Development manual planning scheme policy (PSP)

SC6.4.17 Structures

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SC6.4.17.13 Temporary works

SC6.4.17.1 Introduction

(1) Objective

This section sets out design considerations to be adopted in the design of structural engineering elements associated with:

(a) road traffic bridges;

(b) pedestrian/cyclist bridges;

(c) any structure designed to carry a road or a path over a waterway, depression, or obstacle;

(d) culverts;

(e) retaining walls;

(f) acoustic fences;

(g) fences;

(h) sign support structures;

(i) structures used for public safety; and

(j) temporary works.

(2) Design considerations

Such structures may be primarily constructed of concrete, timber, steel, or other materials appropriate to the application. The design should always have a primary emphasis on safety and whole of life cycle costs. The structure/s should comply with current Safety in Design principles and guidelines, relevant Department of Transport and Main Roads Specifications where applicable, relevant AS Codes, and statutory authority requirements.

Each design is to be RPEQ certified that the proposed structure will not become unfit for use during its intended design life. This assessment will have measured regard to all associated issues with the proposed structure including:

(a) consideration of any future infrastructure planning;

(b) economic constraints;

(c) physical or structural constraints;

(d) aesthetic considerations;

(e) flooding or hydraulic capacities (if applicable);

(f) safety in design;

(g) maintenance and repair constraints;

(h) constructability; and

(i) be fit for purpose.

(3) Safety and service performance

The safety and service performance of a structure will depend on the quality control exercised in fabrication, supervision of the site, control of unavoidable imperfections, and the experience and skill of the personnel involved. Specific attention must therefore be given to these factors.

(4) Reference and source documents

Reference and source documents that must be read in conjunction with this section are as follow:

(a) SC6.4 Development manual planning scheme sections:

Section SC6.4.6 Road works and traffic control

Section SC6.4.7 Clearing, grubbing, and earthworks

Section SC6.4.9 Stormwater quantity

Section SC6.4.18 Concrete works

(b) Australian Standards:

AS 1158	*Lighting for roads and public spaces*
AS/NZS 3845	*Road safety barrier systems*
AS 5100	*Bridge Design*
AS 1428	*Design for access and mobility*
AS 1170	*Minimum design loads on structure* (SAA Loading Code)
AS 1684	*National timber framing code*
AS 1720	*Timber Structures*
AS 3600	*Concrete structures*
AS 3700	*Masonry in buildings* (SAA Masonry Code)
AS 4100	*Steel structures*
AS1597.1	*Precast reinforced concrete box culverts - Small culverts*
AS 1597.2	*Precast reinforced concrete box culverts - Large culverts*

AS/NZS ISO 9001:2008 - *Quality management systems - Requirements*

Other codes and guidelines referred to in the Australian Standards, as relevant.

(c) Department of Transport and Main Roads:

MRTS70	*Concrete (10/11)*
MRTS71	*Reinforcing Steel (06/09)*
MRTS72	*Manufacture of Pre-cast Concrete Elements (08/13)*
MRTS05	*Unbound Pavements*
MRTS24	*Manufacture of precast concrete culverts*
MRTS62	*Bridge Substructure*
MRTS63	*Cast-In-Place Piles*
MRTS64	*Driven Tubular Stel Piles*
MRTS65	*Precast Prestressed Concrete Piles*
MRTS66	*Driven Steel Piles*
MRTS68	*Dynamic Testing of Piles*
MRTS72	*Manufacture of Precast Concrete Elements*
MRTS73	*Manufacture of Prestressed Concrete Members and Stressing Units*

MRTS74 *Supply and Erection of Prestressed Concrete Deck and Kerb Units*

MRTS75 *Supply and Erection of Prestressed Concrete Girders*

MRTS76 *Supply and Erection of Steel Girders*

MRTS77 *Bridge Deck*

MRTS78 *Manufacture of Structural Steelwork*

MRTS80 *Bridge Bearings*

(d) Other:

Austroads *Guide to Bridge Technology Part 4 - Design Procurement and Concept Design, 2009*

Austroads *Guide to Geotextiles*

Department of Transport and Main Roads *Road Planning and Design Manual, 2006*

Department of Transport and Main Roads *Road Traffic Noise Management: Code of Practice, 2000*

Department of Energy and Water Supply *Queensland Urban Drainage Manual*

SC6.4.17.2 Bridges, culverts, and other structures - basis of design

(1) The basis of the proposed bridge design is to principally conform to Austroads' road design standards, Department of Transport and Main Roads specifications, and AS 5100 as appropriate. The design must be based on sound engineering principles and certified by a suitably qualified engineer (RPEQ).

(2) All design criteria for bridges in the Townsville City Council local government area must be approved by Council prior to the design being carried out. The designer must make reference and address all issues outlined in Appendix A of AS 5100.1. and the relevant Department of Transport and Main Roads Specifications.

(3) Adequate management control and supervision by experienced engineers (RPEQ) is required at all stages of the design and construction to prevent the occurrence of any unapproved non-conformances with the design plans, and specifications.

(4) Specifications must be notated on the drawings with sufficient details to ensure that the above-described strategies are able to be effectively implemented throughout the construction stage.

SC6.4.17.3 Provisions for pedestrian and cyclists on road bridges and culverts

(1) Provision for pedestrians, and cyclists on bridges and culverts is required in rural residential as well as urban areas. The minimum provision is a 1.5 m wide footpath with a 150 mm high kerb at the traffic lane edge. The design is to consider pedestrian safety on a bridge. A safety railing is to be provided between pedestrians and the trafficable lane together with 2.0 m (min) wide shoulder to accommodate on road cyclists on bridges.

(2) Council may require the provision of a combined cycleway and pedestrian footway should the risk to on road cyclists be too high.

(3) Disability access across the proposed bridge is to be DDA compliant and generally in accordance with AS1428.

(4) Urban bridge approaches should be lit in accordance with AS 1158.

SC6.4.17.4 Road traffic bridges, pedestrian bridges, and culverts – design

(1) The design of all bridges, and culverts with a combined span of 1.5 m or greater, must be based on geotechnical investigation undertaken by a Geotechnical Engineer as set out in Section SC6.4.16 Geotechnical investigations.

(2) Bridge and culvert design must only be carried out by properly qualified persons who are Registered Professional Engineers of Queensland (RPEQ) and experienced in structures design. If requested, such designers must submit evidence of these qualifications and experience to Council prior to approval of any bridge design.

(3) The *Bridge Design Code* (AS 5100) must be used for all bridge design, together with relevant Austroads and Department of Transport and Main Roads requirements.

(4) Bridges and culverts must have low maintenance finishes. Adequate precautions must be taken for protection of the materials used in the bridge design; for example, timber and steel require special consideration. Heavy debris and bed loads may be characteristic of some streams so that large spans with slender piers are encouraged. If floodwater overtopping is to occur, pedestrian safety rails and road safety barriers could be omitted to reduce debris collection on the roadway, subject to pedestrian safety considerations. Flood depth indicators and appropriate signposting are required in such cases.

(5) Preventative maintenance is a key issue affecting the design life of the structure. The drawings must specify the design life of the structure together with the relevant maintenance programs to be adopted upon which the design life is based. Parameters used in the design must also be shown on the drawings.

(6) Timber shall only be used in exceptional circumstances where all other avenues have been exhausted.

(7) All steelwork shall be hot dipped galvanised.

(8) All major structures in urban areas, including bridges and culverts, must be designed for the 1% AEP storm event with minimal afflux. Some afflux and upstream inundation may be permitted in certain rural and urban areas provided the increased upstream flooding does not adversely impact private property or critical infrastructure.

(9) Where structures are designed to be inundated, the effect of the backwater gradient on upstream property must be identified on the drawings. Detailed consideration of alternate evacuation routes are to be considered where the bridge structure is to be inundated.

(10) Where no inundation is permitted, 500 mm freeboard to the underside of the bridge deck structure or top of culvert deck structure is required. All road structures with a 1% annual exceedance probability (AEP) designed waterway greater than 5 sqm must be modelled using current hydrological modelling practices (software) to determine the upstream impacts over the full range of storm events.

(11) Safety limitations – Overtopping of Roadways. All floodwaters overtopping a major structure such as a culvert or bridge structures within a road are to be checked for safety and stability limitations for both pedestrians and vehicles. Assessment of the waterway crossing safety and stability is to be undertaken based on criteria outlined in QUDM and AR&R latest edition.

(12) The designer is to enquire with the appropriate authority on any current or likely provisions for public utilities or services on bridges. These should be concealed for aesthetic reasons. Consultation with the appropriate utility authority is to be undertaken during the structural design, particularly in regard to the location and placement of existing and future public utilities.

SC6.4.17.5 Bridge construction

(1) Adequate management control and supervision by experienced engineers (RPEQ) is required at all stages of construction to prevent the occurrence of any unapproved non-conformances with the design plans, and specifications.

(2) All bridge construction is to be undertaken in conformance with the relevant Department of Transport and Main Roads Specification provisions.

(3) Only suitably qualified and experienced contractors will be approved to undertake the construction of bridges.

(4) Details of minimum site geotechnical investigations required for bridge sites are set out in Section SC6.4.16 Geotechnical investigations.

(5) Bridge crossings in urban and rural residential areas must be provided with street lighting in accordance with AS 1158. Such requirements will be noted accordingly on the design drawings.

SC6.4.17.6 Culvert construction

(1) General

(a) Cast in-situ base slabs and culvert structures shall be constructed in concrete and in accordance with Section SC6.4.18 Concrete works.

(b) Details of minimum site geotechnical investigations required for bridge and culvert sites are set out in Section SC6.4.16 Geotechnical investigations.

(2) Materials

(a) Culvert units, link and base slabs

(i) The supply and testing of precast reinforced concrete box culvert units, link and base slabs shall be in accordance with MRTS24 with the following alterations or additional requirements;

(ii) proof load testing must be arranged by the Contractor in batches as specified in Clause15.2 of MRTS24;

(iii) proprietary lifting anchors must be provided in the culvert units, link, and base slabs;

(iv) delivery and unloading is the Contractor's responsibility using appropriate equipment;

(v) the supplier of precast units must implement and maintain a quality system in accordance with ISO 9001 to ensure materials, manufacture and proof load testing conform to the appropriate Standards;

(vi) a conformance certificate, to Clause 15.3 of MRTS24 must be submitted to the Superintendent at least 3 working days prior to dispatch;

(vii) Each unit must be marked at time of manufacture with:

1. the date of manufacture and unique identification number;
2. the manufacturer’s name and registered mark;
3. the size of the culvert component;
4. the maximum mass of the culvert component; and
5. the Technical Specification number and version to which the culvert component has been manufactured.

(b) Handling and delivery

(i) Ensure adequate equipment and load shifting machineries are available for safe handling and unloading.

(ii) Upon delivery of precast units, ensure that the following criteria have been achieved:

1. 70% of the minimum concrete strength; and

2. cured to MRTS24 clause 13.8.

(iii) Prior inspection of the stored precast box culvert units is to be undertaken for dimensional accuracy and defects following delivery. Results of the inspections must show that the units conform to the following:

1. small culvert unit: To AS 1597.1; and

2. large culvert unit: To AS 1597.2.

as set out in MRTS24 Clause 13.10.

(c) Selected backfill

The quality of selected backfill shall comply with the requirements in AS 1597.2, or alternatively comply with the requirements of side/overlay zone materials in Section SC6.4.9 Stormwater quantity, Table SC6.4.9.7 Bedding Material Grading Limits.

(d) Ordinary backfill

Ordinary backfill is material obtained from culvert excavations, cuttings and/or borrow areas which are in accordance with the requirements for the upper 0.3 m of embankment construction as detailed in Section SC6.4.7 Clearing grubbing and earthworks.

(3) Siting of culverts

(a) Before commencing construction of any culvert, the Contractor shall set out on site the culvert inlet and outlet positions to the location and levels shown on the drawings and shall present this set out for inspection by the Superintendent.

(b) The Superintendent may amend the inlet or outlet locations or designed levels or the culvert length to suit actual site conditions. Any such amendments must ensure no negative impacts on neighbouring land parcels and existing properties. Prior approval must be sought from Council for any changes.

(c) Should the Contractor propose changes to the culvert location, length, designed levels, culvert strength, conditions of installation or cover to suit the construction procedures, the Contractor shall present the proposed culvert set out in addition to the designed set out for consideration by the Superintendent and Council. No changes shall be made unless prior written approval from Council is obtained.

(4) Alignment

(a) Unless otherwise shown on the drawings, headwalls shall be constructed parallel to the road centreline and wingwalls at 120º to the headwall or as shown on the drawings.

(b) Where the culvert is laid skew to the road, the wingwalls and headwalls shall be splayed so that the front edge of the wing bisects the angle between the centreline of the culvert and the headwall.

(c) Energy dissipaters shall be constructed in accordance with the drawings and with centreline on the axis of the culvert.

(5) Excavation

Excavation shall be carried out in accordance with the provisions in Section SC6.4.9 Stormwater quantity.

(6) Bedding – cast in-situ slabs

No bedding material shall be placed until the foundations have been inspected and approved by the Superintendent.

Bedding shall be either mass concrete or lightly bound paving material which complies with the requirements of at least a Type 3, Subtype 3.3 material as defined in the Specification MRTS05, whichever is shown on the drawings.

Mass concrete bedding blinding layer shall be 20 mPa compressive strength and shall not be less than 50 mm thick over any point in the foundation. It shall be laid to the line and level of the underside of the base slab to a tolerance of ±10 mm in level and ±50 mm in line. The bedding shall be finished to a smooth surface. Where longitudinal gradients are less than 0.5 per cent, concrete blinding layers shall be installed with +/- 6 mm of the grade line.

(7) Bedding – precast base slabs

Precast base slabs, U-shaped culvert units and one-piece culvert units shall be supported on a bed zone of selected backfill of minimum compacted depth 150 mm in accordance with AS 1597.2.

If suitable compaction of the trench subgrade cannot be achieved, it will be the responsibility of the developer to recommend an alternate solution to Council to achieve the desired bearing capacity for the structure prior to construction.

(8) Cast in-situ base slabs

(a) Cast in-situ base slabs shall be constructed to the dimensions shown on the drawings and in accordance with the requirements of Section SC6.4.18 Concrete works. The invert levels shall be within -10 mm to +10 mm of the design level, grade 5mm in 2.5m (1 in 500) and plan position ±50 mm. Where longitudinal gradients are less than 0.5 per cent cast in-situ base slabs shall be installed within +/- 6 mm of the grade line.

(b) Recesses or nib walls to accommodate the walls of the precast crown units shall be formed in the base slab to the dimensions shown on the drawings.

(9) Installation of precast units

(a) Precast units shall not be installed until the base slab has attained a minimum compressive strength of 20 MPa.

(b) Precast crown units shall be placed on a bed of mortar either on the slab or in the recesses in the base slab. Any gaps between the side walls and the sides of the recesses shall be packed with cement mortar. Lifting holes and butt joints between units shall be packed or sealed with cement mortar or grout or flexible joint filler.

(c) Before placement of top slabs on U-shaped units or link slabs on adjacent crown units, the bearing area of the supports shall be thoroughly cleaned and covered with a bed of mortar of minimum thickness 5 mm after placement of precast unit.

(d) Lifting anchor recesses shall be filled to the surface with cement mortar.

(e) In the case of multi-cell culverts, a nominal 40 mm gap shall be provided between adjacent cells. This gap shall be filled with cement mortar or grout.

(f) All mortar joints shall be protected from the sun and cured in an approved manner for not less than 48 hours.

(g) All external surfaces of vertical joints between precast crown units, shall be covered full length, and minimum 100 mm width, with strips of Denso tape or similar as an alternative to joint filling.

(10) Headwalls and wingwalls

The wingwalls shall be designed and constructed to retain the batters effectively. Where the dimensioned drawings do not satisfy this requirement, the Superintendent shall be notified before the headwalls and wingwalls are constructed. The Superintendent shall direct the Contractor as to the action to be taken. Where rock is encountered at the bottom of excavations for wingwalls and headwalls, and after approval is given by the Superintendent, the depth of cut off walls in uniform rock over the full width of the foundations may be reduced to less than that shown in the drawings but must be not less than 150 mm into sound rock.

(11) Backfill

(a) All bracing and formwork shall be removed prior to backfilling. Prior to backfill placing, present to the Superintendent for inspection all seals, joints, and levels.

(b) Selected backfill shall be placed in the side zones of the box culverts and wingwalls, and to a depth of 300 mm in the overlay zone of the culverts, in layers with a maximum compacted thickness of 150 mm in accordance with the backfilling and compaction requirements of AS 1597.2. Alternatively, cohesionless materials can be compacted in one operation by saturation and vibration to achieve a minimum Density Index of 70. The remainder of the excavation shall be backfilled with ordinary embankment fill in accordance with Section SC6.4.7 Clearing, grubbing, and earthworks.

(c) Backfill shall be placed against wingwalls, headwalls and retaining walls in accordance with Section SC6.4.18 Concrete works.

(d) Backfill layers shall be placed simultaneously on both sides of the culvert with a maximum 600 mm level difference to avoid differential loading. Backfilling and compaction shall commence at the wall and proceed away from it.

(e) Where the slopes bounding the excavation are steeper than 4:1, they shall be cut in the form of successive horizontal terraces of at least 1 m width before the backfill is placed.

(12) Excavation of inlet and outlet channels

Excavation of inlet and outlet channels shall be carried out as shown on the drawings and shall extend to join the existing stream bed in a regular manner as detailed in Section SC6.4.9 Stormwater quantity, Clause SC6.4.9.16.

(13) Construction loading on culverts

(a) Construction vehicles and plant shall not pass over the culvert until 28 days after the casting of the base slab or until the cylinder compressive strength of the base slab concrete has reached 32 MPa.

(b) Construction vehicle loads on culverts for various design fill heights shall be in accordance with AS 1597.2.

(14) Limits and tolerances

The limits and tolerances applicable to the various clauses in this section are summarised in Table SC6.4.17.1 Summary of Limits and Tolerances below:

Table SC6.4.17.1 - Summary of Limits and Tolerances

Item	Activity	Limits/Tolerances	Spec Clauses
(1)	**Mass Concrete Correction**		
	(a) Over highest points of rock	50 mm	Clause SC6.4.17(6)(f).
(2)	**Mass Concrete Bedding**		
	(a) Level	± 10 mm	Clause SC6.4.17(6)(h)
	(b) Level where grade line <0.5%	+/- 6 mm	
	(c) Line	± 50 mm	Clause SC6.4.17(6)(h)
(3)	**Culvert Location**		
	(a) Invert Level	±10 mm	
	(b) Invert where grade line is <0.5%	+/- 6mm	Clause SC6.4.17(6)(h)
	(c) Grade	5 mm in 2.5 m (1 in 500)	Clause SC6.4.17(6)(h)
	(d) Plan Position	± 50 mm	Clause SC6.4.17(6)(h)

SC6.4.17.7 Culverts, retaining walls, sign support structures, and fences

Public utility structures, large culverts, retaining walls, major sign support structures, and fences, and the like, will be designed by a competent, practicing engineer (RPEQ certified) who is accredited in the design of such structures. The design must be in accordance with the SC6.4 Development manual planning scheme policy, relevant Austroads codes, all relevant Australian Standards, and the requirements of any utility owners that may be applicable.

SC6.4.17.8 Retaining walls

(1) Retaining walls to a maximum height of 1.0 m of wall and fill or cut retained, are prescribed building works under Schedule 1 of the *Building Regulations 2006*, and do not require approval, providing there is no surcharge loading over the zone of influence, and the wall is no closer than 1.5 m to a building or another retaining wall.

(2) Retaining walls that do not qualify as prescribed building works under Schedule 1 of the *Building Regulations 2006,* require Building Certification issued by a Building Certifier and should be designed and certified by a suitably qualified RPEQ engineer who will determine the extent of geotechnical investigations required to verify soil type and soil bearing pressure for the design of the retaining wall.

(3) Retaining wall located within the Landslip Overlay of the City Plan will require Council development approval.

SC6.4.17.9 Acoustic fences

Notwithstanding the provisions for fenced under clause (10) below, acoustic fences adjacent to Queensland Rail or roads under the control of the Department of Transport and Main Roads will require approval from the relevant authority.

SC6.4.17.10 Fences

(1) Fences to a maximum height of 2.0 m above natural ground level, and are not a swimming pool fence, are prescribed building works under Schedule 1 of the *Building Regulations 2006*, and do not require approval.

(2) Fences greater than 2.0 m in height require a Building Certification issued by a building certifier and should be designed and certified by a suitably qualified RPEQ engineer who will determine the extent of geotechnical investigations required to verify soil type and soil bearing pressure for the design of the fence. Concrete masonry solid panel and screen fences shall be designed for cyclonic wind loads for Region C as set out in AS 4055 Wind Classification.

(3) Fences greater than 2.0 m in height will require a referral agency response from Council to the building certifier as part of the building certification approval process.

SC6.4.17.11 Signs and sign support structures

(1) General

Sign support structures shall be fabricated from steel sections which shall comply with the requirements of AS 1163, AS 3678 and AS 3679.1.

Signs support structures shall be standard round galvanised posts of 50, 65, or 80 mm, nominal bore, or purpose designed steel structures as shown on the drawings and manufactured in accordance with the requirements of AS 1250.

Splices in members shall be restricted to a maximum of one splice per member. Splices shall be full penetration butt welds.

All welding shall be as shown on the drawings and in accordance with the requirements of AS 1554.1, Category GP.

(2) Protective treatment

Except for standard galvanised posts, all steel components including brackets shall be protected by hotdip galvanising after all fabrication processes are completed.

The steel components shall be finished by the hot dip galvanising process in accordance with AS/NZS 4680 to provide an average minimum coating thickness of 85 microns and a bright finished surface free from white rust and stains.

Bolts, nuts and washers and brackets shall be galvanised in accordance with AS 1214.

Splices in standard galvanised posts shall be painted by using an organic zinc rich primer, or inorganic zinc silicate paint, in accordance with the repair requirements in Appendix E of AS/NZS 4680.

Scratched and slightly damaged surfaces of galvanised coatings shall be renovated by using an organic zinc rich primer, or inorganic zinc silicate paint, in accordance with the repair requirements in Appendix E of AS/NZS 4680.

This method of renovation shall be restricted to areas not exceeding 2500 square millimetres on any one structure. Any structure with totally damaged coating areas exceeding 2500 square millimetres shall be regalvanised by the Contractor.

(3) Attachment of new signs

Posts and other components shall be provided with the required sign attachment holes or fittings to suit the typical attachment systems as shown on the drawings. Sign panels shall be attached to each supporting member at each extrusion section or bolt hole in the sign panel.

The Contractor shall submit details of the proposed attachment systems for the Superintendent's approval.

(4) Erection of new signs

(a) Setting out

The location of signs shall be as shown on the drawings or as directed by the Superintendent. The Contractor shall set out the work to ensure that all signs and support structures are placed in accordance with the drawings or as directed by the Superintendent.

Signs shall be aligned approximately at right angles to the direction of the traffic they are intended to serve. On curved alignments, the angle of placement should be determined by the course of approaching traffic rather than the orientation of the road at the point where the sign is located. Parking signs will generally be aligned at 45 degrees to the kerb line if not otherwise specified on drawings.

The Contractor shall submit details of and set out, for the Superintendent's inspection and approval, the proposed location and alignment of each sign support structure.

Work on the foundations of the sign support structure shall not commence until the Superintendent has approved the location and alignment of the sign support structure.

The Contractor is responsible for locating existing underground services in proximity of the signs prior to placement of footings and erection of signs to protect services from damage.

(b) Clearing

The Contractor shall advise the superintendent of any trees and undergrowth within 3 m of the sign support structure and along a driver's line of sight to the front of the sign that are required to be cleared and removed. On receipt of this advice from the Superintendent, Council will inspect and advise what action is to be taken by the Contractor.

(c) Sign structure footing

The footings for a simple pipe support or the footings for each post of a purpose designed sign support structure shall be constructed in accordance with the drawings or as directed by the Superintendent.

The footings shall be neatly excavated to the depth and width shown on the drawings. The material from the excavation shall be disposed of in a responsible and legal manner.

When anchor bolt assemblies are specified, they shall be accurately placed and firmly supported. Anchor bolt assemblies shall be provided with levelling nuts under the sign structure base plates to allow adjustment of the structure after installation.

Steel reinforcement shall be placed as shown on the drawings.

Concrete in the footings of sign support structures shall comply with Section SC6.4.18 Concrete Works and have a minimum compressive strength at 28 days of 20 MPa for pipe support footings and 32 MPa for purpose-designed support footings.

If ready mixed concrete is used, the concrete shall be mixed and delivered in accordance with AS 1379.

(d) Erection

All components shall be accurately positioned and supported during erection.

The top of each pipe support post shall extend sufficiently beyond the upper extrusion section or bolt holes on the sign panels to enable attachment of the signs. The top of each post shall be below the top edge of the sign panel.

For pipe support multi post installations, the tops of the posts shall be at the same level except where sign shape or the arrangement of sign panels dictates otherwise.

During erection, sign panels shall be suitably supported and braced, and the sign face protected from damage. Signs damaged during erection shall be repaired to a standard equivalent to the original sign or replaced by the Contractor.

Galvanised coatings on purpose designed support structures which are scratched or slightly damaged during erection shall be renovated by using an organic zinc rich primer, or inorganic zinc silicate paint, in accordance with the repair requirements in Appendix E of AS/NZS 4680. This method of renovation shall be restricted to areas not exceeding 2500 square millimetres on any one structure. Any structure with totally damaged coating areas exceeding 2500 square millimetres shall be regalvanised.

(e) Adjustment of existing signs and support structures

Where shown on the drawings, and, where directed by the Superintendent, the Contractor shall adjust existing sign panels and sign support structures. The work shall include minor adjustments of existing sign panels and/or sign support structures or the work may extend to the dismantling of signs and sign support structures, relocation or replacement of sign support structures including footings and re erection of signs including all fittings.

(5) Special requirements

All street name, service and tourist signs shall comply with Council's adopted signage system and with the details as shown on the drawings.

Proprietary signs shall be manufactured and installed in accordance with the requirements of Parts 1 and 6 of MUTCD to the following details:

(Sample only - to be completed by compiler)

(a) Colour:

(i) Legend - Blue, Non-reflective

(ii) Background - Yellow, Class 1 Retroreflective

(b) Lettering and numerals:

(i) Font Type - Series D

(ii) Height – 100 mm

Details of Council's logo shall be supplied to the Contractor by the Council.

Details of the signs and legends are to be shown on the drawings.

The Contractor shall submit details of the manufacturer of all sign materials and sign attachment system to the Superintendent for approval by the Council prior to commencement of sign manufacture.

(6) Limits and tolerances

The limits and tolerances applicable to the various clauses in this section are summarised in Table SC6.4.17.2 Summary of Limits and Tolerances below:

Table SC6.4.17.2 - Summary of Limits and Tolerances – Signs

Item	Activity	Limits/Tolerances	Clause
(1)	**Sign Support Structures**		
	(a) Protective Treatment thickness	> 100 microns	Clause SC6.4.17 (11)
	(b) Paint coating over Splices in standard galvanised posts	> 100 microns	Clause SC6.4.17 (11)(b)
	(c) Damaged Surface of galvanised surfaces:		
	(i) Coating with zinc rich paint	Area < 2500 sq. mm	Clause SC6.4.17 (11)(b)
	(ii) Regalvanise	Area > 2500 sq. mm	Clause SC6.4.17 (11)(b)
(2)	**Clearing**		
	(a) Trees and Undergrowth to be cleared	< 3 metres from sign support structure	
(3)	**Concrete in Foundations of Sign Support Structures**		
	(a) Strength	> 25 MPa at 28 days	

SC6.4.17.12 Structures used for public safety

(1) General

Since the requirement of road safety barriers and pedestrian safety rails on bridges are different, the design engineer must consider whether separate traffic and pedestrian barriers can be detailed to satisfy the major functional requirements.

The *Bridge Design Code* (AS 5100.1 Sections 10 - 12) and AS/NZS 3845 are recommended references in this regard.

It is essential that all safety barriers and rails have been fully tested and accredited for the intended use under quality assurance provisions.

Bridge crossings in urban and rural residential areas must be provided with street lighting in accordance with AS 1158. Such requirements will be noted accordingly on the drawings.

(2) Non-rigid road safety barrier system

(a) Scope

The work to be executed under this section consists of the setting out, supply of all materials, and erection of road safety barriers and terminals, in accordance with the requirements for non-rigid road safety barrier systems in DTMR *Road Planning and Design Manual (Chapter 8),* at the locations shown on the drawings or as directed by the Superintendent.

This section details the requirements for public domain non-rigid road safety barrier systems. Where a patented non-rigid road safety barrier system is specified and shown on the drawings, all materials shall be inaccordance with the manufacturer's specifications and, it shall be constructed strictly in accordance with the manufacturer's instructions.

(b) Reference and source documents

Reference and source documents that must be read in conjunction with this section are as follow:

(i) SC6.4 Development manual planning scheme policy sections:

Section SC6.4.6 Road works and traffic control

Section SC6.4.18. Concrete works

(ii) Department of Transport and Main Roads:

Road Planning and Design Manual (RPDM) 1st edition – (Chapter 8), Safety Barriers and RoadsideFurniture – as amended.

(iii) Australian Standards:

AS/NZS 1906.2 *Retroreflective devices (non-pavement application)*

AS/NZS 3845 *Road safety barrier systems*

AS/NZS 4680 *Hot-dip galvanised (zinc) coatings on fabricated ferrous articles*

(c) Materials

(i) Components

All steel components for public domain non-rigid road safety barrier systems, W beam and Thriebeam, shall be designed and constructed strictly in accordance with the RPDM (Chapter 8 – as amended) using crushable energy absorbing materials and shall be of the type as shown on the drawings.

(ii) Certification

Road safety barrier components shall not be erected until the Contractor has produced documentary evidence to the Superintendent that such safety barrier components conform to the requirements of this section.

For galvanized steel components provide a manufacturers certificate of compliance certifying that the zinc coating mass conforms to AS/NZS 4680 or, for components of proprietary safety barrier systems or devices, to the manufacturer's recommendations.

(d) Construction

(i) General

The Contractor shall at all times conform to the requirements of Section SC6.4.6 Road works and traffic control, Clause SC6.4.6.17.

Construction of non-rigid road safety barrier shall comply with TMR RPDM, except where explicit departures are approved on the drawings.

Road safety barriers shall be erected after the construction of the base on concrete pavements and after the placing of the initial layer of asphaltic concrete or sprayed seal on a flexible pavement, unless otherwise approved by the Superintendent.

The Contractor shall set out the work to ensure that all road safety barriers and terminal sections are located, in accordance with the drawings or as directed by the Superintendent.

Underground cables and ducts laid in the road safety barrier area shall be located prior to the erection of posts and all care must be taken not to damage such cables and ducts.

The posts should be set to the full depth as shown on the drawings. If this is not possible due to the presence of an underground obstruction, an alternative method of setting the posts, as approved by the Superintendent, shall be used.

Posts shall stand vertical and the spacing shall be such that when the safety barrier is erected no post movement is necessary to align holes or for any other reason.

(ii) Erection of steel posts

The safety barrier posts are to be located as shown on the drawings. The top of the post shall be 750 mm, 845 mm, or 905 mm as appropriate for W beam, Thrie-beam or modified block out -Thriebeam respectively, above the ground level, unless otherwise shown on the drawings. On terminal ends, the level of the posts shall be such as to conform to the extended crossfall of the main pavement unless otherwise shown on the drawings.

When erected in position the posts shall be on a smooth line both horizontally and vertically with the tops of posts within ±10 mm of the heights specified in Clause (iv) 2 of this clause.

Steel posts shall be erected by driving, or by other means, as directed by the Superintendent, in accordance with the requirements for foundation posts in the TMR RPDM. The open section of the post shall point in the same direction as adjacent traffic. The posts are to be firm in the ground and any movement at ground level shall not exceed 3 mm in any direction when force tested in accordance with TMR guidelines

The posts shall not have any obvious deformation as a result of driving. Any damage which does occur to the posts is to be repaired within 24 hours using an organic zinc rich primer in accordance with the repair requirements of Appendix E in AS/NZS 4680.

Any post which has been excessively damaged will be rejected by the Superintendent and shall be replaced bythe Contractor at the Contractor's expense.

(iii) Erection of road safety barriers

Steel block out pieces shall be erected with the open section pointing in the same direction as adjacent traffic.

All rail laps shall be in the same direction as adjacent traffic such that approach rail ends are not exposed to traffic.

Stiffening pieces, 300 mm long, shall be used on intermediate posts.

Road safety barrier rails and block out pieces shall be handled and erected in such a manner that no damage occurs to the galvanising. Any minor damage occasioned to the galvanising shall be repaired within 24 hours using an organic zinc rich primer in accordance with the repair requirements of Appendix E in AS/NZS 4680.

Any road safety barrier rails or block out pieces that have been excessively damaged will be rejected by the Superintendent and shall be replaced by the Contractor at the Contractor's expense.

Road safety barrier rail attachment bolts and splice bolts are to be tightened initially such that the barrier can be erected. Adjustments are then to be made to the rails using the slotted holes provided to produce a smooth regular line, free of any kinks or bumps. The overall line of the top of the safety barrier rails is to visually conform with the vertical alignment of the road pavement.

When the alignment both vertically and horizontally is obtained the splice bolts are to be fully tightened. The bolt head (not the shoulder) should be in full bearing with the rail.

(iv) End treatment of road safety barriers

Both the approach and the departure end of the road safety barrier shall be constructed with leading and trailing terminal sections at locations shown and as detailed on the drawings.

An appropriate terminal end treatment shall be constructed, as detailed on the drawings, at the approach and end locations of road safety barriers as shown on the drawings. Consideration of alternate terminal end treatments will include sufficient clearance behind the safety fence to accommodate pedestrians and cyclists, where applicable.

The approach and the departure end of double-sided road safety barriers shall have terminal sections as detailed on the drawings.

Non-rigid road safety barrier connections to rigid road safety barriers or bridge parapets shall be as detailed on the drawings.

(v) Delineators

Delineators complying with AS 1906.2 shall be fixed with brackets to the road safety barrier, to the details and at the locations shown on the drawings beginning at the first post and then in accordance with Table SC6.4.17 3 below.

Table SC6.4.17.3 - Spacing of Reflectors on Barriers

Radius of Curve	Spacing of Reflectors on Barrier
m	every
30 - 90	3rd post
90 - 180	5th post
180 - 275	8th post
275 - 365	11th post
over 365 (including straight road)	16th post

The delineators shall be so arranged that drivers approaching from either direction will see only red reflectors on their left side, and white reflectors on their right.

(vi) Connection to existing safety fence

The Contractor is to inspect and document the condition of all existing barrier fencing and its suitability to meet current specifications and standards, prior to connection or incorporation into the subject works. All documentation of existing fencing is to be made available to the Superintendent for future inspection, if requested.

If any existing safety fencing is deemed not to comply with current design and safety standards, it is to be replaced by the Contractor.

(e) Limits and tolerance

The limits and tolerances applicable to the various clauses in this section are summarised in Table SC6.4.17.4 Summary of Limits and Tolerances below:

Table SC6.4.17.4 - Summary of Limits and Tolerance

Item	Activity	Limits/Tolerances	Clause
1	**Vertical Alignment** Tops of steel posts	± 10 mm	Clause SC6.4.17(12)(b)(iv)
2	**Post Movement**	± 3 mm	Clause SC6.4.17(12)(b)(iv)
3	**Concrete Footings** Diameter	-0 mm or +50 mm	Clause SC6.4.17(12)(b)(iv)

SC6.4.17.13 Temporary works

Structures which are proposed for the temporary support of roads, services and the like must be designed by a qualified engineer (RPEQ certified) experienced and accredited in the design of such structures and designed in accordance with the *Bridge Design Code* (AS 5100). A construction programme, indicating the sequence of events leading to the implementation and removal of the temporary structures must be specified on the drawings. The design of such temporary structures is to mandate the safe constructability and use of these structures throughout the term of the construction works.