Government of South Australia
Department of Planning, Transport and Infrastructure

DPTI DESIGN STANDARD: STRUCTURAL

CONTENTS

1. GENERAL

This Design Standard specifies the requirements for the design of the following structures:

(a) bridges and associated structures which support loading from road traffic, light railways, heavy railways, pedestrians and / or bicycles;

(b) underpasses (traffic and pedestrian);

(c) culverts with a clear span greater than or equal to 1.5 m;

(d) major drainage structures and structures for Utility Services;

(e) retaining walls and associated structures;

(f) noise barriers; and

(g) non-standard sign support structures, such as cantilever signs and gantries.

Refer to DPTI Design Standard:"Reinforced Soil Structures" for the design of reinforced soil structures.

"Small Box Girder" means girders which are inaccessible internally, including Super –T and voided slab structures.

"Medium Box Girder" means a box girder with internal access and an internal vertical clearance less than 2.0 m.

"Large Box Girder" means a box girder with an internal vertical clearance greater than or equal to 2.0 m.

"Design Life" in regard to concrete, means the time for de-passivation of concrete at the reinforcing layer to occur plus 20 years to when surface cracks start to appear.

In this Design Standard, "Part" means a part of the DPTI Master Specification.

2. REFERENCES

Unless specified otherwise, all design and / or documentation must comply with the following:

1. DPTI: Structures Group Drafting Guidelines for Consultants
2. DPTI: Shear Design Guidelines for Culverts
3. AS 1100: Technical Drawing
4. AS 1312: Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings
5. AS 1428: Design for Access and Mobility

6. AS 2865: Confined Spaces
7. AS 4678: Earth Retaining Structures
8. AS 4680: Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
9. AS 5100: Bridge Design
10. NSW Roads & Maritime Services (RMS) specification B316: "Modular Bridge Expansion Joints", available from http://www.rta.nsw.gov.au/doingbusinesswithus/index.html
11. Austroads: Guide to Road Design, available from, http://www.austroads.com.au
12. Worksafe Victoria: Construction and Erection of Bridge Beams, available from www.worksafe.vic.gov.au
13. VicRoads Bridge Technical Note 1999/006: “Design Criteria for Noise Barriers”, available from: http://www.vicroads.vic.gov.au/Home/Moreinfoandservices/RoadManagementAndDesign/DesignStandardsManualsNotes/

DPTI standards and guidelines are available from http://www.dpti.sa.gov.au/standards/structures.

3. SAFETY IN DESIGN

The design process must take safety into account to ensure that the structures can be safely constructed, operated and maintained. The design of girder bridges must comply with the requirements of the Worksafe Victoria Publication: “Construction and Erection of Bridge Beams”.

4. DESIGN REQUIREMENTS FOR BRIDGES

4.1 General

Bridges (and where relevant, other structures) must be designed to meet the requirements of this clause and Clause 5 “Interpretation of the Bridge Design Standard”.

4.2 Accessibility for Inspection and Maintenance

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

Deck joints must be readily accessible with provision to allow for inspection, maintenance and replacement in accordance with AS 5100.4, Clause 17.3 "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.

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".

The design / drawings 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.

4.3 Box Girder Bridges

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

	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	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.

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.

All box girders must incorporate bird proofing.

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

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

4.4 Super T-Beams - Bearings

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. The design must compensate for crossfall by either:

(a) providing a tapered plate between the beam and the bearing (preferred); or

(b) providing a tapered recess in the bottom of the beam for the bearing.

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

4.5 Post –tensioned Elements

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

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

4.6 Drainage of Voids in Bridge Superstructures

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. 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. 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.

4.7 Joints in Girder Bridges

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

4.8 Bridge Approach Slabs

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.

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. In fill areas provision must be made to jack the bridge approach slabs after any settlement occurs. The methodology for re-levelling of bridge approach slabs after settlement occurs must be included in the design drawings.

4.9 Bridge Abutments

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; and

(d) have a uniform plane surface.

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

The design and prediction of soil movement must be undertaken and documented by a qualified geotechnical and foundation Professional Engineer.

4.10 Utility Services and Lighting

Where required, the design must provide for road lighting, feature 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. Conduits must not be visible. All conduits must be provided with draw cords.

Where road lighting poles and/or incident management columns 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. Any poles or columns must not be positioned inside the traffic and pedestrian barriers.

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

Exposed fixtures must be grade 316 stainless steel. Fixtures inside box girders must be hot-dip galvanised steel or stainless steel. Fixtures must not be attached by drilling into concrete.

Design of Utility Services and lighting on structures must be in accordance with the requirements of Part “D027 Design -Utility Services” and Part D029 “Design – Lighting” respectively.

4.11 Plaques

The design of each bridge or culvert structure must incorporate a plaque, located on the outside face of the left hand side wing wall at the approach end of the bridge or culvert closest to Adelaide. Plaque details are provided in the DPTI "Structures Group Drafting Guidelines for Consultants". The date on the plaque must be the year in which the structure was completed.

4.12 Attachments

Attachments to concrete sections of the structure (e.g. holding down bolts) must be cast into the structure and not fitted after construction.

4.13 Pedestrian/Bicycle Bridges

Bridges that are exclusively for pedestrians and / or bicycles must comply with the following:

(a) provision for the disabled must be made in accordance with AS 1428 "Design for Access and Mobility";

(b) where a level rest area is provided (including a rest area on the approaches), straight edge kerbs must be provided in order to conceal the deck when viewed in elevation;

(c) the requirements of Austroads: Guide to Road Design;

(d) include provision for the incorporation of fully enclosed screens in accordance with AS 5100.1 – 12.3 “Protection screens for objects falling or being thrown from bridges”; and

(e) where the bridge passes over a road, piers must not be located in a road median or the clear zone.

4.14 Deck Waterproofing

At a minimum, bridge deck waterproofing membranes must:

(a) be applied over the whole deck area; and

(b) consist of an approved modified bitumen product.

4.15 Lightning Strike Protection

This clause applies where metallic structures that protrude more than 2m above the deck surface are attached to the bridge (such as lighting support structures, traffic signal supports and traffic sign structures).

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.

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

4.16 Earthquake Design Provision

Bridges must be designed using the provisions of AS 5100.2 and AS 1170.4, using an earthquake annual probability of exceedance of 1 in 2000 years. Notwithstanding any conflicting terminology used in these standards, the following provisions must apply:

(a) The Acceleration coefficient (a) is assumed to be equal to the Hazard factor (Z).

(b) The Probability Factor (kp) must be taken as 1.7.

(c) The Site Factor (S) must be determined using the soil profile definitions from AS 1170.4-2007 and the following:

- For Site sub-soil Class Ae, S is assumed to be 0.67
- For Site sub-soil Class Be, S is assumed to be 1.0
- For Site sub-soil Class Ce, S is assumed to be 1.25
- For Site sub-soil Class De, S is assumed to be 1.5
- For Site sub-soil Class Ee, S is assumed to be 2.0

Note: In determining the Bridge earthquake design category (BEDC) using AS 5100.2 Table 14.3.1, the Probability factor kp is not applied.

(d) The Importance factor (I) is assumed to be 1.0.

(e) Static analysis must be undertaken using the provisions of AS 5100.2, except that the Horizontal design earthquake force (H*u) must be taken as equal to V and calculated using AS 1170.4-2007 and the following:

(f) The Structural performance factor (Sp) is deemed to be 1.0.

(g) The Structural ductility factor (μ) is deemed to be 0.7Rf, where Rf is the Structural response factor from AS 5100.2 Table 14.5.5.

(h) The H*u upper limit from AS 5100.2 Clause 14.5.2 is increased by a factor of 1.7.

The detailing of reinforcement must comply with Section 10.7.3.5 in AS 5100.5.

4.17 Anti Graffiti Coating

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/.

5. INTERPRETATION OF THE BRIDGE DESIGN STANDARD

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

AS 5100 must be read to incorporate the corrections listed in Appendix 1: “AS 5100 – Corrections”. The Design Report must include details of any additional interpretations or clarifications proposed.

Clause	Requirement	
AS 5100.1 – 6.2 "Design Life"	**ELEMENT**	**DESIGN LIFE (Years)**
	Structures, excluding the elements listed below	100
	Bridge bearings	50
	Expansion joints	50

Clause	Requirement
AS 5100.1 – 9.6 "Horizontal Clearance to Substructure Components of Bridges over Roadways"	All piers adjacent to roadways must be designed for collision load in accordance with AS 5100.2 - 10 "Collision Loads". Where the design speed of the adjacent roadway is 80 kph or greater, the collision load applied in AS5100.2 - 10.2 must be increased to 3000 kN. 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.
AS 5100.1 – 14 "Drainage"	Drainage water from the bridge must not discharge directly into any water course, railway line, traffic lane or footpath. The drainage system must be designed so that a minimum amount of water flows across deck joints. Free draining scuppers through decks must not be used. 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 5100.3 – 14 "Buried Structures"	For the design of culverts, the culvert units are assumed to be able to sway.
AS 5100.4 - 5 "Functions of Bearings and Deck Joints"	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. 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 must not be used. 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. Joints must not inhibit the proper placement of concrete and must have adequate provision for maintenance and inspection access. Joints must be detailed and constructed such that the noise generated by traffic crossing the joint is kept to a minimum. If modular type joints are used, the joints must comply with the Road and Maritime Services (New South Wales) specification B316 "Modular Bridge Expansion Joints", available from: http://www.rta.nsw.gov.au/doingbusinesswithus/specifications/bridgeworks.html The maximum open gap of deck joints is limited to 70 mm at the serviceability limit state and 85 mm at the ultimate limit state. The use of steel angles exposed at deck level as part of the joint system is not permitted. Sliding plate expansion joints must not be used for road bridges except for adjacent footpaths. Anchorage of deck joints must be in accordance with AS 5100.4, Clause 17.4 "Anchorage of Deck Joints."
AS 5100.5 – 9.2.2 "Design Shear Strength of Slabs"	The shear strength of culvert slabs must be calculated in accordance with Appendix 2: "Precast Reinforced Concrete Culverts Shear Design Guidelines".
AS 5100.5 – 2.8 "Cracking"	Minimum reinforcement must be 500mm^2/m for any 300mm length or width of concrete element.

6. MATERIALS AND DURABILITY

6.1 General

In addition to the requirements specified in Division 3 “Concrete”, Division 4 “Structures” of the DPTI Master Specification and AS 5100, the Works must be designed to comply with the requirements of this clause.

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.

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

6.2 Concrete

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

(a) Dense, durable high strength concrete must be used. The minimum strength of concrete to be used must be 40 MPa except for blinding, mass or unreinforced concrete. 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 equals or exceeds AS 5100.5 – 4.3 exposure classification B2, the concrete must be specified as High Durability Concrete (refer Clause 320.9 “High Durability 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 thick concrete members, the Design Documents must include details of the methodology to ensure that the maximum differential temperature between core and surface concrete does not exceed 25^{O} C and the maximum concrete temperature anywhere does not exceed 82^{O} C.

(f) Epoxy coated reinforcement must not be used.

Testing to verify that the proposed concrete mix design will achieve the specified properties must 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 AS5100.5.

6.3 Steelwork

Unless specified otherwise, all exposed steelwork must be either:

(a) hot dipped galvanised in accordance with AS4680; or

(b) protected by a high grade protective coating system.

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.

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

The Design Documents must include the Contract Specific Requirements (CSR) for Part 435 “Protective Treatment of Structural Steelwork” and include full details of the protective treatment design in the CSR.

Where hot dipped galvanizing is to be used, the Design Documents must include all specific details necessary for Part 437 "Galvanizing", which includes the information listed in Appendix A "Purchasing Guidelines" of AS 4680.

6.4 Balustrades and Barriers

Replaceable Balustrades and barriers must have a minimum life to major maintenance of 30 years. Non-replaceable balustrades and barriers must have a design life as specified in Clause 5.

Where precast safety barriers are used, galvanised reinforcing must be used at the stitch pour or the concrete for the stitch pour must be special class low shrinkage mix with an approved waterproofing additive.

6.5 Durability Plan

This clause applies where a Durability Plan has been specified.

The Durability Plan 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.

For concrete structures, the Durability Plan must:

(a) use chloride diffusion and carbonation coefficients 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.

Durability of uncompacted concrete must be demonstrated by a rapid chloride permeability test on the proposed concrete mix design prior to commencement of construction.

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

7. DESIGN REQUIREMENTS FOR MAJOR SIGN STRUCTURES

Major sign structures (including cantilever signs and gantries over traffic) must comply with AS 5100.2 clause 23. 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.

Fatigue provisions in accordance with AS 5100.6, Section 13 will apply. The number of fatigue stress cycles at the serviceability limit state must be taken as 100,000 cycles. The fatigue strength of members and welded connections must be determined using full stress reversal for the stress range. For bolted connections and holding down bolts stress reversal need not apply. For holding down bolts where levelling nuts are used, full stress reversal must be considered.

If the structures are to be galvanised, refer to Part 437 “Galvanising” for further design requirements.

If the structure supports a Variable Message Sign, an access platform must be provided for the full length of the overhead structure (refer Part 266 Clause 9 “Access Platform”). 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.

8. DESIGN REQUIREMENTS FOR NOISE BARRIERS

This clause applies where noise barriers are specified.

Noise barriers must be in accordance with the requirements of Part D 020 “Design – Environmental”, Part D 037 “Design – Landscaping and Urban Design” and Vicroads Bridge Technical Note 1999/006: “Design Criteria for Noise Barriers”.

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; and

(c) facilitate straightforward and efficient maintenance, repair and replacement.

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

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

(b) defacement by sharp implements;

(c) graffiti; and

(d) ignition by cigarettes or similar.

9. RECORDS

The following records must be prepared:

Drawings

Construction drawings in hard copy and AutoCAD format. 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. Any reference to any standard or ancillary drawings on any sheet must have the reference to its sheet number.

Reports

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:

- summary of design methodology, design loadings and design assumptions;
- summary of design calculations;
- erection methodology and equipment;
- geotechnical design methodology, assumptions and summary calculations; and
- 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”.

(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.

Maintenance Plan

A plan providing comprehensive details 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.

APPENDIX 1

AS 5100 –CORRECTIONS AND ADDITIONAL REQUIREMENTS		
REFERENCE.	**EXISTING WORDING (where applicable)**	**CORRECTED / ADDITIONAL WORDING**
Section 1 – Scope and General Principles		
Appendix B, Figure B1	Figures B3.3.1 to B3.3.4	Figures B5 to B8
Section 2 – Design Loads		
Clause 6.3 Heavy Load Platform Loads		The design loads for bridges are the W80, A160, SM1600 and HLP400 The lateral placement of the HLP400 is: - a) Two *marked* lane bridge ± 1.0 m either side of centreline of the bridge, or b) 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) shall be applied to create the worst effect. An Accompanying Lane Factor of 1.0 shall be applied to this co-existent load. c) One lane ramp Shall be positioned on a one lane ramp as located by the designer. The tolerance on lateral position shall be specified . d) The designer location of the HLP400 shall be shown on the General Arrangement drawing.
Clause 6.7.3(ii)		0.1 for a cover depth of 2 m or more for all loads excluding S1600
Clause 8.5.1, 2nd paragraph, 2nd line	8.5.4	8.5.5
Clause 11.2.1 First sentence		The design criteria, including loads and geometric requirements, provided in this Clause 11 and in AS 5100.1, Clause 10 shall be used for the following
Fig 15.2.1	0.2	2000

AS 5100 –CORRECTIONS AND ADDITIONAL REQUIREMENTS		
REFERENCE.	**EXISTING WORDING (where applicable)**	**CORRECTED / ADDITIONAL WORDING**
Horizontal axis, right end		
Fig 17.3	structure depth d	structure depth D
Section 4 – Bearings and Deck Joints		
Clause 12.6.8 (c)	For plain pads and strips:	For plain pads and strips the value of the compressive strain (εc) to be used in deriving the compressive deflections (*dc*) shall be determined as follows:
Clause 14.2 2nd paragraph	AS 1449	ASTM A240/A240M-03b
Section 5 – Concrete		
Additional requirements to AS 5100.5 for prestressed members		Maximum compressive stress at transfer: $0.6f_{cp}$ (in accordance with Clause 8.1.4.2) Maximum compressive stress at all other times: $0.4f'_c$ Maximum compressive stress when HLP320 or HLP400 present: $0.6f'_c$
Clause 8.6.2(a) (ii)		The increment in steel stress beyond decompression shall be 170 MPa for SM1600 and 200 MPa for the HLP400 loading combinations.
Clause 8.6.2(b)		*Segmental members at unreinforced joints* under all serviceability limit state loadings except those incorporating the HLP320 or HLP400, a minimum pre-compression of 1.0 MPa shall exist. For all serviceability limit state loadings incorporating the HLP320 or HLP400, tension stress shall not be permitted. For dry joints, a minimum precompression of 1.5 MPa and 0.5 MPa shall exist for these loadings respectively.
Table 4.10.3(A)		Concrete decks on deck units and T girders only For: • exposure classification B2, and • concrete decks on deck units and T girder superstructures, the cover of the top reinforcing steel shall conform to AS 5100.

AS 5100 –CORRECTIONS AND ADDITIONAL REQUIREMENTS		
REFERENCE.	**EXISTING WORDING (where applicable)**	**CORRECTED / ADDITIONAL WORDING**
		However, the cover on the bottom reinforcement above the deck units and/or T girder may be reduced to 40mm. The cover of the bottom reinforcement on the cantilever shall be: • 40mm in a benign environment • In accordance with AS 5100 in wet areas or over salt water.
Equation 8.1.6(1)		$\delta_{pu} = \delta_{p.ef} + 6200 \times \frac{(d_p - k_u d)}{L_{pe}}$
Clause 8.6.1 (a)		This clause is deleted
Clause 13.3.2 Third Paragraph	$0.1L_p$	$0.1L_{pt}$
Appendix H Figures H1(B) and H1(C) - Bottom flange thickness on all cross sections	1b	t_b
Section 6 – Steel		
Clause 5.1.8.3	hydrid	hybrid
Equation 5.6.1.1(2)	$\alpha_{s} = 0.6 \left[\sqrt{\left(\frac{M_s}{M_{oa}}\right)^2 + 3 - \left(\frac{M_s}{M_{oa}}\right)} \right]$ (Error: length of square root sign)	$\alpha_{s} = 0.6 \left[\sqrt{\left[\left(\frac{M_s}{M_{oa}}\right)^2 + 3\right]} - \left(\frac{M_s}{M_{oa}}\right) \right]$
Equation 5.6.1.2(1)	$M_o =$	$M_o =$

<table>
<tr><th colspan="3">AS 5100 –CORRECTIONS AND ADDITIONAL REQUIREMENTS</th></tr>
<tr><th>REFERENCE.</th><th>EXISTING WORDING (where applicable)</th><th>CORRECTED / ADDITIONAL WORDING</th></tr>
<tr><td></td><td>$$\sqrt{\frac{\pi^2 EI_y}{L_e^2}}\left[\sqrt{GJ+\left(\frac{\pi^2 EI_w}{L_e^2}\right)}+\left(\frac{\beta_x^2}{4}\frac{\pi^2 EI_y}{L_e^2}\right)+\left(\frac{\beta_x}{2}\sqrt{\frac{\pi^2 EI_y}{L_e^2}}\right)\right]$$
(Error: length of square root sign)</td><td>$$\sqrt{\frac{\pi^2 EI_y}{L_e^2}}\left[\sqrt{\left[GJ+\left(\frac{\pi^2 EI_w}{L_e^2}\right)+\left(\frac{\beta_x^2}{4}\frac{\pi^2 EI_y}{L_e^2}\right)\right]}+\left(\frac{\beta_x}{2}\sqrt{\frac{\pi^2 EI_y}{L_e^2}}\right)\right]$$</td></tr>
<tr><td>Equation 5.6.2</td><td>$$\alpha_S = \left[\sqrt{\left[\left(\frac{M_s}{M_{ob}}\right)^2+3\right]}-\left[\frac{M_s}{M_{ob}}\right]\right]$$</td><td>$$\alpha_S = 0.6\left[\sqrt{\left[\left(\frac{M_s}{M_{ob}}\right)^2+3\right]}-\left[\frac{M_s}{M_{ob}}\right]\right]$$
(Error: 0.6 missing)</td></tr>
<tr><td>Table 5.6.5(A)</td><td>(Error: ‘2’ missing from in front of (d1/L))</td><td>1+[2(d1/L) (tf/2tw)3]/nw</td></tr>
<tr><td>Table 5.6.5/B</td><td>
<table>
<tr><th>Longitudinal position of the load</th><th>Restraint arrangement</th><th colspan="2">Load height position</th></tr>
<tr><th></th><th></th><th>Shear centre</th><th>Top flange</th></tr>
<tr><td>Within segment</td><td>FF, FP, FL, PP, PL,
LL, FU, PU</td><td>1.0
1.0</td><td>1.4
2.0</td></tr>
<tr><td>At segment end</td><td>FF, FP, FL, PP, PL,
LL, FU, PU</td><td>1.0
1.0</td><td>1.0
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<tr><td rowspan="2">Within segment</td><td>FF, FP, FL, PP, PL, LL,</td><td>1.0</td><td>1.4</td></tr>
<tr><td>FU, PU</td><td>1.0</td><td>2.0</td></tr>
<tr><td rowspan="2">At segment end</td><td>FF, FP, FL, PP, PL, LL,</td><td>1.0</td><td>1.0</td></tr>
<tr><td>FU, PU</td><td>1.0</td><td>2.0</td></tr>
</table>
</td></tr>
<tr><td>6.4.2.2(5)</td><td>$$\lambda_d = 0.018\left(\frac{L_b}{r_y}\right)^{1/2}\left(\frac{d_w}{t_w}\right)^{1/3}$$</td><td>$$\lambda_d = 0.018\left(\frac{L_b}{r_y}\right)^{1/2}\left(\frac{d_w}{t_w}\right)^{1/3}-0.4$$</td></tr>
</table>

AS 5100 –CORRECTIONS AND ADDITIONAL REQUIREMENTS		
REFERENCE.	**EXISTING WORDING (where applicable)**	**CORRECTED / ADDITIONAL WORDING**
Appendix A, Equation A4 (3)	$K = \frac{\sqrt{\pi^2 EI_w}}{GJL^2}$	$K = \frac{\pi}{L}\sqrt{\frac{EI_w}{GJ}}$
Appendix E, Equation E (5)	Mp = fy [A.dg – bf (dh + ds) dh]	Mp = fy [A.dg – bf (dh - ds) dh]
Section 7 Rating of Existing Structures		
Appendix A, Figs. A11, A12, A13	Diagram of Fig. A11 Diagram of Fig. A12 Diagram of Fig. A13	Shifted to Fig. A13 Shifted to Fig. A11 Shifted to Fig. A12 All three Figures should have two notes: ‘Dimensions in metres’ and Axle loads in kN’ The title of Fig. A12 should be ‘Figure A12 300-A-12 Railway Traffic Loadings Axle Group Spacings’
Appendix A, Clause A 3.2, first sentence Line 2	Figure A12	Figure A11
Appendix A, Clause A 3.2, first sentence Line 3	Figure A13	Figure A12