Structures

Master Specification

ST-SD-D1 Design of Structures

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1	Initial issue	28/06/19
2	Formatting for publishing	24/09/19
3	Updates to references and standards, added sustainability requirements, additional design life requirements, plaques deleted and minor changes elsewhere	August 2021

Document Management

Contents

ST-SD-D1 Design of Structures

1 General

1.1 The Contractor must perform its obligations to design structures in accordance with the Contract.

1.2 This Part specifies the minimum requirements for the design of bridges and civil infrastructure structures, including culverts with a clear internal dimension greater than or equal to 1.5m.

1.3 This Part does not include the design of tunnels or buildings.

1.4 Some clauses in this Part may be referenced discretely from other Parts.

2 Design Standards

2.1 The following standards, documents and guidelines (including the most recent revisions and amendments) are referenced in this Part:

a) AS 5100 Bridge Design.

b) AS 2865 Confined Spaces.

c) AS 4680 Hot-dip galvanized (zinc) coatings on fabricated ferrous articles.

d) AS 4678 Earth Retaining Structures.

e) NSW Roads & Maritime Services (RMS) specification B316: "Modular Bridge Expansion Joints", available from: https://roads-waterways.transport.nsw.gov.au/business-industry/partners-suppliers/document-types/specifications/design-construct/bridge.

f) Worksafe Victoria: Construction and Erection of Bridge Beams, available from https://www.worksafe.vic.gov.au/.

g) AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals (Sixth Edition 2013).

h) Queensland Department of Transport and Main Roads Technical Note 62: Assembly and Tensioning of High Strength Bolts and Nuts, Parts 1, 2 & 3.

i) VicRoads Bridge Technical Note 007: “Noise Attenuation Walls”, available from: https://www.vicroads.vic.gov.au/business-and-industry/technical-publications/bridges-and-structures.

j) Austroads Guide to Road Design, available from: https://austroads.com.au/.

k) VicRoads Bridge Technical Note 14: “Sign Gantries and Lighting Masts,” available from: https://www.vicroads.vic.gov.au/business-and-industry/technical-publications/bridges-and-structures.

3 Safety in Design

3.1 The design process must take safety into account to ensure that the structures can be safely constructed, operated and maintained. Risks must be eliminated or minimised “so far as is reasonably practicable”.

3.2 The design of girder bridges must comply with the requirements of the Worksafe Victoria Publication: “Construction and Erection of Bridge Beams”.

3.3 The Contractor must design structures that do not permit easy or unauthorised pedestrian access (e.g. ledges and overhanging structures that can be easily accessed etc.). The design of measures to prevent unauthorised access must be incorporated into the design of the structure(s).

3.4 Use of loose material, that could represent a hazard if used by a vandal to throw into the path of traffic, is not permitted as part of any treatment.

4 Sustainability in Design

4.1 Design of concrete elements (including pipes and culverts) will achieve a reduction in whole of life embodied carbon and increase in recycled content compared with Business As Usual materials and technologies (described in the Department's Sustainability Manual Appendix 6).

4.2 A strategy for minimising whole of life embodied carbon and optimising recycled content in concrete elements will be developed and applied across the project. The preliminary strategy will be included in the Preliminary Design Report for Structures (notional 30% design). The final strategy must be included in the Final Design Report for Structures (IFC).

4.3 Opportunities to reduce Portland Cement to the maximum extent practical as a means of reducing embodied carbon will be investigated, with assessment completed in accordance with Section 9 of the Department's Sustainability Manual and justification provided for in the final mix design.

4.4 As a minimum, the Contractor shall ensure the minimum Portland Cement replacement levels in Table 4-1 are achieved, or alternative mixes that achieve equivalent or greater reduction in whole-of-life embodied CO2-e emissions are specified:

Table 4-1 Minimum Portland Cement replacement levels for concrete

Exposure Classification	Concrete Strength Grade (MPa)	Minimum Portland cement replacement level
B1	32	30% (1)
B1	40	30% (1)
B2	40	30% (1)
B2	50	30% (1)
C1	50	40% (1)
C2	50	70%
U	Project specific mix design to be submitted for approval	

Note: (1) Higher replacement levels (50% or higher) shall be specified where 56-day concrete strengths are specified (refer Part SC-ST-S7 Clause 4).

5 Interpretation of AS5100

5.1 The design must be undertaken using the clarifications and interpretations of AS 5100 Bridge Design contained within this Clause.

5.2 AS 5100 must be read to incorporate the corrections listed in Section 5: "Corrections & Additional Requirements to AS 5100". The Structural Design Report must include details of any additional interpretations or clarifications proposed.

CLAUSE	INTERPRETATION / REQUIREMENT	
AS 5100.1 – 8.2 "Design Life"	ELEMENT	DESIGN LIFE (Years)
	Structures, excluding the elements listed below	100
	Bridge bearings	50
	Expansion joints	50
	Protection screen panels*	50
	Noise wall panels*	50
	* not primary load carrying framework	
AS 5100.1 – 13.6 "Horizontal Clearance to Substructure Components of Bridges over Roadways"	The clear distance between the edge of the lane and the face of such barrier must be in accordance with Austroads: Guide to Road Design; Part 6A - Roadside Safety.	

CLAUSE	INTERPRETATION / REQUIREMENT
AS 5100.1 – 18 "Drainage"	• Drainage water from the bridge must not discharge directly into any water course, railway line, traffic lane or footpath. Free draining scuppers through decks must not be used. • The drainage system must be designed so that a minimum amount of water flows across deck joints. • All pipework for structure drainage must be corrosion resistant, fire proof and must be concealed from all public view except from directly underneath. • All drainage structures must be readily accessible for cleaning and maintenance purposes. • All drainage must be conducted to the ends of the bridge or culvert for disposal.
AS 5100.1 – 23.3 "Anchor bolts and baseplates" (of Road Signs and Lighting Structures)	The method of design – whether levelling nuts are used or not - must be explicitly stated on the design drawings.
AS 5100.2 – 9 "Rail Traffic"	The rail traffic design load must be based on the 300LA design loading. If a lower design load level is specified, then the design actions must be obtained by proportioning the specified load by the 300LA load requirements under AS5100.2 Clause 9.
AS 5100.2 – 24.4 "Fatigue limit state design" (of Road Signs and Lighting Structures)	AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals (Sixth Edition 2013), or a later edition, must be used. The natural wind gust formula from AASHTO must be used (not AS1170.4). The height limit of 55 ft (16.8 m) for high mast lighting must be disregarded.
AS 5100.3 – 9 "Buried Structures"	• Culverts must be designed based on the methods of limit state design, using theoretical strength and serviceability calculations. • Design based on prototype or proof-load testing is not permitted. • In the design of culverts, the culvert units must be designed for sway.
AS 5100.4 – 5 "Functions of Bearings and Deck Joints"	Refer to Clause 11.6 of this Part for clarifications and interpretations.
AS 5100.5 – 9.2.2 "Design Shear Strength of Slabs"	The shear strength of culvert slabs must be calculated in accordance with AS1597.2 Appendix H.
AS 5100.5 – 2.4.3 "Cracking"	Minimum reinforcement of 500 mm2/m must be over any 300 mm length or width of concrete element. SL81 reinforcing mesh is deemed to meet this requirement.
AS5100.5 – 7.3 "Ties"	Reinforcement in tension elements designed as Ties (including those designed with Strut-and-Tie modelling) must not be lapped. Such reinforcement must be either continuous or mechanically connected.

6 Corrections & Additional Requirements to AS5100

6.1 The design must be undertaken using the Corrections & Additional Requirements to AS 5100 Bridge Design contained within this Clause.

CLAUSE	CORRECTED / ADDITIONAL WORDING
Clause 7.3 "Heavy Load Platform Loads"	The design loads for bridges are the W80, A160, SM1600 and (when specified) HLP400 The lateral placement of the HLP400 is: • Two marked lane bridge + 1.0 m either side of centreline of the bridge, or • Three or more marked lanes In two marked lanes with the vehicle travelling + 1.0 m either side of centre of any two adjacent marked lanes. Consideration should be given to the most likely path of the vehicle. The code co-existent half SM1600 on the adjacent lane(s) must be applied to create the worst effect. An Accompanying Lane Factor of 1.0 must be applied to this co-existent load. • One lane ramp Must be positioned on a one lane ramp as located by the designer. The tolerance on lateral position must be specified. The design location of the HLP400 must be shown on the General Arrangement drawing.
Clause 16.5.5 "Loads on superstructures with superelevation (due to water flow)"	Amendment No.1:2017 to AS 5100.2: 2017 - published on 07-August-2017.
Additional requirements to AS 5100.5 for prestressed members	Maximum compressive stress when HLP320 or HLP400 present is 0.6f'c
Clauses 8.2.1.2, 8.2.1.3, 8.2.1.5, 8.2.2.1, 8.2.3.3, 8.2.4, 8.2.4.1 to 8.2.4.7, 8.2.4.10, 8.2.5, 8.2.5.2, 8.2.5.5, 8.2.7, 8.2.8, 8.2.9.1, 8.2.9.3 Strength of Beams in Shear and Torsion	Amendment No. 1:2018 to AS5100.5:2017 - published on 12-November-2018
Equations 8.2.1.7 Strength of Beams in Shear and Torsion	Amendment No. 1:2018 to AS5100.5:2017 - published on 12-November-2018
Equation 8.5.3.1 Deflection of Beams	Amendment No. 1:2018 to AS5100.5:2017 - published on 12-November-2018
Table 4.14.3.2 Required cover where standard formwork and compaction are used	Concrete decks cast onto precast elements (such as deck units and Super T-girders) must have a minimum cover at the bottom of the cast-in-place deck of: • 30 mm for Exposure Classifications A and B1 • in accordance with AS 5100 Table 4.14.3.2 for other exposure Classifications

7 Selection of Structure Type

7.1 The Contractor shall assess and recommend the optimal bridge structure type (or types) to achieve the project objectives.

7.2 The selection of the structure type shall assess and balance the requirements of:

a) whole of Life Cost including CAPEX & OPEX;

b) constructability including;

i) construction safety;

ii) Impact to the adjacent local community including traffic, residents and users;

c) maintenance aspects including;

i) future maintenance (minimising) of the bridge structure, bearings and joints;

ii) impact of maintenance activity on operational services;

d) bridge aesthetic requirements and public realm; and

e) benefit to local industry.

7.3 Submission and written acceptance of the proposed structure type by the Department's Principal Structural Engineer shall constitute a **Hold Point**.

7.4 The supporting information on the selection of the structure type may be included within the Design Basis report.

8 Aesthetic Requirements

8.1 The bridge structural design shall be integrated with the aesthetic requirements using the RMS NSW, Bridge Aesthetics Design Guideline: https://roads-waterways.transport.nsw.gov.au/business-industry/partners-suppliers/documents/centre-for-urban-design/bridge-aesthetics-guidelines.pdf.

8.2 In addition, the bridge shall include the following aesthetic requirements:

a) soffits of bridges must be in plane (i.e. girder underside soffit levels must be at the same depth as adjacent girder(s) after taking into account deck crossfall);

b) the minimum height from the finished ground level (of a publically accessible area) to a bridge soffit shall be 3.0m, unless agreed with in writing by the Principal;

c) white cements are not permitted for use in any part of any structure;

d) use of materials that may result in "rust" staining (e.g. corten) of any part of any structure is not permitted;

e) where there is significant variability in the colour of concrete finishes in highly visible areas, painting of concrete must be used to provide a consistent uniform appearance; and

f) temporary lifting and erection recesses or formwork marks must not be visible (for precast concrete elements).

8.3 The Contractor shall submit a Bridge Aesthetic report detailing the collaboration between the architectural and structural design, addressing the RMS Bridge Aesthetics Design Guideline elements.

8.4 Submission of the Bridge Aesthetic report shall constitute a **Hold Point**.

8.5 The Bridge Aesthetic report may be included within the Design Basis report.

9 Earthquake Design Provisions

9.1 Unless otherwise specified, all bridges must be designed as BEDC-3 structures.

9.2 The detailing of reinforcement must comply with Section 10.7.6 of AS 5100.5.

9.3 Lapping of reinforcement (including legs of ligatures between the outside face of the main flexural reinforcement and the surface of the member) in potential plastic hinge zones is not permitted.

9.4 Identification of potential plastic hinge zones must recognise the possibility of a seismic event larger than that used in the design.

9.5 In potential plastic hinge zones, pile helice terminations must be anchored. If it is not possible to extend helices into capping beams, pile caps or footings, they must be anchored at their ends by an extra 1½ turns and then welded onto themselves in accordance with AS 1554.3, or cogged around a longitudinal bar and passed into the pile and through the core. The last ligature / termination must end within 50 mm of the pile concrete end adjacent to the capping beam, pile cap or footing. A series of ligatures must then extend into the capping beam, pile cap or footing to restrain the longitudinal pile starter bars as per AS5100 requirements.

9.6 Potential laps within adjacent piles in piled retaining walls must also be staggered to avoid issues with potential plastic hinges.

10 Bridge Abutments & Substructures

Bridge Abutments

10.1 Where an abutment has a sloping embankment beneath the bridge superstructure, slope protection must be provided at least over the area directly underneath the bridge superstructure. The slope protection must:

a) blend in and harmonise with the environment;

b) require minimal maintenance;

c) be structurally stable;

d) have a uniform plane surface; and

e) if paving bricks or rocks and the like are used they must be adequately bonded in place to prevent removal by vandals.

10.2 Care must be taken in the design to avoid damage to the bridge abutment from movements of soft soil caused by loading from the approach embankment. Down drag (negative skin friction) effects due to settlement on piles must be allowed for in the design of such piles together with methods to reduce such effects.

10.3 Where the depth of soft soil over weathered bedrock exceeds 3 m, raking pile configurations must not be used in abutments.

10.4 The design and prediction of soil movement must be undertaken and documented by a qualified geotechnical and foundation Chartered Professional Engineer (CPEng).

Bridge Approach Slabs

10.5 Bridges must be provided with adequately designed and suitably proportioned approach slabs with a minimum length of 3 m in cuts and 5 m in fills.

10.6 At each bridge abutment, one end of the approach slab must be tied to the abutment to prevent sliding of the approach slab relative to the abutment and settlement of the road surface next to the bridge.

10.7 In fill areas, provision must be made to jack the bridge approach slabs after any settlement occurs.

10.8 Approach slabs constructed in-situ must be designed in two equal width parts with a construction joint along the centreline (of the bridge / approach slab). Lift points must be included at the approach slab end (away from the bridge deck) to facilitate lifting of the approach slab.

10.9 The methodology for re-levelling of bridge approach slabs after settlement occurs must be included in the design drawings.

10.10 The approach slab nosing adjacent to the bridge must be designed to allow a minimum pavement thickness of 325 mm to be placed over the remainder of the approach slab. The approach slab must then grade downwards away from the bridge deck at a 10% slope.

10.11 For bridges in cut, the Principal may accept an alternate treatment to manage the differential settlement between the bridge and the abutment, where it can be demonstrated:

a) the risk of differential settlement is appropriately mitigated; and

b) the proposed alternative provides a Whole of life (CAPEX and OPEX) benefit.

10.12 Submission and acceptance of alternative treatments shall constitute a **Hold Point**.

Substructures

10.13 Depending upon the grade separation type, pile caps must be designed so the top of the pile cap is below ground level and not visible (i.e. road (at grade) is under the elevated bridge) or the piles and pile-caps must be covered by an approved façade (i.e. where the bridge (at grade) is over the lowered road).

Bridge Pier & Abutment Protection Barriers

10.14 Piers are to be avoided in a road median or the clear zone wherever possible. Where piers are used the following provisions must be applied.

10.15 Irrespective of protection provided, all piers and vertical abutments must be designed for the collision load specified in AS 5100.2 – 11.2. Where the road speed environment is 80 kph or greater, the collision load must be increased to 4000 kN.

10.16 Protection barriers must extend past the limits of the pier / abutment to a minimum of 15 m on the approach side, and a minimum of 8 m on the trailing side for a road speed environment of 80 kph or greater. The barrier length may be reduced for lower speed environments (as per Austroads requirements) however a minimum of 4 m must be provided on the trailing side.

10.17 The clear zone for barrier deflection purposes adjacent to layback abutments must be taken from the carriageway edge line to the toe of the layback abutment.

10.18 Layback abutments must be treated as non-frangible elements for the purpose of calculating barrier deflection requirements.

10.19 Approval of alternative barrier treatments will be at the sole discretion of the Principal.

10.20 Bridge piers and vertical bridge abutments must have TL5 rigid concrete barrier protection in accordance with the following options, in order of precedence:

<u>Option 1 – Barrier with > 3.0m clearance from the back of barrier to the face of the pier / abutment</u>

10.21 A 1100 mm high TL 5 barrier must be used where there is at least 3 m clearance from the back of barrier to the face of the pier / abutment, and meet the following requirements:

a) roll allowance to Austroads Guide to Road Design, Part 6;

b) designed in accordance with drawing S-4064, Sheet 2;

c) a minimum 1500 mm wide 75 mm thick asphalt strip (adjacent to the back of the barrier) between the barrier and the pier; and

d) barrier set 75 mm into the asphalt.

<u>Option 2 – Barrier with 0.3 m to 3.0 m clearance from the back of barrier to the face of the pier / abutment</u>

10.22 A 1300 mm high TL 5 barrier must be used for 0.3 m to 3 m clearance from the back of the barrier to the face of the pier / abutment, and meet the following requirements:

a) roll allowances to Austroads Guide to Road Design, Part 6;

b) designed for a 600 kN transverse impact load as per AS 5100.2, Table 12.2.2;

c) the barrier and integrated footing / piles must either be structurally designed and have reinforced concrete footing / piles with full strength, moment and shear barrier connections or the barrier, footing and connection can be based on full scale crash testing (reference note 3 – barriers at front of rigid structural hazards, Drawing S-4064, Sheet 3);

d) must span the length of the pier and be approved by the Commissioner; and

e) backfill between the barrier and the pier must be subject to approval by the Commissioner.

Option 3 – Barrier separated 0.05 m to 0.3 m from the back of barrier to the face of the pier / abutment

10.23 The design impact load for the pier / abutment footing must be the collision load from AS 5100.2-11.2, increased if the speed environment is 80 kph or greater.

10.24 The barrier must be connected to the pier / abutment footing where there is 0.05 m to 0.3 m clearance from the back of the barrier to the face of the pier, and meet the following requirements:

a) roll allowances to Austroads Guide to Road Design, Part 6;

b) designed for a 600 kN transverse impact load as per AS 5100.2, Table 12.2.2. No component of barrier impact loading must be transferred to the pier behind; and

c) backfill between the barrier and the pier must be subject to approval by the Commissioner.

Bridges with Supports on Railway Station Platforms

10.25 Collision loads on support elements specified in AS 5100.2 Clause 11.4.2 do not apply to piers and columns located on platforms with all of the following characteristics:

a) platforms are earth-filled and designed and constructed in accordance with AS 4678;

b) the transverse location of the face of a pier or column is at least 4.3 m from the centreline of the closest rail track; and

c) the longitudinal distance of a pier or column is more than 20 m from the end of a ramped platform (excluding the length of the ramp), or is more than 2.6 m from the end of a vertical (non-ramped) platform.

10.26 All piers and columns, including those on platforms as described here, must be designed for the minimum collision load specified in AS 5100.2 Clause 11.4.3.

10.27 Platforms must not be assumed to provide a degree of protection to permit reduction of this collision load.

11 Traffic Barriers and Roll Allowance

11.1 Roll allowance clear widths to Austroads Guide to Road Design, Part 6 must be provided behind all barriers from the toe of the barrier up to a height of 4.3 m. Where non-rigid barriers are used, design barrier deflection widths must be added to the roll allowance clear width.

12 Bridge Superstructure

Girder Bridges

12.1 Stepped or half-joints must not be used in girder bridge designs.

Super T-Beams

12.2 Where Super T-beams are used and are designed to be placed with the top flange of the beam matching the deck crossfall, the bearings must be placed horizontally and consideration given to have the bearing centreline vertically in line with the centre of gravity of the beam to ensure beam stability during erection.

12.3 The design must compensate for crossfall by providing a tapered plate between the beam and the bearing.

12.4 Bridges with a skew angle of 35 degrees or greater must have special consideration given to the detailing at the ends of the beams.

Post Tensioned Elements

12.5 Where structural components incorporate post-tensioned elements, the design must clearly state whether the basis of the design is bonded or un-bonded stressing tendons with appropriate annotations being made on the construction drawings.

12.6 Segmental precast post-tensioned structures must use oversize ducts to allow for additional strand capacity in the event of duct blockages.

Elastomeric Bearings

12.7 All elastomeric bearings must have keeper plates top and bottom. A tapered steel bearing plate between the bridge girder and upper (flat) bearing plate must be used.

Drainage of Voids in Superstructure

12.8 Where bridge superstructures contain voids (e.g. box girder, super T-Beam, voided slab construction and voids under footway slabs, etc.) provision must be made for drainage to ensure no pooling of water within any void.

12.9 For voids in beams, the drainage outlet must have an opening not less than 25 mm in diameter. For all other voids, the drainage outlet must have an opening not less than 50 mm in diameter.

12.10 For voids under footway slabs, provision must be made for drainage of the void with drainage taken to drainage pits off the structure and connected to an appropriate drainage system.

Deck Joints

12.11 Decks of bridges must be continuous over the full length of the bridge with movement joints permitted at the abutments only for bridges less than 100 m long.

12.12 Adequate provision must be made for end diaphragms to move against the fill (where applicable).

12.13 Intermediate deck joints must not be used in bridges where the deck length is less than 100 m. Where abutment movement joints are not used, adequate provision must be made for end diaphragms to move against the fill.

12.14 For bridges over 100 m long, joints must be used. Free draining finger plate type joints are preferred provided joint geometry is suitable for cyclists as appropriate. Bonded steel / rubber type joints are not permitted. Where finger plate type joints are used, adequate measures, including drainage, must be taken to prevent water or other liquids from staining any pier or abutment, causing any damage to any bearing or restraint, or causing corrosion or deterioration to concrete or metal surfaces.

12.15 Joints must not inhibit the proper placement of concrete and must have adequate provision for maintenance and inspection access.

12.16 Joints must be detailed and constructed such that the noise generated by traffic crossing the joint is kept to a minimum.

12.17 If modular type joints are used they must comply with the Road and Maritime Services (New South Wales) specification B316 "Modular Bridge Expansion Joints".

12.18 The maximum open gap of deck joints must be limited to 70 mm at the serviceability limit state and 85 mm at the ultimate limit state.

12.19 The use of steel angles exposed at deck level as part of the joint system is not permitted.

12.20 Sliding plate expansion joints are not permitted for road bridges, except on footpaths. Anchorage of deck joints must be in accordance with AS 5100.4, Clause 19.4 "Anchorage of deck joints for road bridges".

Deck Waterproofing

12.21 At a minimum, bridge deck waterproofing membranes must:

a) be applied over the whole deck area directly onto the deck surface;

b) as far as practicable – over (vertical) negative moment regions of fully integral abutment bridges; and

c) consist of an approved modified bitumen product over negative moment regions. Other approved products may be used elsewhere on the deck.

Pedestrian / Bicycle Bridges

12.22 Bridges that are exclusively for pedestrians and / or bicycles must include provision for the incorporation of fully enclosed screens in accordance with AS 5100.1 – 16.4 “Protection screens for objects falling or being thrown from bridges”.

13 Bridge Fixtures & Fittings

Utility Services and Lighting

13.1 Where required, the design must provide for road lighting, telecommunications and / or incident management systems in bridge structures by the provision of conduits on both sides of the structure and if practicable, incorporated into the kerb or footpath.

13.2 Conduits must not be visible. All conduits must be provided with draw cords.

13.3 Where road lighting poles and / or incident management columns are to be positioned on a bridge structure, provision must be made for conduit connections including cable junction boxes between the poles / columns and the street lighting / incident management system conduits.

13.4 Conduits, poles and columns are to be positioned outside the clear zone, or else behind a barrier, and they must be fixed independently of the barrier so as not to fall onto traffic in a vehicle collision incident. This may require an independent footing system passing through the barrier. They must be positioned to satisfy the requirements for vehicle roll allowance as outlined in Austroads Guide to Road Design Part 6.

13.5 In situations where it is not possible to locate the pole independent of the barrier, then the pole-to-barrier connection must be designed to the full plastic capacity of the pole section at the connection point – in this case the plastic capacity of the pole must be un-factored and increased by 20% to account for over-strength.

13.6 Gas and water mains must not be located inside box girders. Other services may be located inside box girders provided they are carried by appropriate racks or brackets.

13.7 In multi-beam bridges, services must be located between beams, above the soffit plane.

13.8 Design of Utility Services and lighting on structures must be in accordance with the utility service asset owner’s requirements.

13.9 No sag under dead loads and utility services loads is permitted.

Attachments and Fixtures

13.10 Attachments to concrete sections of the structure (e.g. holding down bolts) must be cast into the structure and not fitted after construction. These must be hot-dip galvanized steel or grade 316 stainless steel.

13.11 Exposed fixtures must be hot-dip galvanized or grade 316 stainless steel.

13.12 Fixtures inside box girders must be hot-dip galvanized steel or stainless steel.

13.13 Fixtures must not be attached by drilling into concrete.

13.14 Any ferrules cast into the structure must be hot-dip galvanized steel or grade 316 stainless steel.

13.15 All infrastructure (e.g. supports, brackets, pits, etc) associated with services must be approved by the relevant service authority.

Lighting Strike Protection

13.16 This clause applies where the top of metallic lighting poles attached to the bridge are more than 2m higher than those located in the adjacent terrain.

13.17 In this case, the bridge must incorporate lightning strike protection that effectively provides an electrical connection between the metallic structures and earth. This must include one or more of the following:

a) electrical connectivity of all reinforcement and support structures;

b) installation of lightning conductors of cross sectional area and frequency in accordance with AS 1768; and

c) installation of flexible electrical conductors to bypass bearings (if present) complying with AS 1768.

13.18 Any ITS equipment mounted on the bridge must incorporate lightning strike protection in accordance with AS 1768.

Bridge Deck and Upper Retaining Wall Traffic Barriers

13.19 Bridge barrier components, including precast concrete elements, must be placed with a tolerance of ± 5 mm from the design location.

13.20 Concrete finish and installation tolerances must be in accordance with AS 3610 (Class 3) and AS/NZS 3845.1-2015. The concrete colour must be standard portland grey.

13.21 Attachments such as light poles, signs, cameras, throw screens, noise walls and urban design attachments will not be permitted to be attached to bridge traffic barriers. Any such items must be set behind the roll allowance clear width.

13.22 Clear widths for roll allowance behind the barrier must be in accordance with Austroads, Guide to Road Design, Part 6. This clear width must be measured from the toe (bottom) of the barrier and extend upwards above the barrier over the full 4.3 m height of the design vehicle envelope.

13.23 Barrier transitions must be designed for the appropriate design loading at each end of the transition element.

13.24 At its leading end, the barrier must be transitioned into the crash cushion or another type of barrier with a suitable crashworthy terminal. Alternatively it must have another type of impact protection as approved by the Department.

13.25 Design drawings must show an isometric view of the connecting element between the bridge barrier and the approach barrier, if appropriate.

13.26 Installation of service conduits within the barrier is not allowed.

14 Protection Screens (Anti-Throw Screens)

14.1 Protection screens or anti-climb devices are to be provided, where warranted, to manage the risk of anti-social behaviour, including of pedestrians throwing missiles from a structure, climbing on structures or jumping from structures, including potential self-harm.

14.2 As a minimum, protection screens must be provided when:

a) pedestrians are able to access the bridge, and

b) there is vehicular traffic beneath the bridge.

14.3 The Contractor shall undertake a risk assessment to determine:

a) the probability, consequence of anti-social behaviour on the bridge;

b) recommended type of protection screen;

c) the extent and type of any anti-throws.

14.4 Protection screens must comply with the provisions in AS5100 and the following requirements:

a) an additional robustness serviceability requirement that the maximum screen deflection relative to posts must be less than 30 mm for a transverse load of 0.6 kN applied over an area of 0.2 m by 0.2 m, acting anywhere on the screen;

b) maximum post deflection must be h/300 (h = height of the screen above the base connection) for a 1 in 20 ARI wind load or a transverse load of 0.6 kN acting at the top of the post;

c) must be designed for fatigue using a wind speed of 20 m/s and 200,000 cycles;

d) screens must be located outside the roll allowance clear width behind the barrier which must be in accordance with Austroads Guide to Road Design, Part 6. This clear width is measured from the toe (bottom) of the barrier (traffic side face) and extends upwards above the barrier over the full 4.3 m height of the design vehicle envelope. For non-rigid barrier systems, barrier deflection must also be taken into account;

e) where screen elements are able to be dislodged by a vehicle collision incident, then all such elements must be tethered and, depending on the material type, must be of an anti-shatter type;

f) to prevent electrochemical reaction, isolation must be provided between incompatible materials of the screen system;

g) the use of weathering steel is not permitted where it is possible for water runoff from the element to stain other elements, and that this staining is visible and likely;

h) the screen design (and general structural form) must prevent climbing by unauthorised person(s); and

i) anti-climbing devices should be included in the screen design if there is a risk of accessing the screen or behind screen.

14.5 Submission and acceptance of the protection screen risk assessment, and acceptance of the recommended extent type of protection screens shall constitute a **Hold Point**.

15 Noise Barriers

15.1 This clause applies where noise barriers are required in accordance with the requirements of PC-ENV4, Noise Assessment, treatment Design and Implementation and VicRoads Bridge Technical Note 007: “Noise Attenuation Walls”.

15.2 Where noise barriers are located in the vicinity of traffic barriers, the noise barriers must be located outside of the traffic barriers with sufficient clearance to avoid any damage in the event of vehicular impact upon the traffic barriers. The noise barriers must:

a) not rattle or vibrate;

b) be vandal resistant;

c) facilitate straightforward and efficient maintenance, repair and replacement. The construction and material of the screen must result in little or no maintenance over the period of its design life; and

d) be designed for fatigue using a wind speed of 20 m/s and 100,000 cycles. Where collapse of the noise barrier could fall onto marked traffic lanes, the design must consider fatigue using a wind speed of 20 m/s and 200,000 cycles.

15.3 Design of noise barriers will achieve a reduction in embodied carbon and increased recycled content compared to Business As Usual materials and technologies (described in the Department’s Sustainability Manual Appendix 6).

15.4 Alternative materials to concrete will be investigated as a means of reducing embodied carbon and increasing recycled content, with assessment completed in accordance with Section 9 of the Department’s Sustainability Manual. Justification will be provided for selection of the final approach.

15.5 The Design Report must include information on resistance of the barrier to the following:

a) impact resistance from 4 kg projectile dropped from height of 3.0 m;

b) defacement by sharp implements;

c) vermin;

d) graffiti; and

e) fire.

16 Major Sign Structures

16.1 Major sign structures (including cantilever signs and gantries over traffic) must comply with AS 5100.2 clause 24.

16.2 Where a structure supports electric or electronic devices or equipment, the structure must incorporate provision for all necessary ducts, cables, cable trays and junction boxes.

16.3 The fatigue strength of members and welded connections must be determined using full stress reversal for the stress range. Fatigue design shall be in accordance with VicRoads Bridge Technical Note 14 – Sign Gantries and Lighting Masts.

16.4 If levelling nuts are used on anchor bolts under baseplates, full stress reversal must be considered in the design of the anchor bolts. If levelling nuts are not used then full stress reversal does not apply. Drawings must state explicitly whether levelling nuts can be used, or not.

16.5 If the structure supports a Variable Message Sign, an access platform must be provided for the full length of the overhead structure (refer RD-ITS-D1 - ITS Design). The platform must be free of sharp corners and projections that may cause injury and must not obstruct the rear access doors to the sign.

16.6 The allowable clearance under a Gantry sign to the pavement must be a minimum of 6.5 m.

16.7 The location of the gantries must be assessed for traffic safety in accordance with Austroads Guide to Road Design Part 6: Roadside Design, Safety and Barriers, to determine appropriate level of traffic protection.

16.8 The Contractor must provide the proposed safety protection drawings for each gantry for the Principal's approval before the gantry installation. Submission of the drawings for the proposed safety protection for each gantry shall constitute a **Hold Point**.

17 Maintenance Requirements

Accessibility for Inspection and Maintenance

17.1 All structures must be designed and constructed to provide for ease of inspection and maintenance in accordance with the relevant Australian Standards.

17.2 Deck joints must be readily accessible with provision to allow for inspection, maintenance and replacement in accordance with AS 5100.4, Clause 19.3 "Requirements". Where stormwater pipes are embedded within the structure, the pipes must be accessible for cleaning and must be fire-proof in the event of a hydrocarbon fire.

17.3 Bearings must be readily accessible with provision to allow for inspection, maintenance and replacement (including jacking of components) in accordance with AS 5100.4, Clause 7 "General Design Requirements".

17.4 The design must:

a) ensure that bearing replacement can take place without the need to close the bridge;

b) include a procedure for replacement, including details of any traffic speed / lane restrictions required during replacement; and

c) indicate permissible jacking locations and estimated jack loads on the drawings.

17.5 The Contractor shall submit details of the proposed access for Inspection and Maintenance. Submission of information on the Inspection and Maintenance access shall constitute a **Hold Point.**

17.6 The information on the Inspection and Maintenance access may be included within the Design Basis report.

Box Girder Bridges

17.7 Safe access for inspection of medium and large box girders must be provided in accordance with the following:

ITEM	MEDIUM BOX GIRDER	LARGE BOX GIRDER
Internal lighting and power supply for inspection	Not required	Required
Access to each internal cell	Lockable hatch in bottom flange, located at least every second span.	Lockable hatch through abutments and / or in bottom flange, located at least every second span.
Access through internal diaphragms	Minimum opening 1.0 m wide x 0.6 m high (for concrete) Minimum opening 0.6m wide x 1.0 m high (for steel)	Minimum opening 0.9 m wide x 2.0 m high.
Position of internal diaphragm access openings	The opening invert must be positioned at a convenient height to crawl through - i.e. not level with the bottom flange floor, with ramps provided to the invert.	The opening invert must be level with the top surface of the box girder bottom flanges.
Ventilation holes	One 75 mm diameter hole in the bottom flange of each box girder span covered with bird proof mesh.	One 100 mm diameter hole in the bottom flange of each box girder span covered with bird proof mesh.

17.8 Access hatches must be positioned to allow for practical ease of access and to minimise the need for traffic control when in use. Accessibility design must comply with the requirements of AS 2865 Confined Spaces.

17.9 Submission of the drawings showing the access arrangements through internal diaphragms shall constitute a Hold Point.

17.10 All box girders must incorporate bird proofing.

17.11 Box girders with 3 or more spans shall have internal signage showing direction and location of exit points.

17.12 Large Box Girders constructed of concrete must have circular internal fillets of sufficient radii to mitigate stress concentrations due to torsional shear flow.

17.13 Large Box Girders must include additional post-tensioning ducts and anchorages for installation of future tendons.

Anti-Graffiti Coating

17.14 Where an anti – graffiti treatment has been specified, it must:

a) be approved to APAS – 1441/1 where a permanent clear finish is required;

b) be approved to APAS – 1441/2 where a colour is required; and

c) comply with the technical requirements specified in VicRoads Standard Specification Section 685 Anti-Graffiti Protection and Graffiti Removal, available from: http://webapps.vicroads.vic.gov.au/VRNE/csdspeci.nsf/.

Maintenance Plan

17.15 A plan providing comprehensive details of the maintenance required for the structure, including procedures and time schedules for the repair and / or replacement of elements such as bearings and expansion joints.

17.16 As a minimum, the procedures must include in detail:

a) a copy of the Durability Plan;

b) details of the frequency and extent of inspection required;

c) details of the frequency and extent of monitoring required;

d) deterioration levels at which rectification work or replacement is required;

e) intervention methods; and design limitations / considerations;

f) details of how to safely access locations for regular maintenance, inspections or replacement of elements;

g) method of replacement of specific elements;

h) contact details of suppliers of replacement elements and spares;

i) warranties on proprietary products;

j) any manuals and drawings available from the manufacturer of all externally supplied components used in the works, including mechanical and electrical elements; and

k) a historical record of construction issues and their resolutions.

17.17 Submission of the Maintenance Plan shall constitute a **Hold Point.**

18 Materials and Durability

18.1 In addition to the requirements specified in the Department's Master Specification and AS 5100, the Works must be designed to comply with the requirements of this clause.

18.2 Materials, components and processes for all permanent works must provide the required durability for each element of the works. Where an item is not readily accessible for maintenance or replacement, it must be designed so that it will function for the life of the structure without maintenance.

18.3 The Design Documents must clearly display details of all materials to be incorporated into the Works.

Concrete

18.4 Durability design for concrete must be in accordance with the AS 5100 with the following additional requirements:

a) Dense, durable concrete must be used. In areas of severe exposure (equal to or exceeding AS 5100.5 – 4.3 exposure classification B2), blended cements must be used.

b) Where the Exposure Classification is B2 or more severe, the concrete must be specified as High Durability Concrete (refer to ST-SC-S7 "Supply of Concrete").

c) Concrete mix design must include design for the prevention of the deleterious effects of erosion, delayed ettringite attack, acid attack, sulphate attack and alkaline aggregate reaction as applicable.

d) Special measures must be taken to minimise the possible deleterious effects of heat of hydration in thick concrete sections, e.g. by the use of blended cements, cooling the concrete during curing, insulated forms and larger aggregates.

e) For large concrete members, the Design Documents must include details of the methodology to ensure that, during the concrete placement and curing period:

i) the maximum differential temperature between core and surface concrete does not exceed 20° C; and

ii) the maximum concrete temperature anywhere within the concrete member not exceed 75° C.

f) Epoxy coated reinforcement must not be used.

g) Cast-in-place stitch pour concrete (i.e. such as that used to connect precast concrete barriers to concrete bridge decks) must have a maximum shrinkage of 600 micro strain.

h) Reinforcement elements crossing construction joints must be galvanized, where the construction joint:

i) is subject to constant exposure to weather; or

ii) is located in a highly visible area; or

iii) is in a critical location where it is possible that water is able to enter through a crack at the construction joint and cause corrosion of the reinforcement in the life of the structure. This includes construction joints below the water table and in-situ infill concrete within precast traffic barriers.

i) All bridge and culvert structures must conform to the following requirements:

i) durability planning and design must incorporate the recommendations of the Concrete Institute of Australia publication: Recommended Practice, Durability, Z7; and

ii) the design must incorporate a Durability Report prepared by a durability consultant.

18.5 Testing to verify that the proposed concrete mix design will achieve the specified properties may be undertaken sufficiently early to enable the test results to be incorporated into the design. If this is not practicable, the design must incorporate a range of concrete properties, as indicated in AS 5100.5.

18.6 The submission of the Concrete mix designs and testing for concrete design parameters shall constitute a **Hold Point.**

Creep and shrinkage testing.

18.7 The designer may choose to undertake the following creep and shrinkage testing to refine their design:

a) Prior to the receipt of long term testing results on creep, shrinkage and modulus of elasticity of the concrete mix design, the Structural Engineer must use a range of parameters equal to plus and minus 30 % of the creep factor and design shrinkage strain and plus and minus 20 % of the modulus of elasticity of concrete determined from AS 5100.5.

b) Following receipt of shrinkage and creep testing, the Contractor may adopt the actual values in the design for creep, shrinkage and modulus of elasticity.

c) The concrete mix components tested in accordance with this clause, including aggregate, additives and cement, must be obtained from a single material source with sufficient dedicated resources to ensure that the concrete in all components constructed from that mix has constant concrete properties, including heat generation, shrinkage and creep.

d) The results of this testing, plus any available past testing of similar concrete mixes using the proposed constituent materials, must be used to inform the Contractor and may be used to modify the range of creep and shrinkage parameters adopted in the design, subject to the approval of the Superintendent.

Steelwork

18.8 Unless specified otherwise, all exposed steelwork must be either:

a) hot dipped galvanized in accordance with AS 4680; or

b) protected by a high grade protective coating system.

18.9 The life to major maintenance of a protective coating system must not be less than 25 years. Coating systems must include a primer and finish coat as a minimum.

18.10 Any painting system over galvanized steel must have a 10 year warranty against chipping, flaking, peeling or bubbling without the need for periodic preventative maintenance.

18.11 The assessment of the corrosivity at the location of the structure must be carried out in accordance with AS 4312 and take account of any knowledge of microclimates or other influencing factors specific to the location.

18.12 The use of uncoated corrosion resistant steel in a situation where the steelwork can be seen by pedestrians or road users is not permitted.

18.13 The Design Documents must include the requirements for ST-SS-S2 “Protective Treatment of Structural Steelwork” and include full details of the protective treatment design in the Contract Documents.

18.14 Where hot dipped galvanizing is to be used, the Design Documents must include all specific details necessary for ST-SS-S3 "Galvanizing", which includes the information listed in Appendix A "Purchasing Guidelines" of AS 4680.

18.15 Site welding of the steelwork must be used as a last resort, in order to minimise damage to steelwork protective treatment(s).

18.16 Selection of the coating system must be based on Table 6.3 of AS 2312 for the appropriate corrosivity category.

18.17 The coating system used must be selected from the following system designations, as detailed in AS 2312, Table 6.3:

a) EHB6 (Primer must be PRN C01a, C01b or C01c).

b) PSL1 (System must include an additional intermediate coat of PRN C13 epoxy MIO to 125µm).

c) PUR5 (Primer must be PRN C01a, C01b or C01c).

d) Where a decorative or aesthetic finish is desired, only systems PSL1 and PUR5 are able to be used.

18.18 The total minimum dry film thickness for each coat must be as specified for the designated system detailed in AS 2312, Table 6.3, measured in accordance with test procedure MAT-TP913.

18.19 Fasteners to be hot dip galvanized in accordance with AS 1214 (bolts and nuts) and AS 4680 (washers).

18.20 Submission and Acceptance of steel coating systems constitutes a **Hold Point.**

Major Sign Structures

18.21 All components of major sign structures must be hot dip galvanized after fabrication in accordance with AS/NZS4680. Prior to galvanizing, steel work to be blast cleaned to Class 3 in accordance with AS 1627.4, to preparation grade SA-3 in accordance with ISO 8501-1.

18.22 If painting of galvanized steel is required, all galvanized surfaces to be abrasive sweep (brush) blast cleaned in accordance with AS/NZS 4680, Appendix 1 and painted with primer suitable for the selected brand of the top coat.

18.23 The top coat must be one coat of a two pack polyurethane gloss finish as approved under APAS-2911 to a minimum dry film thickness of 50 um.

Super T Girders

18.24 Strand cutting and coating of the end of the strand must be delayed for as long as practical, with a minimum of 3 days, after de-moulding of beams.

18.25 The strand end face coating must allow for further shortening of the girder (relative to the remaining debonded strands) by providing suitably sized voids at the end of each individual debonded strand prior to epoxy coating of the girder end. Alternatively, if voids aren’t used, the epoxy coating must be reinspected for cracking just prior to girder installation and the epoxy reapplied to any cracks.

18.26 Strands that are debonded along their entire length must be fully removed as soon as practical after de-moulding of the beams. The void left from the removed strand at the girder ends must be plugged with a high build, non-sagging epoxy paste.

18.27 The inside top (void) face of the bottom flange of Super T girders does not require reinforcement normal to the longitudinal axis of the girder.

Balustrades and Barriers

18.28 Replaceable pedestrian balustrades and barriers must have a minimum life to major maintenance of 30 years.

18.29 Non-replaceable balustrades and barriers must have a design life as specified in Clause 4.

18.30 Ferrules must be galvanized or stainless steel. Zinc plated ferrules are not permitted.

Durability Report

18.31 This clause applies where a Durability Report has been specified as part of the project scope or requirements.

18.32 The Durability Report must address all key elements addressing how the required design life will be achieved and be prepared by a person with appropriate qualifications and extensive experience in this field.

18.33 For concrete structures, the Durability Report must:

a) use appropriate concrete properties that are based on testing of the concrete mix designs to be utilised in each of the concrete elements;

b) adopt a probabilistic performance based durability design approach; and

c) account for the expected variation in these concrete properties and in the concrete cover and surface chloride concentration; and

d) conform to clause 17.1

18.34 Durability of self-compacting concrete and uncompacted concrete must satisfy the same durability requirements as for compacted concrete.

18.35 In thick concrete members, special measures must be taken to limit the maximum differential temperature between core and surface concrete to 25° C and the maximum concrete temperature anywhere must not exceed 82° C.

18.36 Submission of the Durability Report shall constitute a **Hold Point.**

19 Records

Drawings

19.1 Design drawings and records are to be provided in accordance with the Engineering and Design Management Plan PC-EDM1.

19.2 Construction drawings are to be provided in hard copy and AutoCAD format.

19.3 The drawings must be to a level of detail such that no further production of drawings (e.g. 'shop detail drawings') will be required to assist construction.

19.4 Any reference to any standard or ancillary drawings on any sheet must have the reference to its sheet number.

19.5 The as-constructed drawings must be drafted and presented in accordance with the Department's Road Design Standards and Guidelines.

Reports

19.6 The design report(s) must include:

a) A full set of design calculations, incorporating calculations and determinations for all elements, appropriate sketches and details;

b) details of structural design, including:

i) summary of design methodology, design loadings and design assumptions;

ii) summary of design calculations;

iii) approach to minimising whole of life carbon emissions

iv) erection methodology and equipment;

v) geotechnical design methodology, assumptions and summary calculations; and

vi) durability, maintenance and access.

c) procedure for replacement of bearings;

d) comprehensive details of the protective coating system (for steel members);

e) electronic structure models and data files including Microsoft Excel spreadsheets;

f) Durability Plan (where specified);

g) design summary details in accordance with Appendix 3: “Form STR-DP1-2”; and

h) design summary sketch and bridge live load capacity in accordance with Appendix 4: “Form STR-DP1-3” sufficient to assess the bridge’s ability to handle wide, high and / or heavy loads.

20 Hold Points

20.1 The following is a summary of Hold Points referenced in this Part:

Document Ref.	HOLD POINT	RESPONSE TIME
7.3	Submission and written acceptance of the proposed structure type	10 Working Days
8.4	Submission of the bridge aesthetic report	10 Working Days
10.12	Submission and acceptance of alternative treatments to bridge approach slab	10 Working Days
14.5	Submission of the protection screen risk assessment & treatments	10 Working Days
16.8	Submission of the proposed safety protection drawings for each gantry	10 Working Days
17.5	Submission of Inspection and Maintenance access information	10 Working Days
17.9	Submission of the drawings showing the access arrangements through internal diaphragms	10 Working Days
17.17	Submission of the Maintenance Plan	10 Working Days
18.6	Submission of Concrete mix designs and testing for concrete design parameters	10 Working Days
18.20	Submission and acceptance of the steel coating system	10 Working Days
18.36	Submission of the Durability Report	10 Working Days

21 Appendix A

Form STR-DP1-2 DESIGN SUMMARY

Plan No. _____ Project Leader: _____ Date: _____

Project: _____

_____

Structure Description: _____

Design Standard: _____

_____

Roadway Width: _____

No. Design Lanes: _____

Vehicle Loads:

Load Type	DLA (%)	Transverse positions of loads considered

Load Distribution:

Other relevant design decisions:
Include the following where applicable:
variations from Codes,
information critical to the design or future structure performance

22 Appendix B

Form STR-DP1-3 STRUCTURE CAPACITY SUMMARY

Designer: _____ Date: _____ PLAN NO. _____

Checked: _____ Date: _____

Structure / Road names: _____
Structure Description: _____

Design Year: _____ Design Standard: _____
Line Diagram of Structure (show spans used in analysis):

Diagram of cross section:

LIVE LOAD CAPACITIES1

ULTIMATE STRENGTH:	Edge Beam2	Internal Beam
Ultimate LL Moment Capacity		
SERVICEABILITY: (PSC only)3 Required: Yes ☐ No ☐ LL Moment Capacity - Case 1		
(steel stress increment) - Case 2		

Shear or Reaction check required5 ? Yes ☐ No ☐ If yes, complete capacity information on reverse side

Live Load Distribution Factor4 _____
Comments:

DLA used in design _____

If Shear or Reaction is likely to be critical5, complete the following capacities:
(only complete if required. Insert dash in cell if not critical)

LIVE LOAD CAPACITIES1

ULTIMATE STRENGTH:	Edge Beam2	Internal Beam
Ultimate LL Shear Capacity		
Ultimate Reaction on Substructure		

NOTES

These forms are suitable only for simply-supported structures. For continuous structures, capacities are required at tenth points along each span. Attach capacities as appropriate. For continuous structures, the dead load effects, superimposed dead load effects, and any other load effects considered, must also be included, together with the limit state load factors applied. If negative moment redistribution has been applied in the design, the redistribution percentage must be given.

For structures without beam components (e.g. box girders, slabs etc), only complete one column. For slabs, indicate the width of slab to which the capacity applies. For culvert structures, provide corner and mid-span live load moment capacities.

Serviceability capacities are only required for prestressed concrete structures. The crack control provision of AS 5100.5 - clause 8.6.2.1 (b) and 8.6.2.2 must be used for the two cases as follows:

	Steel Stress Increment Past Decompression	Min. Concrete Compression at Unreinforced Segment Joints‡
Case 1	0.75 x Table 8.6.2.1 value, or 0.55fy†	1.0 MPa
Case 2	Table 8.6.2.1 value, or 0.75fy†	0 MPa

† Whichever is lesser; fy refers to reinforcement only (this may govern for low strength steel e.g. grade 230).
‡ Segmental structures only.

The Live Load Distribution Factor is that proportion of load from a standard design lane that is distributed to the critical structural element, i.e. it is the actual load effect in the critical structural element divided by the load effect from one full design lane of load on the same structural element.

Designer to assess if shear or reaction capacity is critical in assessing future vehicle loads on the structure. If likely to be critical, shear or reaction capacities are required.