7.1 Scope

Add the following:

Section 7 applies only to buried structures with a span greater than or equal to 3 m.

Commentary: *The CHBDC Commentary (C7.1 Scope) indicates that Section 7 applies only to buried structures with spans greater than 3 m.*

For buried structures with spans less than 3 m, see Section 1000 of the Ministry Supplement to TAC Geometric Design Guide.

Specifications for materials, fabrication and construction of buried structures should be in accordance with SS 303 Culverts and SS 320 Corrugated Steel Pipe, where applicable.

Some types of buried structures are procured using a proprietary design process where the supplier provides the engineering for the structure as part of the tendered contract. Simple structures up to 6 m in span should be designed and included in the tender documents rather than utilizing a proprietary design process.

7.5 Design

Add the following:

When live load effects are governed by the single axle no.4, the CL-625 truck shall be used.

Commentary: *The axle no.4 CL-800 truck loading is considered to be overly onerous compared to actual single axle loads.*

7.5.1 Sustainability and durability

7.5.1.2 Durability

7.5.1.2.1 General

Commentary: *Refer to Cl. 1.9.1.2 for additional commentary.*

7.5.1.2.2 Steel structures

Add the following:

The design life for Soil-Metal Structures, for the purpose of durability and corrosion allowance calculations, shall be 100 years.

Design shall be in accordance with the following Corrugated Steel Pipe Institute (CSPI) Technical Bulletins unless otherwise Consented to by the Ministry:

Technical Bulletin 1 – Performance Guideline for Corrugated Steel Pipe Culverts (300mm to 3,600mm Diameter) – November 2020

Technical Bulletin 13 – Performance Guideline for Buried Steel Structures – February 2012 using the AASHTO corrosion loss model.

Inverts shall be assessed for deterioration for erosion and bedload abrasion and additional protection shall be provided when necessary. Abrasive stream flows should be avoided wherever possible by appropriate hydraulic measures.

Commentary: *The Ministry has noted the premature failure of buried structures due to corrosion and/or abrasion because of inadequate consideration of site conditions. Options to mitigate these effects include armour plates, energy dissipaters concrete liners, thicker galvanic coating and polymer coatings.*

Note that CSA G401 coating thickness is total both sides.

7.5.1.2.5 Design detail

7.5.1.2.5.2 Membranes

Add the following:

The top slab of concrete structures within 600 mm of the finished roadway surface shall be treated with a waterproofing membrane system. The membrane may be omitted on LVR structures when Consented to by the Ministry.

7.5.3 Load factors

Add the following:

When checking buried structures for buoyancy (refer also to Clause 3.11.3), the designer shall consider the potential effects of soil-structure interaction and soil particle behaviour.

Commentary: *Section 7 refers generally to Section 3, Clause 3.5.1, for load factors but design of buried structures against buoyancy effects is not addressed. For buried structures, wall friction is usually dependent on actual soil-structure interface properties achieved during construction, and thereafter, so a conservative minimum value is appropriate for the buoyancy check. Also, a conservative assumption of actual soil state (minimum active or minimum at-rest) is appropriate to assure safety against buoyancy.*

7.5.7 Geotechnical considerations

7.5.7.4 Material for engineered fill

Add the following:

Materials for Zones 1 and 2 shall meet the requirements for Bridge End Fill in accordance with SS 201.40. Zone 3 material may be Bridge End Fill or a Group III material deemed suitable by the designer.

7.5.8 Seismic requirements

7.5.8.1 General

Replace a) in second paragraph with:

a) locations where the design spectral response acceleration for a period of 0.2 s, $S_a(0.2, X)$ at a probability of 2%/50 years, is greater than 0.7 g; or

7.5.14 Site supervision and construction control

Add the following:

For all types of buried structures, the Plans shall specify the following design information:

- Type of Buried Structure;
- Design Life
- Highway Design Loading;
- Unit Weight of Backfill;
- Depth of Cover, H;
- Depth of Cover, H_c, at intermediate stages of construction;
- Construction Live Loading assumed in the design (corresponding to H_c);
- Geometric Layout and Key Dimensions;
- Foundation and Bed Treatment;
- Foundation Allowable Bearing Capacity;
- Extent of Structural Backfill;
- Conduit End Treatment;
- Hydraulic Engineering Requirements, as appropriate;
- Roadway Clearance Envelope, as appropriate; and,
- Concrete Strength, as appropriate.
- Backfill and drainage details including material properties, placement and compaction

For Soil-Metal Structures and Metal Box Structures, the Plans shall also specify the following design information:

- Design life based on corrosion allowance calculations;
- Minimum plate thickness and coating system;
- Corrosion Loss Rates (for substrate metal and for coating system);
- Abrasion Level and abrasion treatment;
- Electrochemical Properties of Soil Materials and Water in contact with the structure;
- Seam Strength at Critical Locations;
- Conduit Geometry including: Rise, $D_{v,}$ Span, $D_{h,}$ Radius at Crown, $R_{c,}$ Radius at Spring-line, R_s and Radius at Base, R_b. etc.

7.6 Soil-metal structures

7.6.3 Design criteria

7.6.3.1 Thrust

7.6.3.1.3 Live loads

Replace item (b)(i) with the following:

(b)(i) within the span length, position as many axles of the CL-800 Truck or Trucks (and/or Special Truck if specified) at the road surface above the buried structure as would give the maximum total load;

7.6.3.4 Design criteria for longitudinal connections

7.6.3.4.1 General

Add the following:

The values of unfactored seam strength for bolted steel plates, S_s, shown in Commentary Figure C7.4 may be used for standard corrugation profile with bolted connections.

7.6.6 Special features

Add the following:

Special features shall be used only when Consented to by the Ministry. All structures having special features shall use refined analysis unless otherwise Consented to by the Ministry.

Commentary: *Cl. 7.6.6. of S6.1:19 (Commentary on S6:19, Canadian Highway Bridge Design Code) provides examples of some of the special features that can be used to improve structural performance and provides guidance for transverse stiffeners and GRS structures.*

7.7 Metal box structures

7.7.1 General

Add the following:

The geometric limitations provided in AASHTO LRFD Bridge Design Specifications (2020) Table 12.9.4.1-1 shall be met (e.g., maximum radius at crown and minimum radius at haunch), unless refined methods of analysis are utilized.

7.7.3 Design criteria

7.7.3.1 Design criteria for crown and haunches

7.7.3.1.3 Live loads

Replace the definition of A_L at the end of this clause with the following:

where A_L is the weight of a single axle of the CL-800 Truck (or Special Truck if specified) for D_h< 3.6 m, or the combined weight of the two closely spaced axles of the CL-800 Truck (or Special Truck if specified) for $D_h \geq 3.6$ m, and k_4 is a factor for calculating the line load, as specified in Table 7.9

7.9 Reinforced concrete buried arches

7.9.4 Construction

7.9.4.4 Waterproofing

Delete and replace with the following:

On paved highways, the top slab of concrete structures within 600 mm of the finished roadway surface shall be treated with a waterproofing membrane system. The membrane may be omitted on structures on gravel surfaced highways. For arches over highways or railways the use of membranes between adjacent segments shall be required unless otherwise Consented to by the Ministry.

When a membrane is required, the arch designer shall consider hydrostatic pressure, if applicable, and the appropriate interface friction in the analysis.

Commentary: *Seepage and the formation of icicles has been observed on buried arch structures at the joints between adjacent segments.*