will provide direction regarding the design requirements.

1.3 Definitions

1.3.2 General administrative definitions

Add the following administrative definitions:

Consent/Consented to - means consented to by the Ministry engineer who has the authority, responsibility and technical expertise to provide consent as allowed herein and documented.

Design Exception - means a deviation from Ministry design standards. Design Exceptions require Approval.

Engineering Association - means the Association of Professional Engineers and Geoscientists of the Province of B.C., currently doing business as Engineers and Geoscientists BC.

Ministry - means the BC Ministry of Transportation and Infrastructure (BC MoTI).

Regulatory Authority - means the persons who may from time-to-time hold, or be acting in the position of, the Office of Chief Engineer of the BC Ministry of Transportation and Infrastructure.

1.3.3 General technical definitions

Add the following technical definitions:

Animal Overpass - means a structure carrying animals or wildlife over a road, highway or other facility

Animal Underpass - means a structure carrying a highway, road or other facility over an animal or wildlife path.

BCL - means British Columbia Loading

BC Supplement to TAC Geometric Design Guide - means the compilation of Ministry recommended design practices and instructions comprising supplemental design guidelines which are published by the Ministry and which are to be used concurrently with the Transportation Association of Canada's (TAC) Geometric Design Guide for Canadian Roads.

CHBDC - means the Canadian Highway Bridge Design Code CSA S6:19.

Design-Build Standard Specifications (DBSS) - means the BC Ministry of Transportation and Infrastructure Design-Build Standard Specifications for Highway Construction relating to material specification, construction methodology, quality testing requirements and payment which are published by the Ministry and which are applicable to Ministry Design-Build bridge and highway construction projects unless otherwise specified. (Note – Where this Supplement to CHBDC S6:19 uses the term SS, then the corresponding DBSS section shall apply to Design-Build projects.)

Embankment - earth or rock slope, with or without a foundation unit, that has been altered by cuts or fills, structurally stabilized, subject to ground improvement, or drainage modification and is adjacent to, or supporting, a highway or bridge.

Flyover - means a structure carrying one-way traffic over a highway from one highway to another highway.

Footbridge - means a structure providing access to pedestrians over water and land but not over a road.

Highway - has the same definition as given in S6:19 and includes a Provincial public undertaking, within the meaning of the Transportation Act, S.B.C. 2004, c. 44.

Low Volume Road (LVR) Structure - means a bridge or structure, as designated by the Ministry, on a side road with an average daily traffic ADT (for a period of high use) total in both directions, not exceeding 400. Numbered Routes are not considered as a Low Volume Road unless otherwise Approved.

Numbered Route - means a highway, within the meaning of the Transportation Act, S.B.C. 2004, c. 44, **designated by number by the Ministry.**

Overhead - means a structure carrying a highway over a railway or a railway and other facility.

Overpass - means a structure carrying a highway over a road or lesser highway.

Pedestrian Overpass - means a structure carrying pedestrians over a road, highway or other facility.

Pedestrian Underpass - means a structure carrying pedestrians under a road, highway or other facility.

Railway Underpass - means a structure carrying a railway or a railway and other facility over a highway or roadway.

Recognized Products List - means a data base of products which is to be used as a guide by the Engineer and Constructor to identify products which may be acceptable to the Ministry. The address is as follows:

http://www2.gov.bc.ca/assets/gov/driving-and-transportation/transportation-infrastructure/engineering-standards-and-guidelines/recognized-products-list/recognized_products_list.pdf

Scuppers - means horizontal openings through a curb or barrier for roadway drainage.

Special Provisions (SP) - means the project specific construction specifications relating to material specification, construction methodology, quality testing requirements and payment which are prepared by or on behalf of the Ministry and are applicable to Ministry construction projects.

Standard Specifications (SS) - means the BC Ministry of Transportation and Infrastructure Standard Specifications for Highway Construction relating to material specification, construction methodology, quality testing requirements and payment which are published by the Ministry and which are applicable to Ministry Design-Bid-Build bridge and highway construction projects unless otherwise specified. (Note – Where this Supplement to CHBDC S6:19 uses the term SS, then the corresponding DBSS section shall apply to Design-Build projects.)

S6-06 - means the Canadian Highway Bridge Design Code CAN/CSA-S6-06

S6-14 - means the Canadian Highway Bridge Design Code CSA-S6-14

S6-19 - means the Canadian Highway Bridge Design Code CSA S6:19

TAC Geometric Design Guide for Canadian Roads - means the roadway design guidelines published by the Transportation Association of Canada which is to be used concurrently with the BC Supplement to TAC Geometric Design Guide.

Tunnel - means a covered roadway or pathway through or under an obstruction such as a highway fill, a mountain or a river etc.

Underpass - means a structure carrying a road or lesser highway over a highway.

1.4 General requirements

1.4.1 Approval

Add the following paragraphs:

Exceptions from the Supplement to CHBDC S6:19, including for the purpose of application of codes other than S6:19, may be obtained with prior written Approval.

The following products, materials or systems shall not be incorporated into Ministry bridge projects unless specifically Consented to by the Ministry:

- a) Steel grid decking;
- b) Impressed current cathodic protection system;

- c) Modular deck joints;
- d) Bridge deck heating systems;
- e) Proprietary composite steel/concrete girders;
- f) Full depth precast deck panels;
- g) Timber components;
- h) Mechanically Stabilized Earth (MSE) walls with dry cast concrete block facings;
- i) Walls with wire facings;
- j) Mechanically Stabilized Earth (MSE) walls with polymeric reinforcement used as abutment walls or wing walls;
- k) Fibre-reinforced polymer (FRP) structural products;
- l) Polymer composite based structural products;
- m) Welded shear keys for precast concrete beams and slabs;
- n) Discontinuous spans between substructure elements; and
- o) Sheet piles carrying vertical loads.

Commentary: Ministry consent is required for the use of above listed products, materials, or systems to ensure that there is a thorough technical review undertaken on a project-by-project basis to assess the risks and to enable informed decisions regarding whether their use is considered acceptable.

1.4.2 Design

1.4.2.3 Design life

Add the following paragraph:

For any calculations which are time dependent including but not limited to fatigue, corrosion, creep and shrinkage, the length of time shall be specified as 100 years.

1.4.2.6 Economics

Delete the first sentence and replace with the following:

After safety, total life cycle costs shall be a key consideration in selecting the type of structure but may not be the determining consideration on all projects.

1.4.2.7 Environment

Delete the last paragraph and replace with:

Particular attention shall be paid to the preservation of fish, wildlife, native vegetation and associated habitat. Structures on fish-bearing streams shall be designed to pass fish in accordance with Approved guides, standards, methods and criteria.

1.4.2.8 Aesthetics

Commentary: General guidelines for bridge aesthetics are set out in the Ministry's Manual of Aesthetic Design Practice.

1.4.4 Construction

1.4.4.3 Construction methods

Commentary: Reference the BC Ministry of Transportation and Infrastructure Commercial Vehicle Safety and Enforcement (CVSE) programs and the Ministry Bridge Standards and Procedures Manual - Volume 2 Procedures and Directions, for guidelines associated with transportation of bridge girders in BC.

1.4.4.5 Plans

The following provisions shall be added to the end of the fourth paragraph:

Approved specifications for construction and rehabilitation shall include the Ministry's SS, DBSS and SP for bridge construction. In the event of any inconsistency or conflict between these Ministry construction specifications and the CHBDC S6:19, the Ministry construction specifications shall take precedence and will govern.

1.5 Geometry

1.5.2 Structure geometry

1.5.2.1 General

Delete the first paragraph and replace with:

Roadway and sidewalk widths, curb widths and heights, together with other geometrical requirements not specified in S6:19 or this Supplement, shall comply with the BC Supplement to TAC Geometric Design Guide, or in their absence, with the TAC Geometric Design Guide for Canadian Roads.

Change the first sentence of the second paragraph to read:

Protected sidewalks, bicycle and multi-use pathways shall be separated from traffic by a barrier or guide rail. For design speeds ≤ 60 km/h, a raised curb may be used with the curb having a face height of 200 mm and a face slope steeper than one horizontal to three vertical.

Add the following paragraphs and Table 1.5.2.1 - Sidewalk Widths

Accommodation of cyclists shall be in accordance with the Ministry Cycling Policy.

Commentary: The Ministry's Cycling Policy can be found at the following link:

<http://www2.gov.bc.ca/gov/content/transportation/driving-and-cycling/cycling/cycling-regulations-restrictions-rules/cycling-policy>

Guidance for Active Transportation can be found in the "British Columbia Active Transportation Design Guide (2019 Edition)" at the following link:

<https://www2.gov.bc.ca/gov/content/transportation/transportation-infrastructure/engineering-standards-guidelines/traffic-engineering-safety/active-transportation-design-guide>

Design widths for shoulder bikeways shall be in accordance with the BC Supplement to TAC Geometric Design Guide.

The following table of sidewalk widths shall be used to determine the sidewalk width for various site conditions. The widths specified shall be the clear distance from the back of parapet or face of curb to the railing. Sidewalks are to be located on the side of the highway which is predominantly used by either pedestrians or cyclists. In dense urban areas, consideration shall be given to providing a sidewalk on both sides of the bridge. Where shoulder widths are provided that are 2.0 m or greater, consideration shall be given to accommodating cyclists on the roadway.

Table 1.5.2.1

Sidewalk widths

Type of Traffic	Direction	Minimum Width (metres)
Pedestrian Only	Bi-directional	1.5 ¹
Pedestrian Only	Bi-directional	1.8 ²
Pedestrian and Cycle	Uni-directional	2.5 ³
Pedestrian and Cycle	Bi-directional	3.5 ³

Notes:

1. Sidewalk width applies where the approach roadways has no sidewalk
2. Minimum sidewalk width or match sidewalk width approaching structure
3. These widths are intended for high volume urban areas. Reductions will be considered on a project specific basis as Consented to by the Ministry.

Commentary: *In most cases, the bridge deck width will incorporate the lane and shoulder width dictated for the highway. Generally, this information shall be provided by the Ministry's Highway Designer or designate. In the case of long bridge structures, consideration may be given to reducing the stipulated shoulder width on the structure. The BC Supplement to TAC Geometric Design Guide and the TAC Geometric Design Guide for Canadian Roads may be used for guidance.*

1.5.2.2 Clearances

1.5.2.2.1 Roadways and sidewalks

Delete and replace with the following:

Minimum vertical clearance to bridge structures shall be 5.0 m over all paved highway surfaces, including any on- or off-ramp(s) that pass underneath. The minimum vertical clearance to pedestrian structures, sign bridges, and other lightweight structures spanning the highway shall be 5.5 m.

Minimum vertical clearances for pedestrian/cycle tunnel structures shall be 2.5 metres. The minimum vertical clearance for pathways under structures shall be 2.5 meters. If the pathway is designated for shared equestrian use, the clearance shall be increased to 3.5 metres.

Long-term settlement of supports, superstructure deflection and future pavement overlay shall be accounted for in the vertical clearances.

Consideration shall be given to providing horizontal separation between adjacent structures for maintenance access.

The proposed horizontal separation shall be determined with consideration of pounding effects during seismic events.

For gaps greater than 0.3 m and up to 3 m between adjacent structures, fall arrest provisions shall be provided to prevent people from errantly falling through the gap.

Commentary: *For adjacent wide structures, consider the clearances required for the operation of an under bridge inspection unit when setting the gap spacing.*

1.5.2.2.2 Railways

Commentary: *The designer shall reference the Ministry's Bridge Standard and Procedures Manual, Volume 2 – Procedures and Directions, Section 5.0 Regulatory Submission Requirements with regards to procedures and drawing requirements for regulatory submissions.*

All regulatory submissions required for grade separated rail crossings to Transport Canada and the railway companies will be made by the Ministry's Rail/Navigable Waters Specialist (part of the Ministry Transportation Systems and Road Safety Engineering department), unless otherwise Consented to by the Ministry.

1.5.2.2.3 Waterways

Commentary: *The designer shall reference the Ministry's Bridge Standard and Procedures Manual, Volume 2 – Procedures and Directions, Section 5.0 Regulatory Submission Requirements with regards to procedures and drawing requirements for regulatory submissions.*

All regulatory submissions to Transport Canada required for water crossings will be made by the Ministry's Rail/Navigable Waters Specialist (part of the Ministry Transportation Systems and Road Safety Engineering department), unless otherwise Consented to by the Ministry.

Add the following clause:

1.5.2.3 Pedestrian/cycle bridges

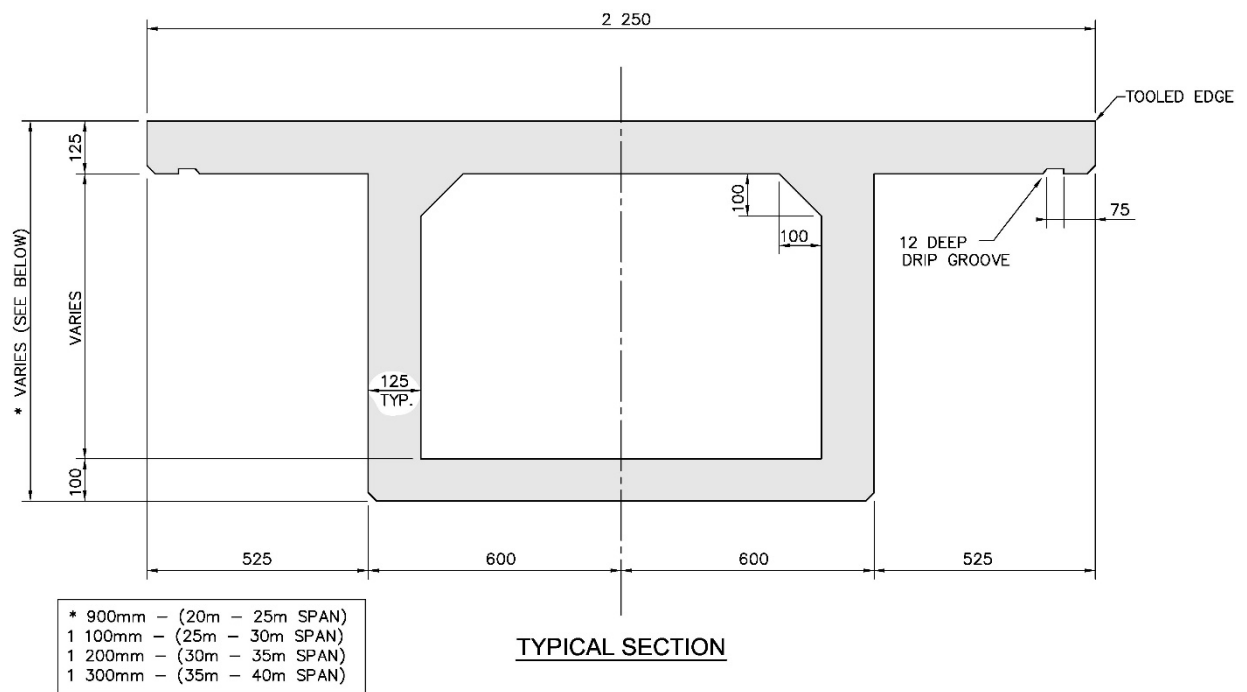
A maximum gradient of 1:12 shall be used for wheelchair traffic on ramps. The clear distance between the railings shall comply with Clause 1.5.2.1 but shall not be less than 2.0 m.

At locations where there is a change in gradient at the piers, the provision of a smooth curve over the piers shall be considered for improving aesthetics.

A crossfall shall be provided on the deck surface of pedestrian/cycle bridges to ensure adequate drainage.

Commentary: Figure 1.5.2.3 details a modified concrete single cell box beam that has been utilized throughout BC as a pedestrian bridge structure.

Figure 1.5.2.3



1.6 Barriers

1.6.1 Superstructure barriers

Add the following paragraph:

The standard sidewalk railing, when incorporated on a structure, shall extend a minimum of 3 m beyond the bridge abutments.

1.7 Auxiliary components

1.7.2 Approach slabs

Delete clause and replace with the following:

Approach slabs shall be provided as follows:

at all Lifeline bridges,

at all Major Route and Other bridges in Seismic Performance Categories 2 and 3,

unless otherwise Consented to by the Ministry, at all Numbered Route bridges where a total settlement greater than 50 mm is anticipated between the abutment and the roadway fill, and,

as Consented to by the Ministry based on project specific conditions.

Approach slabs are not required for low-volume road structures on gravel surfaced roads.

Approach slabs shall be 6 m in length (as measured perpendicular to the abutment), located at least 100 mm below finished grade, anchored to the abutments. and shall be designed to match the full width of the bridge deck. Cover and reinforcing type shall be as per the requirements for deck slabs.

Approach slabs shall be designed as a one-way slab in the longitudinal direction to support CL-800 loading or Special Truck and Special lane loading if applicable, whichever produces the maximum effect. The slab shall be assumed to span 75% of its length (4.5 m). Approach slabs shall be fully supported by fill and shall extend transversely to the limits of the roadway. The joints around the approach slab shall be sealed.

Approach slabs shall have a 100 mm minimum asphalt overlay but do not require a waterproofing membrane unless specified otherwise by the Ministry.

Commentary: *all semi-integral and integral abutment bridges should have approach slabs, though they may not be applicable for short simple span standard prestressed box girder bridges or where push-through deck systems are utilized.*

1.7.3 Utilities on bridges

1.7.3.1 General

Add the following:

The Ministry "Utility Policy Manual" shall apply regarding installation of utilities on or near bridges.

Commentary: *The Ministry's Utility Policy Manual can be found at the following link:*

https://www2.gov.bc.ca/assets/gov/driving-and-transportation/funding-engagement-permits/highway-permits/utility_policy_manual.pdf

1.7.3.2 Location and attachment

Add the following paragraphs:

Conduits for utilities shall not be placed in deck slabs less than 250 mm thick.

No more than two utility conduits shall be located within a concrete barrier and the nominal inside diameter of any such conduit shall not be more than 50 mm. Conduits shall be located vertically above one another with a minimum of 50 mm clearance between adjacent conduits. The bottom conduit shall be located so that there will be at least 50 mm of clearance for fresh concrete to flow under the conduit when the concrete barrier is cast. Conduits should be located towards the center of the barriers to maximize clearance to barrier reinforcing.

***Commentary:** Concrete bridge and combination barriers can serve as a convenient location for running electrical conduit over the bridge length. The size and number of conduits should be limited such that their presence does not have an adverse effect on the crash performance of the barrier or the ability to place and consolidate concrete. The conduit(s) should be located at the base of the barrier, within the rebar cage. The junction boxes to service the conduit should be located in the rear (non-impact) face of the barrier. If additional conduits are required consideration should be given to separate embedded conduits located in thickened deck sections or exposed conduits suspended under the bridge.*

1.8 Durability and maintenance

1.8.2 Bridge deck drainage

1.8.2.1 General

Add the following:

Runoff water from the surface of bridges and/or approach roads shall be conveyed to discharge at locations that are acceptable to environmental agencies and the Ministry.

When deck inlets are required, they shall use air drop discharge unless otherwise directed by environmental agencies. Water shall not be discharged onto railway property, pavements, sidewalks or unprotected slopes. Discharge into rivers and creeks require approval by the appropriate environmental regulatory agency.

1.8.2.2 Deck surface

1.8.2.2.1 Crossfall and grades

Delete the first paragraph and replace with the following:

Bridge deck drainage of the roadway shall be achieved by providing a minimum 2% transverse crossfall and by providing a minimum longitudinal grade of 1%, except where, for limited lengths, vertical curves or superelevation transitions preclude this. In cases where there is extreme topographical hardship, the absolute minimum longitudinal grade may be reduced to 0.5% with the Consent of the Ministry.

All sidewalks, safety curbs, tops of barriers, raised medians, or other deck surfaces that are raised above the roadway, and are wider than 300 mm, shall have a minimum transverse crossfall of 2% to direct surface runoff away from median longitudinal expansion joints. Deck runoff from sidewalks can be directed to the outside of the bridge, subject to approvals from the regulatory environmental agencies.

Commentary: For long term durability, it is preferable to control all drainage and direct it to deck drains. Directing drainage over the fascia can lead to freeze-thaw durability problems in colder climates.

1.8.2.2 Deck finish

Add the following:

Concrete bridge decks shall be textured by tining in accordance with SS 413.31.02.05. Concrete bridge decks which are to receive a waterproof membrane and asphalt topping shall be given a smooth float finish. Sidewalks shall receive a transverse broom finish.

1.8.2.3 Drainage systems

1.8.2.3.1 General

Delete the first sentence of the first paragraph and replace with the following:

The spacing and capacity of bridge deck drains established by hydraulic design and testing shall be sufficient to ensure that for a ten-year design storm the runoff will not encroach more than 1.20 m onto the traffic lane.

1.8.2.3.2 Deck drain inlets

Add the following:

Future settlement shall be considered when locating deck drain inlets.

1.8.2.3.3 Downspouts and downpipes

Add the following paragraph:

Scuppers shall not be used unless Consented to by the Ministry.

Commentary: Improper detailing of scuppers leads to extensive maintenance problems. Use of metal inserts has given rise to corrosion and delamination of the concrete curbing. Large openings can present a hazard due to snagging of a vehicle's wheel during impact. Note that some fabricators use the term scupper for catch basin type systems similar to those in SS582 which do not require consent.

Add the following to the first sentence in the second paragraph:

The portion of the drainage system extending through the deck and the downspout shall be hot dip galvanized steel pipe.

Delete the last sentence in the fourth paragraph and replace with the following:

Downspouts shall project a minimum of 500 mm below any adjacent component, except where prohibited by minimum vertical clearances.

Support brackets shall be considered for deep girders and steel trusses.

Add the following:

Erosion protection shall be provided at discharge areas from downpipes and downspouts similar to the splash pad detail shown on SP504-03, constructed of 10 kg class riprap.

Commentary: Energy dissipators may be required to mitigate erosion due to high velocity discharges.

Typical drain inlet and downspout details are shown in Figures 1.8.2.3.3a and 1.8.2.3.3b.:

Figure 1.8.2.3.3a
Deck drain setting detail

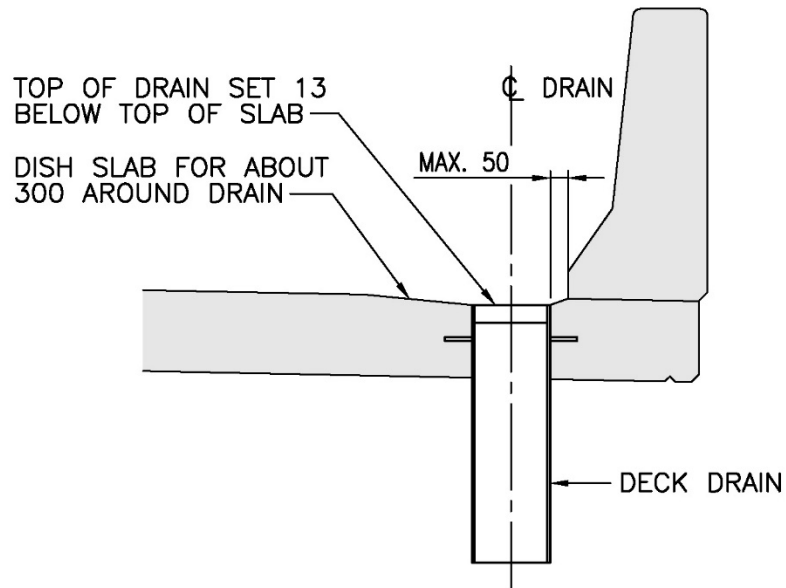
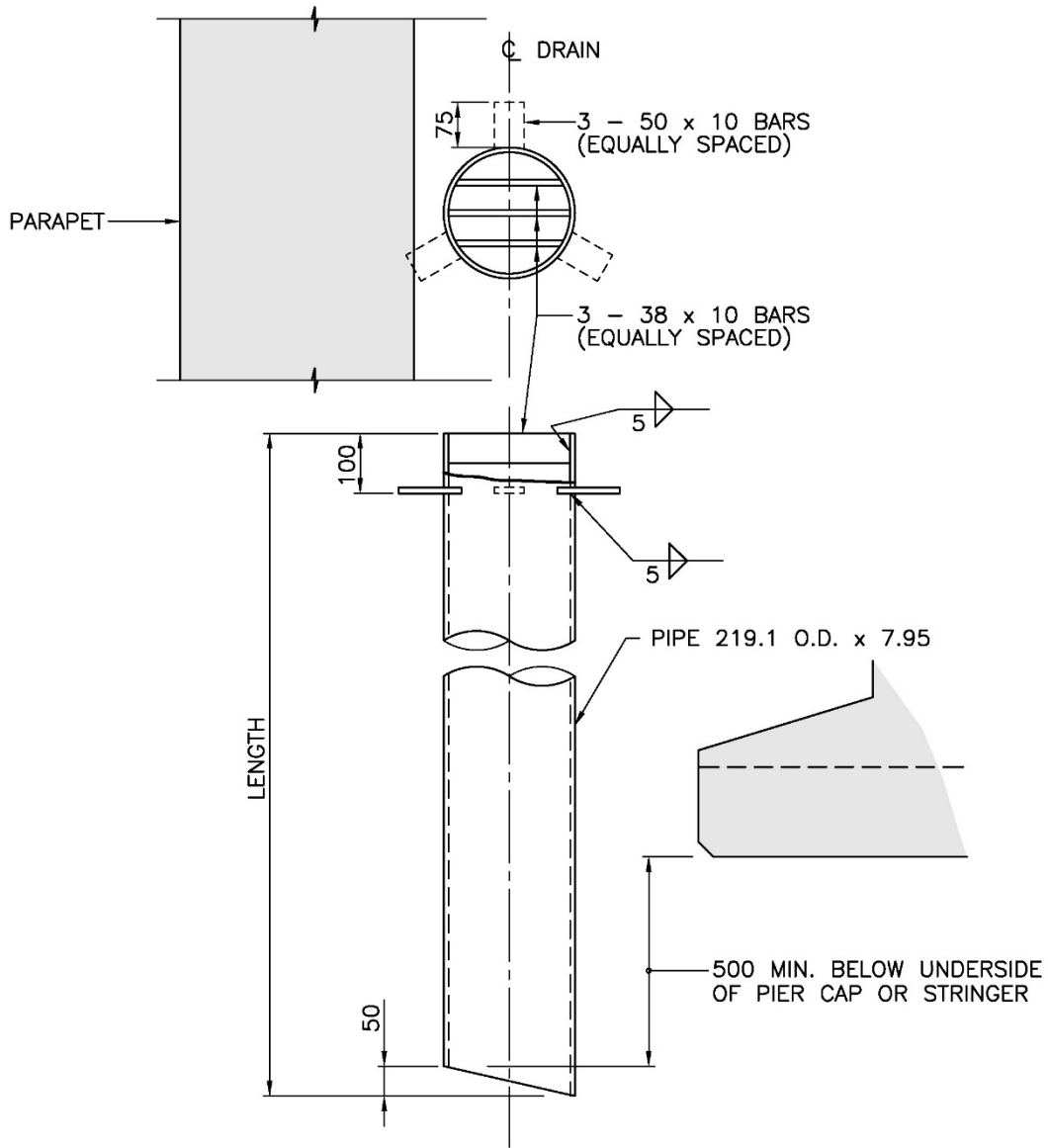


Figure 1.8.2.3.3b
Deck drain fabrication detail



1.8.2.5 Runoff and discharge from deck

Add the following paragraph:

If catch basins are required just beyond the limits of the structure, a continuous length of barrier or curb and gutter shall be provided to connect the bridge curb or barrier to the catch basin to prevent washout of the fill at the ends of the wingwalls.

1.8.3 Maintenance

1.8.3.1 Inspection and maintenance access

1.8.3.1.1 General

Add the following paragraphs:

Permanent equipment access to the stream bed level shall be provided in the design to enable future removal of debris build up at the inlet of buried structures and culverts at locations where the height from the roadway surface to the stream bed level exceeds 5 metres.

The following minimum clearances shall be maintained between the top of the finished fill in front of the abutment and the underside of the superstructure to facilitate inspection:

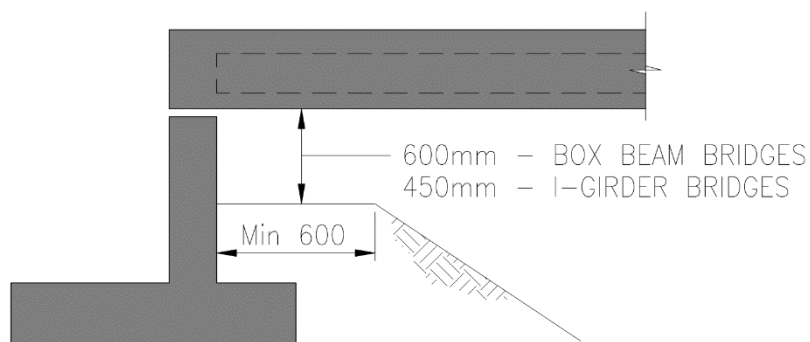
I-Girder Bridges (Steel or Prestressed Concrete) 450 mm

Box Beam Bridges 600 mm

These clearances are applicable for isolated zones of the structure. Where extensive areas of the bridge have clearance restrictions the minimum clearance shall be as Consented to by the Ministry under a site specific access plan.

A minimum 600 mm wide horizontal bench shall be provided as shown in Figure 1.8.3.1 to facilitate inspection and maintenance access unless otherwise Consented to by the Ministry.

**Figure 1.8.3.1
Abutment berm detail**



1.8.3.1.2 Removal of formwork

Add the following sentence to the end of the first paragraph:

All other formwork shall be removed.

Add the following paragraph:

Partial depth precast panels acting compositely with the concrete deck shall not be considered as formwork.

1.8.3.1.3 Superstructure accessibility

Commentary: Access to steel girders for inspection purposes shall be considered in the design in high traffic volume areas in consultation with the Ministry. Designs for inspection access shall be in accordance with Work Safe BC Occupational Health and Safety Regulations (OHS).

1.8.3.1.5 Access to primary component voids

Add the following to the end of the second paragraph:

Drains into voids in bridge girders shall be screened so that the larger mesh opening dimension does not exceed 15 mm.

1.8.3.3 Bearing maintenance and jacking

Delete and replace the third paragraph with the following:

In the design of jack-bearing locations, the assumed factored jacking force shall be the greater of twice the unfactored dead load or the sum of the factored dead load and full factored live load.

Sufficient vertical and horizontal space shall be provided between the superstructure and the substructure to accommodate the jacks required for bearing replacement. For steel girders the web stiffeners of the end diaphragm must be located accordingly.

Commentary: A minimum vertical clearance of 150 mm is suggested for typical short span bridges (<20 m), though may be omitted for standard prestressed concrete box girders. Larger spans should be assessed for the size of jack required.

1.9 Hydraulic design

1.9.1 Design criteria

1.9.1.1 General

Delete and replace the first paragraph with the following:

The hydraulic design of bridges, buried structures, culverts and associated works shall comply with the requirements of the TAC Guide to Bridge Hydraulics, (latest edition) and Part 3 of the Water Sustainability Act (WSA) Regulation.

At a minimum, for buried structures and culverts:

- headwater depth to diameter ratio (HW/D) shall not exceed 1.0 at the design flow.
- outlet control headloss shall be less than 0.3 m under design (flow and tailwater) conditions.

Add the following:

Wave effects for structures in the proximity of lakes and coastal bodies of water may require special consideration.

1.9.1.2 Normal design flood

Delete the first paragraph and replace with the following:

The design flood shall be the peak instantaneous flow including incorporation of climate change resilience in design, with the return periods as follows:

Bridges, retaining walls and river training & channel control works	200-year
Buried structures and culverts \geq 3 m span	200-year
Low-Volume Road – bridges, buried structures, culverts, retaining walls and river training & channel control works	100-year
Temporary Structures (2 years or less in duration)	10-year*

*Calculation of an alternative return period based on an equivalent risk for the duration of detour may be accepted when Consented to by the Ministry for durations greater than 2 years. Climate change does not need to be addressed, but shall be documented on the Design Criteria Sheet for Climate Adaptation.

In accordance with the WSA Regulation the 1 in 200 year maximum daily flow or the hydraulic capacity of the stream channel shall be shown on the Plans as required for environmental approvals.

The design shall also meet the requirements of the regulatory agencies.

Commentary: Floodplain maps are available for a number of locations throughout the Province and show the areas affected by the 200-year flood. The maps are generally drawn to a scale of 1:5,000 with 1 metre contour intervals and show the natural and man-made features of the area. In some cases these maps may be outdated and therefore only suitable for conceptual or early stages of design. The design flood level shall be re-evaluated for the site, accounting for present-day conditions, during detailed design.

For information on maps refer to:

<https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/drought-flooding-dikes-dams/integrated-flood-hazard-management/flood-hazard-land-use-management/floodplain-mapping>

Where fish and fish habitat are involved, additional measures may be necessary to meet the requirements of the regulatory agencies.

For buried structures and culverts, consideration should be given to increasing the size and durability of the structure and/or providing additional measures (e.g. bypass culverts) to ensure maintainability (as per Clause 1.8.3.2) given the high cost of replacement, maintenance and renewal. Consideration should include such items as:

- Traffic volumes,
- Depth of cover
- Detour and alternate route availability
- Required maintenance frequency and maintenance accessibility
- Hydrotechnical issues

1.9.1.3 Check flood

Delete and replace with:

Consideration of a check flood is not required for Ministry structures.

1.9.1.5 Design flood discharge

Delete and replace the paragraph with the following:

The design floods shall be estimated by the following methods, unless otherwise Consented to by the Ministry.

- a) For drainage areas greater than 10 km², the recommended design flow calculation methods are:
 - Station Frequency Analysis
 - Regional Frequency Analysis

Commentary:

Annual maximum daily and peak instantaneous flows are available from Water Survey of Canada (WSC) gauging stations.

For information on Frequency Analysis, refer to: TAC Guide to Bridge Hydraulics, Section 3.2 (June 2001)

- b) For urban and small drainage areas less than 10 km², the recommended design flow calculation is the Rational Method.

If the drainage area is close to the upper limit, the designer shall check the results using other methods (e.g. measured flow data, Soil Conservation Service (SCS) Unit Hydrograph Method, regional frequency analysis, etc.) and confirm with an assessment of channel forming flow and channel flow capacity (by site observation, regime analysis etc.).

Commentary: *For information on the Rational Formula Method, refer to the TAC Guide to Bridge Hydraulics, Section 3.4.1 (June 2001) and the BC Ministry of Transportation, Supplement to TAC Geometric Design Guide, (April 2019).*

1.9.4.1 Scour calculations

Add the following:

The scour shall be calculated using methods as described in the TAC Guide to Bridge Hydraulics or another method Consented to by the Ministry.

1.9.5 Protection against scour

1.9.5.1 General

Delete and replace with the following:

Scour protection requirements for structure foundations shall be such that structural failure will not occur as a result of the design flood.

1.9.5.2 Spread footings

Add the following:

Abutments and piers subject to potential scour on Low Volume Road Bridges shall have piled foundations or be adequately protected from scour in accordance with Clauses 1.9.5.2.1 and 1.9.5.2.2 unless otherwise Approved.

Abutments and piers subject to potential scour on non-Low Volume Road Bridges, shall have piled foundations unless otherwise Approved.

Spread footings used for abutments and piers subject to potential scour shall have protective aprons.

Commentary: *Use of spread footings for abutments and piers where clauses 1.9.5.2.1 and 1.9.5.2.2 are not met, may be considered acceptable on low-volume roads or in other special circumstances provided a Design Exception, is approved.*

The Design Exception in this situation entails a documented design rationale by the Coordinating Professional Engineer with input from the hydrotechnical engineer or geoscientist, structural engineer and geotechnical engineer to determine the hydrotechnical risks the spread footing is operating under and how those risks are mitigated. This assessment shall address site specific features including but not limited to abutment location, geotechnical conditions, stream morphology, natural channel characteristics, sediment and bank material, debris risk, use and function of the road, alternate routes and any other applicable factors.

1.9.5.2.2 Protection of spread footings

Add the following paragraph:

Riprap and/or MSE walls shall not be used as means to justify spread footings founded at a depth less than specified in Clause 1.9.5.2.1 unless Approved.

Commentary: *The use of riprap may be considered for protecting spread footings located adjacent to the stream on low-volume road bridges.*

Riprap installations are not equivalent to piling, sheet piling, concrete or steel inverts, or concrete revetment. Protection of the spread footings must remain effective for the design life of the structure and provide stability to the structure foundation with the streambed at its ultimate elevation. Riprap is inherently prone to damage during floods. Performance can also be significantly affected by issues such as rock quality, weathering, installation details and maintenance. The Design Exception described in BC Supplement commentary 1.9.5.2 shall address the effective protection of spread footings against scour.

Spread footings some distance from the channel and founded on erodible material at an elevation higher than the streambed are vulnerable to failure from scour (see S6:19 commentary). Placing spread footings at streambed level or lower makes them less vulnerable.

1.9.5.3.2 Penetration and strength

Commentary: *Consideration of estimated scour depth and determination of the final bed elevation at the location of the piles should be assessed on a site specific basis as a collaboration between hydrotechnical, geotechnical and structural professionals. Ultimate bed elevation will differ across the channel, horizontal projection of the lowest ultimate bed elevation to all foundation elements may lead to excessively conservative pile designs.*

1.9.5.3.3 Abutments supported on piles

Replace the first sentence with:

The bottom elevation of an abutment designed to be directly exposed to flowing water at the design flood shall be set at least 1.0 m below the ultimate stream bed elevation.

Commentary: *For abutments not directly exposed to water, it is not necessary that the abutment fills be prevented from washing out.*

1.9.5.5 Protective aprons

Replace the second paragraph with the following:

Riprap stone sizes for pier aprons shall be determined using a velocity at least 1.5 times the estimated pier approach velocity at the design flow. The thickness of riprap aprons shall be not less than 1.5 times the median size of the stone

Add the following paragraph:

Riprap should conform to SS 205, unless otherwise Consented to by the Ministry.

1.9.6 Backwater

1.9.6.1 General

Delete the first sentence and replace with:

Backwater shall be calculated using methods Consented to by the Ministry. HEC-RAS numerical analysis may be used for determining the backwater profile.

1.9.7 Soffit elevation

1.9.7.1 Clearance

Delete and replace the first paragraph with the following:

Unless otherwise Approved, the clearance between the soffit and the Q200 design flood elevation shall not be less than 1.5 m for bridges; and not less than 0.5 m on low-volume road bridges for the Q100 flood elevation. For buried structures and culverts greater than or equal to 3 m span, the clearances shall be adequate to pass the anticipated ice flows and floating debris as well as accommodating sediment bed load at the site for the Q200 design flood or for the Q100 design flood on low-volume roads. For temporary structures the clearance shall be as indicated previously except using the Q10 (or alternative return period) flood elevation defined.

Both vertical and horizontal clearances shall be addressed. Increased clearance should be considered for crossings subject to ice flows, debris, debris flows and debris torrents.

Commentary: *Specific risk assessments may be required for debris torrents/flows if the required clearances become excessively large. For navigable waters, the Canadian Navigable Waters Act requires a vertical clearance that allows passage of the largest air draft vessel at the 100-year flood level or the HHWLT (Higher High Water, Large Tide). This allowance also includes a calculation of maximum wave height. For small watercourses capable of carrying only canoes, kayaks and other small craft a clearance of 1.7 m above the 100-year flood level is usually considered to be adequate. For small watercourses less clearance may be considered if cost and road design factors are affected significantly. Transport Canada, having authority of works over or in Navigable Waters, can require other clearance requirements. For minor waterways, the Ministry is to carry out a navigational assessment and determine the requirements for design and navigation. Vessel Surveys and studies may also be required to determine clearance requirements and navigable areas and channel(s) within the waterway. Applications and communications with the Transport Canada and Port Authorities shall be coordinated by the Ministry's Rail, Navigable Waters Specialist.*

For additional information, refer to Ministry's Bridge Standard and Procedures Manual, Volume 2 – Procedures and Directions, Section 5.0 Regulatory Submission Requirements.

1.9.9 Channel erosion control

1.9.9.3 Slope revetments

Add the following paragraphs:

Riprap revetments shall be used for protecting the bank slopes and bridge end fills of abutments, in conformance with SS 205 unless otherwise Consented to by the Ministry. The riprap toe shall be designed to prevent undermining of revetments in accordance with the TAC Guide to Bridge Hydraulics. At minimum, the revetment shall protect the bridge end fills, and the upstream and downstream ends shall be keyed into the bank slopes.

Commentary: *Top of slope revetment should be placed a minimum of 0.3 m above the design high-water level, and preferably 0.6 m. The dimension 0.3 m is consistent with the guidelines set by BC FLNRO for the*

riprap design and construction for dikes - Riprap Design and Construction Guide. For LVR structures this may be revised when consented to by the Ministry.

1.9.11 Culverts

1.9.11.2 Culvert end treatment

Add the following:

Cut-off walls shall be used at both ends of the culvert where there is a possibility of uplift, piping or undermining, unless otherwise Consented to by the Ministry. Cut-off walls shall extend 1 m below the culvert invert or to the estimated depth of scour, whichever is greatest, or as otherwise Consented to by the Ministry.

Commentary: *This will alleviate failure of culverts from uplift and piping during extreme flood events which has occurred at some Ministry sites.*

1.9.11.6 Closed-invert culverts

1.9.11.6.6 Soil-steel structures

Add the following:

Cut-off walls shall be used at both ends for closed-bottom type soil-metal structures where there is a possibility of uplift, piping or undermining. Collars or headwalls are required where there is a possibility of deformation due to debris or ice impact, or hydrostatic forces.