Development manual planning scheme policy (PSP)

SC6.4.6 Road works and traffic control

Editors Note:

Construction specifications and construction processes are project specific and form part of the Project Contract Documentation for construction.

Inclusion of construction specifications and construction methodology statements in the Planning Scheme is not recommended because it locks the construction of works into using a predetermined construction process that may not be appropriate for the specific / unique construction challenges faced by the contractor responsible in performing the works.

Generally, the construction process is dictated by the materials being used and the latent / site specific conditions encountered during the conduct of the works, hence a formal contract document which sets out how to manage site specific challenges and latent conditions is necessary. Often inclusion of construction specifications in a Planning Scheme will lead to issues about which document has precedence (Planning Scheme or Construction Contract).

Legally a Contractor has agreed to perform work in accordance with the terms and specification described within the Construction Contract document, so where there is a dispute about how to conduct construction the Construction Contract document is regarded as the precedent document not the Planning Scheme.

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(6) As constructed drawings

(7) Workmanship guarantee

(8) “Maintenance period” and “on maintenance”

(9) Close-out workshop inspection

(10) “End of maintenance” inspection

(11) What to expect roadworks inspections

SC6.4.6.1 Geometric road design

(1) Introduction

(a) Purpose

(i) This section sets out requirements developed specifically for the design of roads using principles of street design to ensure safety and improved amenity and to reduce pedestrian/vehicular conflicts.

(ii) A fundamental requirement of the design process is for designers to determine the vehicle speed which is deemed acceptable for a particular subdivision or section of road.

(iii) All relevant design principles must be integrated in the development of the road network, recognising the primary role of roads for transport function.

(iv) The objective of road design is to recognise the carrying of through traffic.

(v) The objectives of street design are to recognise improving safety and security, increase vitality and interaction, reduce private motor vehicle dependence, improve development efficiency, provide valuable community space, and retain economic activity in communities.

(b) Scope

(i) This section must be read in conjunction with the IPWEAQ publication *Street Design Manual: Walkable Neighbourhoods and Practice Notes*, with limited adoption in Townsville as follows:

1. in areas with close nexus to the CBD, and in areas where higher densities are encouraged and it can be demonstrated that there is high access and potential use of public transport, then a full adoption of the *Street Design Manual* while tying into existing road and street networks. For infill development and upgrades in these areas, development is to be in line with the *Street Design Manual* principles of pedestrian and cyclist friendly environments, encouraging developments that engage with active street frontages;

2. new, large, master planned developments are to adopt the *Street Design Manual*, although they will be required to recognise the role of public transport as an alternative to moving people between these sites and other areas of Townsville. Designs should emphasise pedestrian and cyclist movements, and allow for retrofitting of public transport options in the future, if and when they become viable;

3. other developments are to apply priorities in line with the *Street Design Manual*, but layout is to be adapted to tie into existing road and street networks, recognising high car dependence, and lack of containment opportunities, where commercial centres, schools and retail facilities are not proposed within the development; and

4. curvilinear street designs are to be avoided wherever practical, with a focus on the grid structure in accordance with the *Street Design Manual* and requirements of the Townsville City Plan.

(c) Aims

A road system within a subdivision is to be designed to achieve the following aims:

(i) to provide convenient and safe access to all allotments for pedestrians, vehicles, and cyclists;

(ii) to provide safe, logical, and hierarchical transport linkages with existing street system, including consideration of crime prevention in streets, bikeways, and pathways;

(iii) to provide appropriate access for buses, emergency, and service vehicles;

(iv) to provide both a permeable and legible street network;

(v) to provide for a quality product that minimises maintenance costs;

(vi) to allow for public utilities;

(vii) to provide an opportunity for visual amenity, E.g., street landscaping;

(viii) to provide convenient parking for visitors;

(ix) to provide connecting streets and places through permeable networks without any corresponding increase in vehicle speeds or "rat runs";

(x) to have appropriate regard for the climate, geology, and topography of the area; and

(xi) to provide connectivity to the external transport networks.

(d) Terminology

For the purpose of this section the definition of terms used to define the components of the road reserve must be in accordance with these AS 1348 terms.

Carriageway	that portion of the road or bridge devoted particularly to the use of vehicles,inclusive of shoulders and auxiliary lanes.
Footpath	the paved section of a pathway (verge).
Pathway	a public way reserved for the movement of pedestrians and of manually propelled vehicles.
Pavement	that portions of a carriageway placed above the subgrade for the support of, and to form a running surface for, vehicular traffic.
Shoulder	the portion of the carriageway beyond the traffic lanes and contiguous and flush with the surface of the pavement.
Verge	that part of the road reserve between the carriageway and the road reserve boundary. It may accommodate public utilities, footpaths, stormwater flows, street lighting poles and plantings.

(e) References and source documents:

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

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

Section SC6.4.5. Road network infrastructure

(ii) Australian Standards:

AS 1348	*Road and traffic engineering – Glossary of terms, Road design and construction*.
AS 1428	*Design for access and mobility.*
AS 1742	*Manual of uniform traffic control devices*.
AS 2890	*Parking facilities.*
AS/NZS 3845	*Road safety barrier systems.*

(iii) Austroads:

Guide to Road Design (Set)
Guide to Road Safety (Set)
Guide to Traffic Management (Set)

Design vehicles and turning path templates

(iv) Department of Transport and Main Roads

Queensland Manual of Uniform Traffic Control Devices

Road Planning and Design Manual

Treatment options to improve safety of pedestrians, bicycle riders and other path users at driveways

(v) Other:

Queensland Government, *Active Healthy Communities*

Queensland Government, *Crime Prevention through Environmental Design*

Queensland Government, *Model Code for Neighbourhood Design*

Institute of Public Works Engineering Australia, Qld Division, *Street Design Manual: Walkable Neighbourhoods and Practice Notes*

(2) Consultation and planning

(a) Consultation

(i) Designers are encouraged to consult with the Council and other relevant authorities prior to and during the preparation of the design. Designers should, in addition to requirements of this section, ascertain the specific requirements of these authorities as they relate to the designs in hand.

(ii) The designer must obtain service plans from all relevant public utility authorities and organizations whose services may exist within the area of the proposed development. These services are to be plotted on the relevant drawings including the plan and cross-sectional views.

(b) Planning concepts

(i) In new areas (as distinct from established areas with a pre-existing road pattern) each class of route should reflect its role in the street and road hierarchy by its visual appearance and related physical design standards. Routes should differ in alignment and design standard according to the volume of traffic they are intended to carry, the required traffic speed, adjoining land uses, and other factors. All higher order road networks under Council jurisdiction must comply with Section SC6.4.5 Road network infrastructure.

(ii) The road network for residential developments should have clear legibility for all road users, particularly pedestrians and cyclists.

(iii) The road network should reinforce legibility by providing sufficient differentiation between the road functions.

(iv) Distinct existing landmark features such as watercourses, mature vegetation or ridge lines should be emphasised within the structural layout to enhance their legibility.

(v) The road networks should by its inherent design and functional distinction provide the necessary legibility and place making.

(vi) The road network should provide for shortest reasonable access from any lot to the major road system for all pedestrian cyclists and vehicles.

(vii) Speed regulation should be built into the street geometry, to create an environment where drivers are actively discouraged from driving above the legislated/design speed. Speed control devices, often known as Local Area Traffic Management (LATM), are considered unnecessary for appropriately designed new streets and should only be used where no other solution is viable, due both to their capital and maintenance costs and possible intrusive nature. Side friction may be considered to assist with speed regulation where appropriate.

(viii) Provide convenient and safe access to all allotments for all road users including pedestrians, cyclists, public transport users, garbage trucks, and motorists. Priority of consideration in streets should be as per *Complete Streets.*

(ix) Include adequate network considerations in the placement and design of safe pedestrian crossing facilities especially across roads and high-volume streets.

(3) Urban design criteria (road geometry)

(a) Road and street hierarchy

(i) A hierarchical road network is essential to maximise road safety, residential amenity, and legibility. Each class of road in the network serves a distinct set of functions and is designed accordingly. The design should convey to motorists the predominant function of the road.

(ii) Transport routes are divided into two distinct levels (refer to Section SC6.4.3 Standard drawings):

1. streets; and

2. roads

(iii) The lowest order of transport route (streets) has as their primary function to facilitate public interaction and movement through a place, village, town, or city.

1. Streets should be designed in accordance with the adjoining land uses

(iv) The highest order of transport route (Roads) should have as its main function the convenient and safe distribution of traffic and should be designed in accordance with the Section SC6.4.5 Road network infrastructure, Austroads, and Department of Transport and Main Roads standards.

(b) Road network

(i) The design features of each type of road or street convey to the driver its primary functions and encourage appropriate driver behaviour.

(ii) Traffic volumes and speeds on any road or street should be compatible with its adjoining land uses and function.

(iii) The maximum length of a residential street should ensure its status as a residential place is retained, where the traffic, in terms of speed and volume will enable the integration of pedestrian, bicycle and vehicular movements. This length will typically be 250m in accordance the *Model Code for Neighbourhood Design* ..

(iv) The distance required for pedestrians, cyclists, and drivers to travel between two points within the development should be minimised.

(v) Where local streets form part of a pedestrian or bicycle network, access links should provide suitable connectivity with adjoining local streets or open space systems to ensure such pedestrian and bicycle network are functionally efficient and safe.

(vi) The road network should ensure that no road intersects with another road which is more than two levels higher or lower in the hierarchy. In exceptional circumstances roads may intersect with others that are more than two levels apart with Council approval, however, no local street should have direct connection to an access controlled arterial road.

(vii) The road and street layout should conform to the requirements of the external road network and satisfy the transport provisions of an outline development plan.

(viii) The external road network should be designed and located to provide routes which are more convenient for potential through traffic within the network. Major roads should be provided at intervals of no more than 1.5 km and should be complete and of adequate capacity to accommodate through network movements.The internal road system should not provide through routes that are more convenient than the external road network.

(ix) The design of major collector roads, sub arterial roads and arterial roads should achieve a context sensitive design by providing an acceptable balance between the level of service, safety, whole of life costs, flexibility for future upgrading or rehabilitation and environmental impact. Consequently, major collector roads, sub arterial roads and arterial roads should provide a higher level of efficiency and safety with space for public transport, bicycle lanes and pedestrian facilities.

(x) Operations on major collector roads, sub arterial roads and arterial roads must be in accordance with Austroads' *Guide to Road Design Part 2:Design Considerations,* taking into account:

1. intersection spacing and control;
2. lane changing;
3. weaving;
4. merging;
5. spacing of median openings;
6. reverse flow/tidal traffic control;
7. pedestrians;
8. cyclists;
9. parking (if permitted);
10. transit lanes for buses and high occupancy vehicles (HOV);
11. provision for B-doubles and multi-combination vehicles;
12. provision for intelligent transport systems (ITS);
13. bus stops;
14. service roads;
15. driveway spacing and their distances from intersections (if permitted); and
16. signage and line marking in accordance with Main Roads' *Manual of Uniform Traffic Control Devices* (MUTCD) and *Traffic and Road Use Management Manual* (TRUM).

(c) Design speed

(i) Design speed is generally used as the basic parameter in the design standards, determining the minimum design value for other elements and is the 85th percentile maximum speed of traffic within the road / street. This is similar to the "Speed Environment" used in Austroads *Guide to Road Design*. Vehicular speeds are also limited by road intersections as well as changes in horizontal and vertical alignment.

(ii) Adoption of a low design speed discourages speeding, however, where vertical or horizontal curves of low design speed are located in otherwise high-speed sections (tangents) the result is a potentially dangerous section of road. Attention should be given to ensuring that potentially hazardous features are visible to the driver and adopting traffic engineering measures which will help a driver avoid errors of judgement.

(iii) Design speed should allow for road characteristics such as:

1. traffic volume;
2. width of carriageway;
3. grades; intersections;
4. the presence and spacing of consolidated property access;
5. traffic characteristics; and
6. traffic composition (pedestrians, cyclists, public transport, passenger vehicles, heavy vehicles).

(iv) The posted speed limit on roads should generally comply with the road hierarchy design criteria detailed in SC6.4.5 – Road network infrastructure, Clause SC6.4.5.7 Attachment A- Road Hierarchy Typical Cross Section Characteristics.

(v) Where there is a proposed change to an existing speed limit or where new roads are proposed with speed limits outside of the range permitted by the road hierarchy, the formal speed limit review process must be followed in accordance with Section 3 of the Queensland Department of Transport and Main Roads, *Queensland Road Safety Technical User Volumes* (QRSTUV): *Guide to Speed Management.*

(d) Sight distance

(i) Stopping sight distance should be provided at all points on the road.

(ii) Stopping sight distance is the sum of the braking distance and the distance the vehicle travels during a reaction time of 2.5 seconds.

(iii) Adequate sight distance should be provided at intersections both horizontally and vertically. Each intersection location must be examined for conformance with the criteria for Approach Sight Distance (ASD), Entering Sight Distance (ESD) and Safe Intersection Sight Distance (SISD).

1. ASD relates to the ability of drivers to observe the roadway layout at an anticipated approach speed.
2. ESD relates to the driver entering the intersection from a minor street and ability to observe the roadway layout and assess traffic gaps.
3. SISD relates to an overall check that vehicles utilising the intersection have sufficient visibility to allow reaction and deceleration to provide adequate stopping distance in potential collision situations.

(e) Longitudinal gradient

(i) A general minimum gradient of 0.5 % should be adopted. In very flat conditions it may be reduced to 0.3% with Council approval. Where underground drainage with gully pits or other special works are used it is preferable to allow near level grades rather than reverting to introduction of artificial undulations. Variable crossfall may be necessary to produce the required grade in the kerb and channel. The maximum longitudinal grade on any street should not exceed 12%, from consideration of pedestrian walking convenience.

(ii) Grades over 8% must provide additional considerations for pedestrians, cyclists, public transport, and heavy vehicles (E.g., garbage trucks, furniture vehicles) where appropriate. Exceptionally steep terrain may be allowed for very short lengths on steep streets of up to 16%. In these exceptional circumstances, the developer must demonstrate that alternate routes for pedestrians, bicycles, and heavy vehicles are available.

(iii) The longitudinal grade of the minor street on the approach to an intersection should not exceed 4% with sufficient length to accommodate a stationary single unit truck. Design of the road alignment and the grades used are interrelated. A steep grade on a minor side street is not acceptable if vehicles have to stand waiting for traffic in the major road.

(iv) Turning circles in cul-de-sacs on steep grades should have grades less than 5%.

(f) Horizontal curves and tangent lengths

(i) The horizontal alignment of a road or street is normally in a series of tangents (straights) and curves which may be connected by transition curves. The choice of the horizontal alignment should be determined from the design speeds for a street, in particular the expected operating speeds and constraints of the developments adjacent to the road in accordance with Austroads' *Guide to Road Design Part 3: Geometric Design*. Designers should ensure that, for a given design speed, the minimum radius of curvature utilised is such that drivers of all vehicles can safely negotiate the curve. Curves which progressively tighten, and sudden reverse curves must be avoided.

(ii) While horizontal alignment is one means of limiting vehicle speed, the greater of the following requirements must be complied with:

1. minimum curve radius for a street - 10 m; or

2. minimum curve radius for a road in accordance with DTMR design standards.

(iii) Carriageway widening applies to all standard carriageway widths. Widening should be applied to the inside kerb line of the carriageway, in accordance with Austroads' *Guide to Road Design.*

(iv) The minimum horizontal sight distance required at any point along the street / road is the general minimum sight distance for the spot speed relevant at that point. The sight distance is measure along the vehicle path, which may be assumed as the carriageway centreline for streets.

(g) Vertical curves

(i) The design of vertical alignment must reflect the expected operating speeds and constraints of the developments adjacent to the road in accordance with Austroads' *Guide to Road Design Part 3:Geometric Design.*

(ii) Vertical curves will be simple parabolas and should be used on all changes of grade exceeding 1%. The length of the crest vertical curve for stopping sight distance is based on speed and should conform with Austroads' *Guide to Road Design Part 3: Geometric Design.*

(iii) In addition to the above general minimum sight distance, which is required to be provided at all points along the street / road, at locations where there may be channelisation or line marking, such as intersections or pedestrian crossings, the driver must be able to see such indications within the stopping distance, I.e., sight distance from 1.15 m eye height to zero is not less than single vehicle stopping distance.

(iv) For adequate riding comfort, lengths of sag vertical curves should conform with Austroads' *Guide to Road Design Part 3: Geometric Design.*

(v) Junctions of streets / roads should be located at a safe distance from a crest, determined by visibility from the side street / road. Location of a side street / road at a crest should only occur if there is no suitable alternative.

(vi) Drainage poses a practical limit to the length of sag curves and a maximum length (in metres) of 15 times the algebraic sum of the intersecting vertical grades (expressed as a percentage) is suggested. To avoid water ponding in excessively flat sections of kerb and gutter, a minimum grade of 0.3% must be maintained in the kerb and channel.

(vii) The three-dimensional coordination of the horizontal and vertical alignment of a street / road should be aimed at improved traffic safety and aesthetics. Economic considerations often require a compromise with aesthetic considerations. The following principles should be applied:

1. the design speed of the street / road in both horizontal and vertical planes should be of the same order;and
2. combined horizontal and vertical stopping sight distance and minimum sight distance should be considered three dimensionally.

(h) Superelevation

(i) The use of superelevation in association with horizontal curves is an essential aspect of geometric design of roads with design speeds more than 60 km/h. Streets which are designed for speeds of 40 km/h or less and with curves of 60 m radius or less generally have the pavement crowned on a curve instead of superelevation.

(ii) The maximum superelevation for urban roads of higher design speeds should be 5%. Any increase in the longitudinal grade leading to excessive crossfall at intersections should be considered with caution. While all curves should be superelevated, negative crossfall should be limited to 3%.

(iii) In general, curve radii larger than the minimum and superelevation rates less than the maximum should be used where possible. The minimum radius of curves is determined by the design speed.

(iv) Superelevation (or maximum adverse crossfall) at any point on the circular portion of the curve, and the maximum coefficient of side friction which allows safe lane changing. Refer to the *Road Planning and Design Manual* Table 11.1.

(v) Recommendations for minimum curve radii (in metres) on major urban roads under varying superelevation/crossfall are as per Austroads' *Guide to Road Design*.

(vi) Plan transitions are required on superelevated curves for appearance and to provide a convenient length in which to apply the superelevation. On urban roads, superelevation may be conveniently applied to the road cross section by shifting the crown to 2m from the outer kerb. The axis of rotation of the cross section for urban roads will normally be the kerb grading on either side which best enables access to adjacent properties and intersections.

(vii) Rate of Rotation for superelevation refer Austroads' *Guide to Road Design Part 3: Geometric Design* (Section 7.7).

(i) Road reserve characteristics

(i) the cross section of the road reserve must provide for all functions that the street / road is expected to fulfil, including the safe and efficient movement of all users, provision for parked vehicles, acting as a buffer from traffic nuisance for residents, the provision of public utilities and street scaping. Road reserve widths will depend on verge widths, service roads and pathway requirements, and major collector roads, sub arterial roads and arterial roads must also allow for future upgrading;

(ii) the carriageway width must allow vehicles to proceed safely at the operating speed intended for that level of road in the network and with only minor delays in the peak period. This must take into consideration the restrictions caused by parked vehicles where it is intended or likely that this will occur on the carriageway. Vehicles include trucks, emergency vehicles and, on some roads, buses. Excessive carriageway widths can be detrimental to safety, amenity, user convenience, capital expenditure and maintenance costs;

For example, for urban residential streets:

1. Access places are narrower urban residential carriageways in accordance with Section SC6.4.3 Standard drawing SD-001. Access places are allowable for shorter street lengths, with low parking demand, and serving standard residential allotments. This carriageway does not allow for any buses or bike lanes. Frequent staggered parking may occur on both sides of the street where there are less than 150 vehicles per day, otherwise on street parking should be infrequent or along one side of the street only. Generally,street lengths should be kept to a maximum length of 250 m. These streets may not function as a through route, and must carry a low traffic volume;
2. Access streets are standard urban residential carriageways in accordance with Section SC6.4.3 Standard drawing SD-001. Access streets are allowable where there is relatively frequent parking on both sides of the street with traffic volumes generally less than 750 vehicles per day;
3. Minor collector streets are wider urban residential carriageways in accordance with Section SC6.4.3 Standard drawing SD- 001. Minor collector streets are required where there is a higher density residential area with higher parking demand or higher volume of traffic (less than 3000 vehicles per day in accordance with Section SC6.4.5 Road network infrastructure, Clause SC6.4.5.1(3)(c) and possible bus routes. Indented bus bays may be required, on advice from Council;

(iii) the safety of pedestrians and cyclists where it is intended that they use the carriageway, must also be assured by providing sufficient width;

(iv) the carriageway width should also provide for unobstructed access to individual allotments. Drivers should be able to comfortably enter or reverse from an allotment in a single movement, taking into consideration the possibility of a vehicle being parked on the carriageway opposite the driveway;

(v) the design of the carriageway should discourage drivers from travelling above the intended speed by reflecting the functions of the road in the network. The width and horizontal and vertical alignment should not be conducive to excessive speeds;

(vi) appropriate verge width should be provided to enable the safe location, construction and maintenance of required footpaths and public utility services (above or below ground), with acceptable clearances and to accommodate the desired level of streetscaping. Wherever possible, services should be in common trenches;

(vii) the verge when considered in conjunction with the horizontal alignment and permitted fence and property frontage treatments should provide appropriate sight distances, considering expected speeds and pedestrian and cyclist movements;

(viii) stopping sight distances and junction or intersection sight distances, provided by the verge, should be based on the intended speeds for each road type;

(ix) safe intersection stopping distance envelopes must be provided to ensure sight distances are achieved in the street layout; and

(x) industrial roads andhigher order roads including major collector roads must be designed to allow access for larger vehicles including B-doubles and multi-combination vehicles into these areas, including safe turning manoeuvres at intersections and to and from allotments.

(j) Crossfall

(i) Roads should be crowned in the centre. Typical pavement crossfalls on straight roads are:

Pavement Type	**Crossfall**
Bituminous seal coat	3%
Asphalt seal	3%
Cement concrete	3%

(ii) There are many factors affecting levels in urban areas which force departures from these crossfalls. Differences in level between road alignments can be taken up by offsetting crown lines or adopting one- way crossfalls. Sustained crossfalls should not exceed 4%, although up to 6% may be used where unavoidable with Council approval. The rate of change of crossfall should not exceed those adopted in Clause SC6.4.6.1(3)(h) Superelevation above.

(iii) The use of one-way crossfalls should be limited taking into consideration overland drainage and the impact on open space, public footpaths, and private properties.

(iv) The crossfall on a higher order transport route should take precedence over the grade in minor side streets. Standard practice is to maintain the crossfall on the major road and adjust the minor side street levels to suit. The crossfall in side streets should be warped quickly either to a crown or a uniform crossfall depending on the configuration of the side street. A maximum change of grade of 2% in the kerb line of the side street relative to the centre line grading is acceptable.

(k) Verge and property access

(i) A suitable design for the verge will depend on utility services, the width of footpath, access to adjoining properties, likely pedestrian usage, and preservation of trees. General design criteria applying to verges are detailed on Section SC6.4.3 Standard drawing SD-015.

(ii) Low level footpaths may only be used if normal crossfalls are impracticable. Crossfalls in footpath paving should not exceed 2.5%, in accordance with Austroads' *Guide to Road Design - Part 6A: Pedestrian and Cyclist Paths*. Longitudinal grade usually parallels that of the road, and this may be steeper than 5%.

(iii) Differences in level across the road between road reserve boundaries may be accommodated by:

1. cutting at the boundary on the high side and providing the verge at normal level and crossfall;

2. battering at the boundary over half the verge width with the other half against the kerb constructed at standard crossfall;

3. a uniform crossfall across the carriageway; and

4. the lower verge being depressed below the gutter level.

(iv) The above measures can be used singularly or combined. The verge formation should extend with a 0.5m berm beyond the road reserve boundary.

(v) The designer must design a vehicular driveway centreline profile for the property access and check this design using critical car templates, to ensure that vehicles can use the driveway satisfactorily.

(vi) Where commuter, pedestrian, and cyclist paths are proposed, appropriate shading and rain protection should be provided. An approved landscaping master plan must be provided for approval.

(l) Intersections

(i) Intersections are defined as junctions of roads or streets and include junctions described as:

1. Signalised intersections;

2. Roundabouts;

3. Priority controlled intersections that maybe either stop or give way controlled; and

4. Uncontrolled intersections, i.e., simple intersections without any signage.

(ii) The design of intersections or junctions should allow all movements to occur safely without undue delay. Projected traffic volumes should be used in designing all intersections, junctions or roundabouts on major collector roads, sub arterial roads and arterial roads.

(iii) Intersection design for the junction of subdivision roads and streets with existing state rural or urban roads and national highways should generally be in accordance with the publication Austroads' *Guide to Road Design – Part 4, Intersections and Crossings*.

(iv) Intersections with state roads or national highways are to be designed, approved, and constructed in accordance with the requirements of the Department of Transport and Main Roads.

(v) Where major intersections are required to serve a development complete reconstruction of the existing road pavements may be necessary.

(vi) Intersections should be generally located in such a way that:

1. the streets/ roads intersect preferably at right angles and not less than 70º;

2. the landform allows clear sight distance on each of the approach legs of the intersection;

3. the minor street intersects the convex side of the major street;

4. the vertical grade lines at the intersection do not impose undue driving difficulties;

5. the vertical grade lines at the intersection will allow for any direct surface drainage;

6. intersection spacing and median breaks on sub arterial roads and arterial roads should be minimum 150m;

7. intersection spacing and median breaks on major collector roads should be minimum100m;

8. spacing of intersections on minor collector streets and local streets should be not less than 50m, this is particularly important when two minor side streets intersect a minor collector street in a left right staggered pattern, the minimum centre-line spacing of 50 m provides for a possible right turn auxiliary lane on the minor collector street; and

9. a right left manoeuvre between the staggered streets / roads is preferable, avoiding the possibility of queuing in the major street / road.

(vii) Adequate stopping and sight distances are to be provided for horizontal and vertical curves at all intersections.

(viii) Appropriate provision should be made for vehicles to park safely, where required. Safe intersection sight distance - refers to Clause SC6.4.6.1(3)(h)(ix) above.

(ix) The drainage function of the carriageway and/or road reserve must be satisfied by the road reserve cross- section profile.

(x) All vehicle turning movements are accommodated utilising Design Vehicles and Turning Templates, as follows:

1. for intersection turning movements involving major collector, sub arterial or arterial roads the minimum size vehicle is a "design semi-trailer" with turning path radius 15m;

2. for intersection turning movements involving minor collector streets, the minimum size vehicle is a "design single unit" bus with turning path radius 13 m;

3. for turning movements involving access streets the minimum size vehicle is a “design single unit” truck; and

4. at the head of cul-de-sac of access places, sufficient area is provided for the "design single unit" truck to make a three-point turn, driveway entrances are not to be used for turning movements. The minimum cul-de-sac head radius is 9 m to kerb lip.

(xi) On bus routes 3-centred curves with radii 15m, 10m, 30m are to be used at junctions and intersections.

(xii) Unsignalized intersections on major collector roads, sub arterial roads and arterial roads at grade should have a median width of at least 5.5m to allow for a two-stage crossing from the side street and possible conversion of the median to 2.5m wide with a 3.0m wide right turn lane.

(xiii) Design of traffic signals on major collector roads, sub arterial roads and arterial roads must be in accordance with the Department of Transport and Main Roads’ *Road Planning and Design Manual* (RPDM), Chapter 18. Council approval is required for use of equipment that is uniquely associated with traffic signals.

(xiv) Barrier kerb and channel must be used at intersection kerb turnouts extending to the tangent point. A one metre kerb transition must be used to connect barrier kerb and channel turnout with adjacent layback kerb and channel.

(m) Roundabouts

(i) Roundabouts are to be approved by Council.

(ii) Roundabouts should be avoided if they exhibit the following characteristics:

1. In urban areas near schools where off-road bicycle lanes are not provided.

2. Locations frequented by the elderly or people with disabilities, e.g., near aged care facilities and medical centres.

3. On principal bicycle network, (existing or future routes) as defined by the Department of Transport and Main Roads.

4. Locations where there is high pedestrian demand to cross the road at the intersection.

5. Elliptical central islands.

(iii) Roundabouts should generally be designed in accordance with the requirements of Austroads *Guide to Road Design - Part 4B - Roundabouts*. Designs adopting alternative criteria will be considered on their merits. Roundabout design should generally comply with the following:

1. safe provision for pedestrians, cyclists, and public transport movements;

2. entry width to provide adequate capacity;

3. adequate circulation width, compatible with the entry widths and design vehicles E.g., buses, trucks, and cars;

4. central islands of diameter in accordance with the minimum prescribed in Austroads *Guide to Road Design - Part 4B - Roundabouts* and sufficient to give drivers guidance on the manoeuvres expected;

   Editor's Note – Central island diameter should be determined by the existed posted limit of the road, reducing the posted speed limit on the approach to a roundabout is not an acceptable design solution to achieve minimum central island diameter compliance.

5. deflection of the traffic to the left on entry to promote gyratory movement and not bypass of the circular lane.

6. adequate deflection of crossing movements to ensure low traffic speeds;

7. a simple, clear, and conspicuous layout; and

8. design to ensure that the speed of all vehicles approaching the intersection will be less than 40 km/h, this can be achieved using deflection curves on the approaches to the roundabout.

(n) Local area traffic management

(i) Local area traffic management (LATM) devices are unnecessary for appropriately designed new streets but may be used to address speed and safety issues in existing streets and must be approved by Council.

(ii) Calming devices such as thresholds, slow points, speed humps, chicanes and splitter islands should be designed in accordance with the requirements of the publication Austroads *Guide to Traffic Management Part 8: Local Area Traffic Management (LATM)* and the *Manual of Uniform Traffic Control Devices*. Device designs should generally comply with the following.

1. Streetscape:

   a) reduce the linearity of the street by segmentation;

   b) avoid continuous long straight lines (E.g., kerb lines);

   c) short straights and short distances between intersections;

   d) enhance existing landscape character;

   e) maximise continuity between existing and new landscape areas;

f) on street parking; and

g) mixed activity precincts.

2. Location of devices/changes:

   a) devices other than at intersections should be located to be consistent with streetscape requirements;

   b) existing street lighting, drainage pits, driveways, and services may decide the exact location of devices; and

   c) slowing devices are optimally located at spacings of 100-150 m.

3. Design vehicles:

   a) emergency vehicles, garbage trucks and furniture vehicles must be able to reach all residences and properties;

   b) local streets with a “feeding” function between arterial roads and streets must be designed for an Austroads Design Single Unit Truck/Bus;

   c) where bus routes are involved, buses should be able to pass without mounting kerbs or travelling over speed humps and with minimised discomfort to passengers; and

   d) in newly developing areas where street systems are being developed in line with LATM principles, building construction traffic must be provided for.

4. Control of vehicle speeds

   a) maximum vehicle speeds can only be reduced by deviation of the travelled path. Pavement narrowing has only minor effects on average speeds, and usually little or no effect on maximum speeds;

   b) speed reduction can be achieved using devices which shift vehicle paths laterally (slow points, roundabouts, corners) or vertically (humps, platform intersections, platform pedestrian/school/bicycle crossings); and

   c) speed reduction can be helped by creating a visual environment conducive to lower speeds. This can be achieved by “segmenting” streets into relatively short lengths (less than 300 m), using appropriate devices, streetscapes, or street alignment to create short sight lines and by inducing in drivers a feeling of constriction through the introduction of side friction.

5. Visibility requirements (sight distance)

   a) adequate critical sight distances should be provided such that evasive action may be taken by either party in a potential conflict situation. Sight distances should relate to likely operating speeds;

   b) sight distance to be considered include those of and for pedestrians and cyclists, as well as for drivers; and

   c) night-time visibility of street features must be adequate. Speed control devices particularly should be located near existing street lighting if practicable, and all street features/furniture should be delineated for night-time operation. Additional street lighting must be provided by the developer at proposed new speed control devices located away from existing street lighting.

6. Critical dimensions

Many devices will be designed for their normal use by cars, but with provision (such as mountable kerbs) for larger vehicles. Some typical dimensions include:

a) pavement narrowing in accordance with Austroads *Guide to Traffic Management;*

b) bicycle lanes (including adjacent to pavement narrowing) – 1.5 m minimum, 1.2 m absolute minimum with Council approval (in accordance with Austroads *Guide to Traffic Management*, and *Guide to Road Design);*provision of a 600 mm wide painted separation strip between the traffic lane and the cycle lane should be provided where sufficient pavement width is available.

c) ;plateau or platform areas 75 mm to 100 mm height maximum, with 1 in 15 ramp slope;

d) width of clear sight path through slowing devices;

e) the width of the portion of carriageway which does not have its line of sight through the device blocked by streetscape materials, (usually vegetation);

f) dimensions of mountable areas required for the passage of large vehicles to be determined by appropriate turning templates; and

g) on bus routes, devices must allow the full bus length to be contained between ramps.

(o) Road safety audits

(i) Road safety audits (RSA) are to be carried out in accordance with Austroads *Guide to Road Safety Part 6: Road Safety Audit*. Council will advise if an RSA is required to support a development proposal / project and the stages required in the RSA. The following stages of the project should be considered for an RSA, as appropriate:

1. feasibility design;
2. completion of design development;
3. completion of final design;
4. during construction, where temporary traffic management measures are proposed;
5. two weeks prior to opening to traffic; and
6. within one week of opening to traffic.

(p) Bicycle lanes

(i) On-road bicycle lanes shall comply with Section SC6.4.4 Active transport infrastructure, Clause SC6.4.4.6 Pathway and cycleway design characteristics.

(ii) Bicycle lanes should be marked on roads with posted speed limits within the range of 60 km/h to 80 km/h, these roads are typically defined as Major Collector, Sub Arterial and Arterial roads.

(iii) The width of on-road bicycle lanes will generally be in accordance with the dimensions on SC6.4.3 Standard drawings SD-001, SD-002, SD-003, SD-004 and as detailed in Section SC6.4.5 Road network infrastructure, Attachment A - Road Hierarchy Typical Cross Section Characteristics.

(iv) All on-road bicycle lanes are to be a minimum 1.5 m wide located adjacent to the marked traffic lanes. Where there is sufficient width within the carriageway a 0.6 m wide separation strip (painted chevron) should also be provided between the bicycle lane and the traffic lane.

(v) Bicycle lane separation strip line marking should be as per Australian Standard 1742.2, Figure 5.26 with only one strip provided between the traffic lane and the bicycle lane.

(vi) Roads and streets that have speed limits of 50 km/h or less do not have marked bicycle lanes, the design of these roads and streets should, however, allow for bicycles to share and use the carriageway with vehicle traffic.

(vii) Roads with speed limits above 80 km/h are not permitted to have bicycle lanes, these roads are designed for high-speed vehicle traffic and cycling facilities within the road corridor should be separated from the road carriageway.

(viii) Where there is insufficient width within the road carriageway to accommodate bicycle lanes off-road cycling facilities must be provided. These off-road facilities may include a dedicated cycleway that is separated from the footpath or a shared use pathway facility that is a minimum of 2.5m wide. Where a combination of on-road bicycle lanes and off-road cycling facilities is used, bicycle ramps and signage must be provided to allow the cyclist to easily transition from on-road to off-road cycling infrastructure.

(q) Parking

(i) Parking shall comply with Section SC6.4.5 Road network infrastructure, Clause SC6.4.5.4 Car parking

(ii) The parking requirements for normal levels of activity associated with any land use should be accommodated on-site.

(iii) The width of on-road parking facilities will generally be in accordance with the dimensions on Section SC6.4.3 Standard drawings SD-001, SD-002, SD-003, SD-004, SD-005 and as detailed in Section SC6.4.5 Road network infrastructure, Attachment A: Road Hierarchy Typical Cross Section Characteristics.

(iv) All on-site parking should be located and have dimensions that allow convenient and safe access and usage. All designs must account for a B99 (AS 2890) vehicle requirement.

(v) Adequate parking should be provided within the road carriageway for visitors, service vehicles and any excess resident parking since a particular use may generate a high demand for parking. Such parking is to be convenient to the use.

(vi) Parking on a footpath or grassed verge area of a street or road either partly or completely is not permitted.

(vii) Where there is demand for parking and there is insufficient width to park on the carriageway, indented parking bays is an option or alternatively parking on-site must be provided.

(viii) All indented parking areas are to be constructed of concrete, interlocking pavers, bitumen with crushed rock or other Council approved base material and are designed to withstand the loads and manoeuvring stresses of vehicles expected to use those spaces.

(ix) The availability of parking should be adequate to minimise the possibility of driveway access being obstructed by cars parked on the opposite side of the street / road.

(x) For non-residential land uses, the opportunity for joint use of parking should be maximised by being shared by several complementing uses.

(xi) Right angled kerbside parking is provided only on streets where posted speeds do not exceed 40 km/h.

(xii) On single lane local streets indented parking spaces should be provided. Such parking should be well defined, and an all-weather surface provided. Such parking may not restrict the safe passage of pedestrians using the road verge.

(xiii) On Access Places (Section SC6.4.3 Standard drawings SD-001) limited parking should be possible for a B99 (AS2890) vehicle on one side of the street sufficient for a council rubbish truck to pass.

(xiv) On Access Streets (Section SC6.4.3 Standard drawings SD-001) limited parking should be possible for B99 (AS2890) vehicles to be parked on both sides of the street sufficient for a council rubbish truck to pass between the parked vehicles.

(xv) On Minor Collector Streets (Section SC6.4.3 Standard drawings SD-001) on-street parking must be provided on both sides of the street sufficient for two-way traffic to pass between the parked vehicles, Minor collected streets will be line marked with edge lines which will define the area of the carriageway that can be used for parking. Parking should be possible for B99 (AS2890) vehicles to be parked on the street between the lane edge line and kerb whilst allowing sufficient space for a cyclist to ride between the parked vehicle and the edge line.

(xvi) On Major Collector Roads (Section SC6.4.3 Standard drawings SD-002) and Sub Arterial Roads (Section SC6.4.3 Standard drawings SD-003) on-road parking must be provided on both sides of the road. Major collected roads and sub arterial roads will be line marked with edge lines and bicycle lanes which will define the area of the carriageway that can be used for parking. Parking should be possible for B99 (AS2890) vehicles to be parked on the road between the bicycle lane edge line and kerb. Where parking demand is high, marked parking bays should be provided.

(xvii) On Arterial Roads (Section SC6.4.3 Standard drawings SD-004) parking will be provided to the same standard as Sub Arterial Roads except when addition lane capacity is enabled by clearways or parking restrictions during peak traffic periods when traffic volumes are very high.

(r) Bus routes

(i) It is important that the road hierarchy adequately caters for buses. The main criteria in determining the location of bus routes is that no more than 5% of residents should have to walk more than 5 minutes to catch a bus. Section SC6.4.5. Road network infrastructure, Clause SC6.4.5.3 Public transport infrastructure details minimum criteria for bus route design, though local conditions, including climate and topography should be taken into consideration to demonstrate that bus routes are readily accessible to the majority of residents.

(ii) Bus shelters on bus routesd are subject to Council’s requirements, refer Section SC6.4.3 Standard drawings

(4) Rural design criteria (road geometry)

(a) General

(i) In addition to the above, this clause specifically applies to all those sites identified as being suited to rural subdivisions inclusive of rural home sites and hobby farm types of developments.

(ii) Design speed is to be generally used as the basic parameter of design standards and the determination of the minimum design value for other elements in rural subdivisions is to be based on the concept of a "speed environment" as outlined in Austroads *Guide to Road Design.*

(iii) Superelevation, widening and centreline shift and their associated transitions are to comply with Austroads guides, where appropriate.

(iv) Where the table drain is likely to scour, a stone-pitched or suitably lined dish drain is to be constructed along the invert. For grades of less than 0.5%, the inverts of the drain are to be lined to prevent siltation. Drains with a minimum gradient of 0.25% are to be concrete lined.

(v) All rural subdivisions should be designed to restrict access to major roads.

(vi) Access should be limited to one point on major collector roads, sub arterial roads and arterial roads.

(b) Sight distance

(i) Stopping sight distance should be provided at all points on the road.

(ii) Stopping sight distance is the sum of the braking distance and the distance the vehicle travels during areaction time of 2.5 seconds.

(c) Horizontal and vertical alignment

Horizontal and vertical curves are to be designed generally to the requirements of Austroads *Guide to Road Design*. These requirements are essential to satisfy the safety and performance of proper road design. Roads having both horizontal and vertical curvature should be designed to conform with the terrain to achieve aesthetic quality and being in harmony with the landform.

(d) Intersections

(i) Intersections should generally be designed in accordance with the publication Austroads *Guide to Road Design Part 4: Intersections and Crossings* and *Guide to Traffic Management Part 6: Intersections, interchanges and crossings*. The type of intersection required will depend on existing and planned connecting roads.

(ii) Adequate sight distance should be provided at intersections both horizontally and vertically. Each intersection location must be examined for conformance with the criteria for Approach Sight Distance (ASD), Entering Sight Distance (ESD) and Safe Intersection Sight Distance (SISD).

1. ASD relates to the ability of drivers to observe the roadway layout at an anticipated approach speed.
2. ESD relates to the driver entering the intersection from a minor road and ability to observe the roadway layout and assess traffic gaps. SISD relates to an overall check that vehicles utilising the intersection have sufficient visibility to allow reaction and deceleration to provide adequate stopping distance in potential collision situations.
3. Tabulated speed/sight distance requirements together with detailed explanations for each of the sight distance criteria are given in the relevant sections of the *Austroads Guide to Road Design*. Repositioning of an intersection may be required to obtain conformance with the sight distance criteria.
4. Stopping distance envelopes must be provided to ensure sight distances are achieved in the street layout.

(e) Carriageways

Carriageway widths for rural roads should generally be as per Section SC6.4.3 Standard drawings SD-010 Typical Road Cross Sections – Rural Roads.

(f) Superelevation

Use of maximum superelevation will be considered where the radius of the curve in approaching the minimum speed environment. Reference should be made to Austroads *Guide to Road Design for superelevation calculation*. At low and intermediate ranges of design speed (I.e., below 80 km/h) all curves should be superelevated to at least a value equal to the normal crossfall of straights.

(g) Table drains

Table drains to rural roads must comply with Austroads *Guide to Road Design Part 3: Geometric Design*. Minimum longitudinal grade of table drains is 0.50%. Refer to Austroads *Guide to Road Design Part 6: Roadside Design, Safety and Barriers* for capacity of drains.

(h) Scour protection

Scour protection of roadside drainage and table drains is required. The level of protection will depend on the nature of the soils, road gradients and volume of stormwater runoff. Protection works may involve concrete lined channels, turfing, rock pitching, grass seeding, individually or any combination of these. Geotechnical investigations should be carried out to determine the level and extent of any protection works prior to proceeding to final design stage.

SC6.4.6.2 Pavement design & seal design

(1) Introduction

(a) This section covers the design guidelines for road pavement to meet the required design life, based on the subgrade strength, traffic loading and environmental factors, and including the selection of appropriate materials for select subgrade, subbase, base and wearing surface, and the design of the subsurface drainage system for the road pavement and/or subgrade.

(b) Pavements shall be designed to provide the following minimum design life.

Road or street type	**Minimum design life**
Urban streets and roads	20 years
Rural streets and roads	20 years
Rigid (concrete)	40 years
Segmental block	25 years

(c) Pavement thickness

Notwithstanding subgrade testing and subsequent pavement thickness design, the minimum pavement thickness on local streets must not be less than 250 mm. This is necessary to ensure that council has sufficient thickness for future insitu stabilisation of pavements (without the risk of mixing the subgrade into the pavement during the process). Additionally, individual compacted layer thickness must be no less than 125 mm nor greater than 250 mm for optimal compaction and to avoid lamination of layers.

(d) Documentation – pavement design criteria and calculations

(i) All considerations, assumptions, subgrade test results, and calculations and other documentation required under this design specification must be submitted with the pavement design for approval by Council.

(ii) The drawings must clearly indicate the structure, material types and layer thicknesses of the proposed pavement and surfacing.

(iii) Pavement design criteria must be shown on the pavement drawings and include the ESA, CBR and expected design life.

(2) References and source documents

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

(a) Austroads:

Guide to Pavement Technology Set

Guide to Road Design

AP-T179/11 – Review of Primes and Primerseal Design

(b) Department of Transport and Main Roads:

Pavement Design Supplement –	Supplemental to *Part 2: Pavement Structural Design* of the *Austroads Guide to Pavement Technology.*

MRTS05	*Unbound Pavements*
MRTS07A	*Insitu Stabilised Subgrades using Quicklime or Hydrated Lime*
MRTS07B	*Insitu Stabilised Pavements using Cement or Cementitious Blends*
MRTS08	*Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends*
MRTS11	*Sprayed Bituminous Surfacing (Excluding Emulsion)*
MRTS12	*Sprayed Bituminous Emulsion Surfacing*
MRTS17	*Bitumen and Multigrade Bitumen*
MRTS18	*Polymer Modified Binder (including Crumb Rubber)*
MRTS19	*Cutter*
MRTS20	*Cutback Bitumen*
MRTS21	*Bituminous Emulsion*
MRTS22	*Supply of Cover Aggregate*
MRTS30	*Asphalt Pavements*
MRTS32	*High Modulus Asphalt*
MRTS36	*Recycled Glass Aggregate*
MRTS38	*Pavement Drains*
MRTS39	*Lean Mix Concrete sub-base for Pavements*

MRTS40 *Concrete Pavement Base*

(c) Concrete Masonry Association of Australia:

CMAA – MA57	*Concrete Segmental and Flag Pavements – Guide to Specifying, 2010*
CMAA - T45	*Concrete Segmental Pavements - Design Guide for Residential Access Ways and Roads*
CMAA - T46	*Concrete Segmental Pavements - Detailing Guide*

Clay Brick and Paver Institute	*Design Manual 1 - Clay Segmental Pavements, A Design and Construction Guide for Sites Subjected to Vehicular and Pedestrian Traffic*

(3) Pavement design parameters

(a) Vehicle loads

(i) Standard Axle Repetition (SAR) is the term given to the loading of one (1) axle with 4 tyres on a road pavement with each tyre exerting a load of 20 kN and the complete axle exerting a load of 80 kN.

(ii) The term Equivalent Standard Axles (ESA) is a measure of the number of SARs passing over a section of road during the design life of the road pavement.

(iii) For the above tyre loading configuration DTMR adopt a tyre-pavement contact stress of 750 kPa as the representative loading of a heavy commercial vehicle on Queensland roads. This is the same contact stress adopted by Austroads in the derivation of Figure 8.4 the design chart used for flexible pavement design, refer Austroads *Guide to Pavement Technology Part 2.*

(iv) For new subdivisions, the design traffic loading must take account of the construction traffic associated with the subdivision development, and the in-service traffic for the subdivision and any future developments linked to that subdivision.

(v) When designing staged developments, the number of vehicle trips (design loading) must take into consideration the ultimate development that will eventually access each segment of the road under consideration with appropriate allowances for bus, garbage, construction, and in-service traffic.

(vi) For interlocking concrete segmental pavements, the simplification of replacing ESAs with the number of commercial vehicles exceeding 3 tonne gross weight contained in CMAA-T45 is acceptable up to a design traffic of 10^6 ESAs. Beyond this, ESAs should be calculated.

(vii) The total number of ESAs travelling on the pavement over its design life is the Design ESA (DESA).

(viii) In the absence of other traffic data, the following traffic values (in ESAs) may be taken as a guide to the minimum design traffic but are subject to variation depending on the circumstances for the particular development.

Table SC6.4.6.2 - Design ESAs

Road / Street Type	Design ESAs - 20-year design life (minimum)
Urban Residential (Local Streets)	
- Access Place / Lane	2×10^4
- Access Street	1×10^5
- Minor Collector Street	1×10^6
Urban - Major Collector	2×10^6
Urban - Sub-arterial / Arterial and Industrial	5×10^6
Rural Roads	1×10^6

(ix) For new residential developments where traffic data is not readily and accurately available, the design may consider the following data to determine the design traffic loading:

1. traffic generation – 10 vehicles per day/allotment plus 20 ESAs per equivalent allotment for consideration of construction traffic;

2. traffic growth rates – 0.5% – 2% for streets. Annual traffic growth rates for roads are subject to confirmation by council and will be based on available traffic data;

3. commercial vehicles – 3%-7% for streets. Commercial vehicle percentages for roads are subject to confirmation by Council and will be based on available traffic data; and

4. ESA per heavy vehicle (ESA/HVAG) - Local Urban 0.7, Local Rural 0.9, and Trunk Roads 1.3.

(x) The calculation of design traffic loading for industrial roads will require a detailed assessment addressing the following factors and must be designed using a mechanistic approach:

1. traffic generation, including peak hour traffic volumes and truck volumes;

2. details of the types of heavy vehicles that are expected to utilise the road; and

3. predicted route patterns (heavy vehicles).

(4) Design subgrade CBR

(a) The road subgrade is the natural material underneath a constructed road or the material on which a new road will ultimately be built.

(b) The strength of the subgrade to support the road loads is typically measured as the California Bearing Ratio (CBR) which is the ratio of the bearing load that penetrates a material to a specific depth compared with the load giving the same penetration into crushed stone.

(c) The subgrade Design CBR adopted for the pavement design must consider the effect of moisture changes in the pavement and subgrade during the service life, and hence consideration must be given to the provision of subsurface drainage in the estimation of equilibrium in-situ CBRs, and hence in the design of the pavement structure.

(d) Design CBR of untreated subgrade must be no greater than 3% unless otherwise approved by council who reserves the rights to carryout independent 3rd party geotechnical investigations to confirm adopted design CBR’s and respective pavement designs.

(e) Subgrade treatment must be carried out in accordance with this document on all natural subgrade CBRs ≤ 3% (97% maximum dry density standard compaction at OMC). The equivalent design subgrade CBR of the treated subgrade must be determined in accordance with this document. Pavement design over treated subgrades may adopt the equivalent CBR determined in accordance with this document.

(5) Pavement structure - general

(a) Unbound granular materials used must comply with the requirements of MRTS05. Bound layers must comply with the requirements under MRTS08.

(b) The subbase layer must extend a minimum of 150 mm behind the rear face of any kerbing and/or guttering. The base and surfacing must extend to the face of any kerbing and/or guttering. Where the top surface of the subbase layer is below the level of the underside of the kerbing and/or guttering, the base layer must also extend a minimum of 150 mm behind the rear face of the kerbing and/or guttering.

(c) For un-kerbed roads, the subbase and base layers must extend for the full width of the formation.

(d) The pavement designer must make specific allowance for traffic load concentrations within car park areas (E.g., entrances/exits).

(e) The pavement designer must make provision for pavement layer drainage on the assumption that during the service life of the pavement ingress of water will occur. Compaction of the subbase, including 150 mm behind the rear face of the kerb and channel, must be carried out before trenching for the subsoil drain behind the kerb.

(6) Subgrade treatment - general

(a) Subgrade treatment may be required subject to ground conditions defined in Table SC6.4.6.3 Ground Conditions for Subgrade Treatment below.

Table SC6.4.6.3 - Ground Conditions for Subgrade Treatment

Category	Condition	Definition	Treatment Type
A	Excessively wet subgrade anticipated prior to construction and/or excessively wet subgrade encountered during construction	"Wet" subgrade	Working Platform
B	Low Design Subgrade Strength*	Soaked CBR ≤ 3%	Capping Layer
C	Highly or very highly expansive subgrade	Swell ≥ 2.5%	Pavement Cover
D	Ground beneath pavement will be exposed to water (due to the effect of capillary rise and/or positive head)	"Water Exposure"	Drainage Layer

* CBR swell at OMC and 97% MDD using Standard compactive effort; 4-day soak based on 4.5 kg surcharge.
(Source: Austroads *Guide to Pavement Technology – Part 2*)

(b) Design subgrade CBR = 3% must be adopted into the pavement design if the subgrade soaked CBR is > 3% but with CBR swell of ≥ 2.5% (classified as highly or very highly expansive).

(c) This specification clause does not provide direct criteria for determining the required depth of subgrade treatment in highly or very highly expansive soils (Category C). However, as Category C subgrade will need to be designed with CBR of ≤ 3%, the subgrade treatment of Category B (low design subgrade strength) will ensure that the total "Pavement Cover" is adequate to meet the cover requirements for an expansive subgrade soil. It is noted that the type of subgrade treatment that is acceptable will depend on the expansive nature of the soil. A subgrade with CBR swell of ≥ 2.5% will require capping material to include a low permeability layer.

(d) Subgrade Treatment selection is outlined in Table SC6.4.6.5 - Selection of Subgrade Treatment Type. Subgrade treatment may comprise one or a combination of the alternatives listed.

(7) Expansive soils

(a) Highly expansive materials are classified as highly reactive with high plasticity. Refer to the classification in Table SC6.4.6.4 below, Guide to Classification of Expansive Soils, with prominence give to classification based on the CBR swell.

(b) Expansive soils have the potential to exhibit significant volume changes with the variation in moisture content leading to possible loss of pavement shape and longitudinal cracking in the future pavement. For this reason, if test results indicate highly expansive materials (classified as "High" or "Very High"), the design CBR must be 3% or less.

(c) Materials having a measured CBR swell ≥2.5% must incorporate a low permeability treatment 'Capping Layer' to minimise significant moisture changes in the underlying subgrade.

Table SC6.4.6.4 - Guide to Classification of Highly Expansive Soils

Expansive Nature	Liquid Limit (%)	Plastic Index	PI x % <0.425mm	Potential Swell (%)*
Very High	>70	>45	>3200	>5.0
High	>70	>45	2200-3200	2.5-5.0
Moderate	50-70	25-45	1200-2200	0.5-2.5
Low	<50	<25	<1200	<0.5

*Swell OMC and 97% MDD using Standard compactive effort; 4-day soak based on 4.5 kg surcharge.(Source: Guide to Pavement Technology – Part 2).

(8) Selection criteria for subgrade treatment type

Table SC6.4.6.5 - Selection of Subgrade Treatment Type

Treatment	Soaked CBR ≤ 3%	Wet at construction	Swell < 2.5%	Water Exposure	Treatment Name
L0			✓		Pavement cover (Select Fill)
L1			✓	✓	Drainage layer
L2		✓	✓		Working platform
L3		✓	✓	✓	Drainage layer & working platform
L4	✓		✓		Capping layer
L5	✓		✓	✓	Capping layer & drainage layer
L6	✓				Capping layer & pavement cover
L7	✓			✓	Capping layer, pavement cover & drainage layer
L8	✓	✓	✓		Capping layer & working platform
L9	✓	✓	✓	✓	Capping layer, drainage layer & working platform
L10	✓	✓			Capping layer, pavement cover & working platform
L11	✓	✓		✓	Capping layer, pavement cover, drainage layer & working platform

(a) Treatment L0 – pavement cover (select fill)

(i) Pavement cover is a layer of Select Fill material used as part of a subgrade treatment solution when additional gravel material is required to achieve the subgrade level. “Pavement Cover” is often used to replace wet in-situ subgrade material that has been removed during road excavation.

(ii) Select Fill may comprise a naturally occurring material from on site or imported to site or may comprise a natural material that has its properties improved by addition of cement or lime. The natural material or improved product must meet the minimum requirements in Table SC6.4.6.6 Material Properties for Select Fill below.

Table SC6.4.6.6 - Material properties for select fill and treated material

Property	Depth below Working Platform [1]	
	≤ 150 mm	> 150 mm
Laboratory CBR (%) [a]	≥ 10	≥ 10
Maximum aggregate size (mm)	75	75
Plasticity index	≥7	≥7
Weighted plasticity index (WPI)	< 1200	< 2200
Swell (%)	≤ 0.5	≤ 2.5
% Passing 0.075 mm	15–30 inclusive	4–30 inclusive

a. material may be chosen with a minimum CBR greater than specified above, if this is considered to provide a better overall design solution. However, for design purposes, the layer may not be modelled with CBR of greater than 15%.

(b) Treatment L1 - drainage layer

(i) A drainage layer must be provided where water exposure occurs, or is likely to occur, from beneath the pavement (due to the effect of capillary rise and/or positive head).

(ii) A drainage layer is often used to replace soft subgrade material which is found to be wet during earthworks.

(iii) The drainage layer must be a minimum 300mm thick and covered by a minimum 150 mm thick “Working Platform” or “Capping Layer” to provide a foundation for additional pavement layers.

(iv) The drainage layer may be as follows:

1. open-graded 20 mm crushed rock (having no more than 3% of material finer than 75 μm), produced by blending size 20mm, 14mm and 10mm aggregates; or
2. 125 mm nominal size rock fill wrapped in a suitable geotextile. The rock fill must meet the quality requirements for rock fill in TMR Specification MRTS04 and the Geofabric must be selected in accordance with TMR Specification MRTS27.

(c) Treatment L2 - working platform

(i) A working platform is typically a cementitiously stabilised granular layer that is used to overlay a “Drainage Layer” or “Capping Layer”.

(ii) A working platform is required to meet the following minimum standards necessary for it to function when it becomes part of the subgrade for the operating service life of the pavement structure:

1. have a minimum compacted thickness of 150 mm;
2. have a surface maintained with a geometric tolerance of ± 10 mm of the specified height and a maximum deviation from a 3 m straight edge of 8 mm at all points on the surface; and
3. where plant mixed cement stabilised gravel is used; gravel must be of a standard no less than DTMR Type 2.3 with a minimum UCS of 0.8 MPa and a maximum UCS of 3.5 MPa at 28 days.

(d) Treatment L3 - drainage layerl and working platform

Treatment L3 combines treatments L1 & L2 with the 150 mm thick ‘Working Platform’ sitting on top of the 300 mm drainage layer.

(e) Treatment L4 - capping layer

(i) A Capping Layer must be provided where the in-situ untreated subgrade has a design CBR ≤ 3% and is typically used to replace a wet layer of in-situ subgrade material which will be subject to ongoing water exposure.

(ii) The thickness of the capping layer is dictated by the natural ground subgrade CBR as follows:

Table SC6.4.6.7 - Material properties for select fill and treated material

Natural subgrade CBR	Capping Layer Thickness
< 1.5 %	400mm
1.5% - 1.9%	300mm
2.0% - 2.4%	200mm
2.5% - 2.9%	150mm

(iii) The Capping Layer can comprise the following options based on the underlaying subgrade material:

1. In-situ lime stabilisation of the subgrade soil is the preferred means of satisfying “Capping Layer” requirements when the subgrade comprises plastic clay soils.
2. Plant mixed cement stabilised gravel is used where in-situ lime stabilisation is not suitable; gravel must be of a standard no less than DTMR Type 2.3 with a minimum UCS of 0.8 MPa and a maximum UCS of 3.5 MPa at 28 days.
3. Rock fill (geofabric wrapped) can be utilised when the required thickness of the capping layer is at least 300 mm. The rock fill must meet the quality requirements for rock fill in TMR Specification MRTS04 and the Geofabric must be selected in accordance with TMR Specification MRTS27.
4. Select Fill maybe used where the natural subgrade CBR is 3% or higher and the layer thickness is min. 150 mm.

(f) Treatment L5 – capping layer and drainage layer

Treatment L5 combines treatments L4 & L1 with the ‘Capping Layer’ sitting on top of the 300 mm ‘Drainage Layer’.

(g) Treatment L6 – capping layer and pavement cover

Treatment L6 combines treatments L4 & L0 with the 150 mm thick ‘Pavement Cover’ sitting on top of the ‘Capping Layer’.

(h) Treatment L7 – capping layer and pavement cover and drainage layer

Treatment L7 combines treatments L4 & L0 & L1 with the 150 mm thick ‘Pavement Cover’ sitting on top of the ‘Capping Layer’ which covers the 300 mm ‘Drainage Layer’.

(i) Treatment L8 – capping layer and working platform

Treatment L8 combines treatments L4 & L2 with the 150 mm thick ‘Working Platform’ sitting on top of the ‘Capping Layer’.

(j) Treatment L9 – capping layer and drainage layer and working platform

Treatment L9 combines treatments L4 & L1 & L2 with the 150 mm thick ‘Working Platform’ sitting on top of the ‘Capping Layer’ which covers the 300 mm ‘Drainage Layer’.

(k) Treatment L10 – capping layer and pavement cover and working platform

Treatment L10 combines treatments L4 & L0 & L2 with the 150 mm thick ‘Working Platform’ sitting on top of the min. 150 mm thick ‘Pavement Cover’ which covers a ‘Capping Layer’.

(l) Treatment L11 – capping layer and pavement cover and drainage layer and working platform

Treatment L11 combines treatments L4 & L0 & L1 & L2 with the 150 mm thick ‘Working Platform’ sitting on top of the min. 150 mm thick ‘Pavement Cover’ which covers a ‘Capping Layer’ and 300 mm ‘Drainage Layer’.

(9) Rural unsealed gravel pavements

(a) An unsealed gravel pavement may be acceptable for assigned traffic volumes of less than 100 vpd on lightly trafficked roads in rural areas.

(b) Where the connecting road to a reconfiguration is also unsealed, it must be upgraded to at least the gravel pavement standard, and, if the assigned traffic volume equals or exceeds 100 vpd, it must be fully sealed, from its connection with an existing sealed road to a threshold point where the assigned traffic volume on the connecting road falls below 100 vpd.

(c) Where an existing rural road is specified as upgraded to gravel pavement standard, the minimum pavement thickness is 100 mm.

(10) Unbound flexible pavement

(a) Generally unbound flexible pavements are the preferred pavement choice on the basis that they are the least expensive option. The disadvantage however of using unbound pavements is that the overall depth of pavement is generally thicker than bound pavements which may cause issues if there are some level constraints which necessitates using a thinner pavement option, such as tying into existing kerb levels.

(b) The design of unbound flexible pavements, including those with cement or lime modified granular materials, is based on the empirical design procedure detailed in the Austroads *Guide to Pavement Technology - Part 2: Pavement Structural Design* and Queensland Department of Main Roads – Supplement to *Part 2: Pavement Structural Design* of the Austroads *Guide to Pavement Technology*.

(c) Figure 8.4 of Austroads *Guide to Pavement Design* - Part 2 : *Pavement Structural Design,* describes the use of DESA to determine the thickness of granular material in an unbound pavement that should be placed above various subgrade CBR strengths. Figure 8.4 has been developed into an empirical design equation for use in flexible pavement design.

(d) The Figure 8.4 pavement design equation is copied below.

$$t = \left[219 - 211(\log CBR) + 58(\log CBR)^2\right]\log(DESA/120)$$

Where t = pavement thickness
CBR = Subgrade CBR
DESA = Design ESAs

(e) Unbound flexible pavements typically comprise 3 layers as follows:

(i) Top Layer – Base (CBR 80) minimum thickness 150mm – DTMR Type 2.1 (MRTS05).

(ii) Mid Layer – Sub-base (CBR 45) minimum thickness 75mm – DTMR Type 2.3 (MRTS05).

(iii) Working Platform / Capping Layer – (Design subgrade CBR 10 or 15) minimum thickness 150mm.

(11) Bound flexible pavement

(a) A bound flexible pavement has a base or sub-base layer that is defined as being composed of either:

(i) Cement stabilised crushed rock with not less than 5% by mass cementitious content to ensure satisfactory erosion resistance (verifiable by laboratory erodability testing) – the cementitious content may include cement, lime/fly ash and/or ground granulated blast furnace slag.

(ii) Dense-graded asphalt.

(iii) Rolled lean concrete having a characteristic 28-day strength of not less than 5 MPa.

(b) Where a bound pavement is being considered a cement stabilised pavement layer is the preferred option and is generally referred to as a Cement Treated Base (CTB) layer. (UCS > 1.5 MPa).

(c) CTB pavements are generally more expensive to construct than unbound pavements and the cement treated layer tends to crack which requires the use of a Strain Alleviating Membrane Interlayer (SAMI) to control cracking and to limit opportunity for water ingress through the pavement via the cracks. The advantage however is the overall pavement thickness being less than unbound pavement and this may be of benefit if underground services are shallow.

(d) The design of bound pavements requires a mechanistic procedure using load calculations based on linear elastic modelling. The computer program CIRCLY is generally used in this design procedure.

(e) Bound flexible pavements typically comprise 4 layers as follows:

(i) Top Layer – Asphalt structural layer and wearing course minimum thickness 50mm (MRTS30).

(ii) Interlayer – SAMI Seal.

(iii) Mid Layer – Plant Mixed Stabilised Sub-base DTMR CAT.1 Standard (MRTS08) 150mm min.

(iv) Working Platform / Capping Layer – (Design CBR 10 or 15) minimum thickness 150mm.

(12) Rigid concrete pavements

(a) Rigid (concrete) pavements, with design traffic up to 1 x 10^6 ESAs must be designed in accordance with either CACA -T51 or Austroads, *Guide to Pavement Technology Part 2: Pavement Structural Design.*

(b) Rigid (concrete) pavements for design traffic above 1 x 10^6 ESAs, the design must be in accordance with Austroads, *Guide to Pavement Technology Part 2: Pavement Structural Design.*

(13) Concrete segmented pavements

(a) Concrete segmental pavements with design traffic up to 1 x 10^6 estimated commercial vehicles exceeding 3T gross must be designed in accordance with CMAA T45.

(b) For design traffic above 1 x 10^6 ESAs estimated commercial vehicles exceeding 3T gross the design must be in accordance with Austroads, *Guide to Pavement Technology Part 2: Pavement Structural Design*, with the calculation of design traffic in terms of ESAs.

(14) Clay segmented pavements

(a) Clay segmental pavements with design traffic up to 1 x 10^6 ESAs must be designed in accordance with Austroads, *Design Manual 1 - Clay Segmental Pavements.*

(b) For design traffic above 1 x 10^6 ESAs and up to 1 x 10^7 ESAs the design must involve consideration of both Austroads, *Design Manual 1 - Clay Segmental Pavements* and Austroads, *Guide to Pavement Technology Part 2: Pavement Structural Design*, with the thicker and more conservative design of each of the two methods adopted.

(c) For design traffic above 1 x 10^7 ESAs, the pavement must be designed in accordance with Austroad, *Guide to Pavement Technology Part 2: Pavement Structural Design.*

(15) Preferred surfacing design configuration

(a) Except where the pavement is designed for concrete or segmental paver surfacing, the preferred surfacing design should be a bituminous wearing surface configured as follows:

(i) Urban roads - asphalting new pavement

1. Apply SAMIprime-K2 Emulsion Prime @ 1.0 L/m^2 (12 hours curing); or
CRS67 Emulsion Primer Seal (10 mm) @ 1.1 L/m^2 & 110 m^2/m^3 (24 hours curing); or
cutback bitumen AMC0 Prime @ 0.9 L/m^2 (72 hours curing); or
AMC7 Primer Seal (10 mm) @ 1.1 L/m^2 & 110 m^2/m^3 (3 months curing).

2. After curing apply PMB S25E SAMI Seal (10 mm) @ 1.8 L/m^2 & 170 m^2/m^3 (No Traffic).

3. After SAMI Seal apply DG10 A15E PMB Asphalt 30mm Thickness (Local Streets); or
DG14 A15E PMB Asphalt 50 mm Thickness (Trunk Roads); or
DG14 HS Asphalt 50 mm Thickness (Industrial Roads).

(ii) Urban roads - asphalting overlay of existing oxidised and/or milled surfaces

1. Apply SAMIprime-K2 Emulsion Prime @ 0.5 L/m^2 (12 hours curing).

2. After curing apply PMB S25E SAMI Seal (10 mm) @ 1.8 L/m^2 & 170 m^2/m^3 (No Traffic).

3. After SAMI Seal apply DG10 A15E PMB Asphalt 30 mm Thickness (Local Streets); or
DG14 A15E PMB Asphalt 50 mm Thickness (Trunk Roads); or
DG14HS Asphalt 50 mm Thickness (Industrial Roads).

(iii) Rural roads – incl. Rural Sub Arterial Road, Rural Major Collector Road, Rural Local Street

1. Apply SAMIprime-K2 Emulsion Prime @ 1.0 L/m^2 (12 hours curing); or
CRS67 Emulsion Primer Seal (10 mm) @ 1.1 L/m^2 & 110 m2/m3 (24 hours curing); or
Cutback bitumen AMC0 Prime @ 0.9 L/m^2 (72 hours curing); or
AMC7 Primer Seal (10 mm) @ 1.1 L/m^2 & 110 m^2/m^3 (3 months curing).

2. After curing apply 1st Seal (14 mm) Class 170 @ 1.2 L/m^2 & 110 m^2/m^3 precoated.

3. Immediately following 2nd Seal (10 mm) Class 170 @ 1.1 L/m^2 & 145 m^2/m^3 precoated.

(iv) Car parking areas (off-road)

1. Apply Cutback bitumen AMC0 Prime @ 0.9 L/m^2 (72 hours curing).

2. After curing apply Class 170 bitumen seal 10mm @ 1.0 L/m^2 & 145 m^2/m^3 - or
DG10 Class 320 Asphalt 30 mm Thickness.

(b) Variations to these requirements may be approved by council in special circumstances.

SC6.4.6.3 Subsurface drainage design

(1) Subsoil and sub pavement drains

(a) Warrants for use

(i) Subsoil drains are designed to drain groundwater or seepage from the subgrade and/or subbase in cuttings and fill areas.

(ii) Sub pavement drains are designed to drain water from base and subbase pavement layers in flexible pavements, and to drain seepage or groundwater from the subgrade.

(iii) Subsoil or sub pavement drains must be provided on both sides of the formation in the following locations, unless the geotechnical report indicates the absence of subsurface moisture at the time of investigation and the likelihood that changes in the subsurface moisture environment will not occur within the design life of the pavement and/or the pavement has been specifically designed to allow for likely variations in subgrade and pavement moisture contents:

1. cut formations where the depth to finished subgrade level is equal to or greater than 400 mm below the natural surface level;

2. locations of known hillside seepage, high water table, isolated springs or salt affected areas;

3. irrigated, flood prone or other poorly drained areas;

4. highly moisture susceptible subgrades, I.e., commonly displaying high plasticity or low soaked CBRs;

5. use of moisture susceptible pavement materials;

6. existing pavements with similar subgrade conditions displaying distress due to excess sub surface moisture; and

7. at cut to fill transitions.

(b) Layout, alignment, and grade

(i) Typical cross sections of subsoil drains are shown in Standard drawing SD-080 – Subsoil Drain. In kerbed roads, the only acceptable location for the line of the trench is directly behind the kerb-line. Pavement layers must extend to at least the line of the rear of the trench.

(ii) In un-kerbed roads, subsoil and sub pavement drains must be located within the shoulder, preferably at the edge of the pavement layers.

(iii) The minimum desirable longitudinal design grade is 1.0%. For non-corrugated pipes, an absolute minimum grade of 0.5% is acceptable.

(iv) Trench widths must be a minimum of 300 mm for a 100 mm diameter slotted pipe or a minimum of 100 mm for strip drains. Outlets must be spaced at maximum intervals of 150 m into gully pits or outlet headwalls. As a salinity prevention measure and where practical, discharge must be on the downhill side of the embankment or in the cut/fill area to reduce the risk of recharge to the sub surface water table. Unless otherwise authorised, where sub surface drains outlet through fill batters, unslotted plastic pipe of the same diameter as the main run must be specified. A small precast concrete headwall must be installed at the drain outlet with a marker post to assist maintenance and protect the end of the pipe.

(v) Cleanouts must be provided at the commencement of each run of drain, and at intervals not exceeding 80 m. Cleanouts must generally be located directly at the rear of kerb or at the edge of shoulder, as applicable.

(vi) In salinity affected areas, the designer should consider providing a separate drainage system for subsurface drains to discharge to a basin where controlled release or desiccation treatment and removal can be facilitated as a maintenance operation. Saline subsurface drainage should not be routinely discharged directly into natural watercourses. Reference to water quality targets for downstream watercourses is essential and the designer must provide advice on discharge operations and maintenance compatible with water quality targets and the requirements of the relevant land and water resource or environmental protection authority.

(2) Foundation drains

(a) Warrants for use

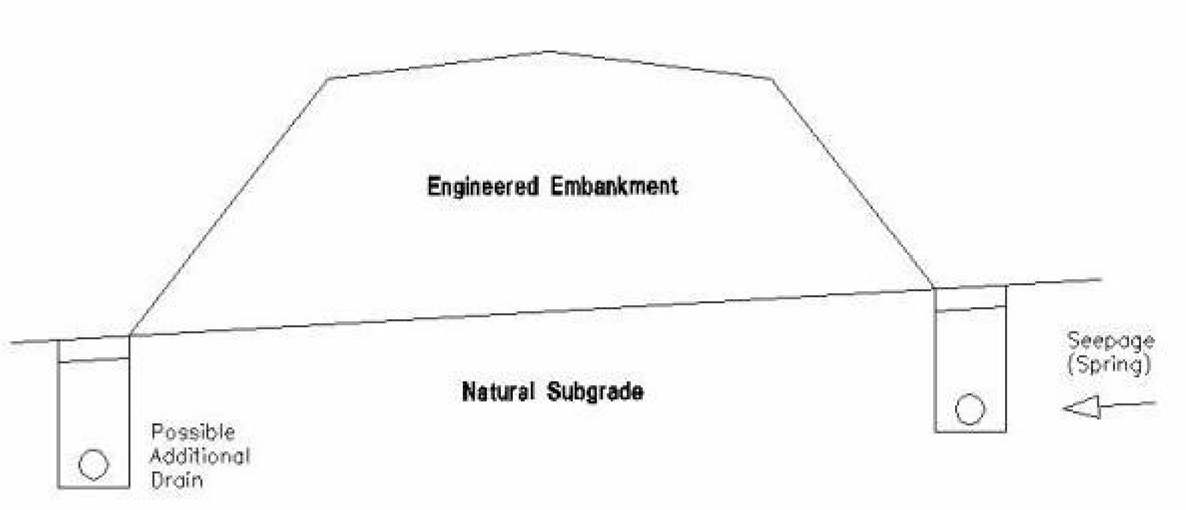
(i) Foundation drains are designed to drain excessive ground water areas within the foundation of an embankment or the base of cutting, or to intercept water from entering these areas.

(ii) The need to provide foundation drains may be apparent from the results of the geotechnical survey along the proposed road formation alignment, and in this case the location must be shown on the drawings. However, more commonly, the need to provide foundation drains is determined during construction, and hence in this situation requirements and locations cannot be ascertained at the design stage.

(iii) Where the road formation traverses known swampy, flood prone, salt affected areas or water charged strata, the drawings must be suitably annotated for the potential need for foundation drains at various locations, in addition to those shown on the drawings.

(b) Layout, alignment, and grade

(i) Typical cross sections of foundation drains are shown below.



1. The minimum desirable design grade is 1%. For non-corrugated pipes an absolute minimum grade of 0.5% is acceptable.

2. Foundation drains must have a minimum trench width of 300 mm, with a variable trench depth to suit the application and ground conditions on site.

3. Outlets must be spaced at maximum intervals of 150 m.

4. Where practicable, cleanouts must be provided at the commencement of each run of foundation drain and at intervals not exceeding 60 m. Where not practicable to provide intermediate cleanouts, outlets must be spaced at maximum intervals of 100 m.

(3) Drainage mats (blankets)

(a) Warrants for use

(i) Type A drainage mats are designed where there is a need to ensure continuity of a sheet flow of water under fills, to collect surface seepage from a wet seepage area, or for protection of vegetation or habitat downstream of the road reserve where a fill would otherwise cut the flow of water. Type A drainage mats are constructed after the site has been cleared and grubbed and before commencement of embankment construction.

(ii) Type B drainage mats are designed where there is a need to intercept water which would otherwise enter pavements by capillary action or by other means on fills and to intercept and control seepage water and springs in the floors of cuttings. Type B drainage mats must be constructed after completion of the subgrade construction and before construction of the pavement.

(iii) The need to design for the provision of drainage mats should be apparent from the result of the geotechnical survey along the proposed road formation alignment.

(4) Documentation – subsurface drainage drawings and calculations

The proposed location of all subsurface drains must be clearly indicated on the drawings, including the nominal depth and width of the trench, and the location with respect to the line of the kerb/gutter or edge of pavement. The location of outlets and cleanouts must also be indicated on the drawings.

SC6.4.6.4 Roadworks construction

(1) Introduction

Generally, the process of road construction is dictated by the materials being used and the latent / site specific conditions encountered during the conduct of the works, hence road works are generally administered using a construction contract.

Contract documents used for road construction typically include construction specifications, design drawings, a bill of quantities and contract provisions which describe how to manage site specific construction challenges and latent conditions if they are discovered during the conduct of the works.

In the absence of a construction contract, minor roadworks maybe undertaken in accordance with the requirements described in the roadworks standard drawings that show the minimum standard that council has adopted regarding roadworks.

To ensure the constructed works are ‘fit-for-purpose’ and comply with the requirements described within the planning scheme and associated roadworks standard drawings, council will inspect the works during construction in accordance with an inspection and test plan agreed between the works contractor and the council inspector.

The inspection requirements set out in this section comply generally with the requirements described in Department of Transport and Main Roads construction specifications and are intended to inform the Developer and the Developer’s Contractor of the inspections process followed by Townsville City Council whilst inspecting roadworks involving existing and future Council assets.

(2) Who attends the inspections

Inspections are carried out by a Council works Inspector and if the works also involve a State Controlled Road a TMR works Inspector may also attend the same inspection. It is recommended that the developer's engineer who holds RPEQ qualifications who will certify the works also attends the inspection. If possible, the developer will be advised beforehand if Council or Main Road's inspectors will be attending the inspection.

(3) When are inspections required

The development approval conditions and / or the Contract and works specification describe various hold points in the work that require inspection before subsequent work can proceed. Similarly, the Council have specific inspection requirements that must be satisfied before the work is accepted as complete. The following list sets out the mandatory inspections that must be carried out in order to comply with Council inspection requirements, additional inspections may also be required, these are detailed in the development approval conditions and / or the contract and works specification and will be advised by Council at the prestart meeting.

(a) Prestart meeting

(b) Subgrade inspection.

(c) Pre-seal inspection

(d) Works completion inspection

(e) Close-out workshop

(f) End of maintenance inspection

(4) Notifying inspections

The Developer's Contractor is responsible for notifying the Council when the work is ready for inspection. Council requires the following notification times, based on logistical considerations, to arrange for the Council Inspector and / or Main Roads to attend the inspection if they so choose. Note, not all inspections will be attended by Council and / or Main Road's inspectors, attendance is at their sole discretion.

(a) Prestart meeting – 2 complete working days.

(b) Subgrade inspection - 2 complete working days.

(c) Pre-seal inspection - 2 complete working days.

(d) Works completion inspection - 2 complete working days.

(e) Close-out workshop – seven (7) days minimum.

(f) End of maintenance inspection - seven (7) days minimum.

The notification times for inspections not listed above will vary, but as a general rule any inspection will require a minimum notification period of 2 complete working days.

(5) Acceptance of the works "works completion"

Acceptance of the works "works completion" is acceptance of Council of the constructed infrastructure as complete and complies with the approved design drawings and development approval conditions. It also allows the road to be operated under traffic.

This acceptance does not however, discharge the Developer's Contractor from their obligation to provide infrastructure free of defects. Any defect which is discovered after the acceptance of "works completion" and prior to "end of maintenance" and attributed to the failure to deliver the work in accordance with the approved design drawings and development approval conditions (if relevant), shall be repaired at the Developer's cost.

(6) As constructed drawings

Following a satisfactory “works completion” inspection, the Contractor shall supply “as constructed drawings” comprising one print of each drawing marked “As Constructed”, excluding Council / TMR standard drawings, and including amendments (shown in red) incorporated in the construction of the work, and overprinted with a certificate or stamp of an approved Surveyor as follows:

“I/We (Name) of (Firm) hereby certify that the works as shown on the ‘as constructed’ drawings reflect any changes that were made during the course of construction (signed with RPEQ No and dated)”.

The survey information obtained by the Surveyor performing the as constructed survey must include levels at all design level locations shown on the originally approved drawing or at 25 m intervals whichever is the more severe, as set out below:

(a) Dimensions detailing traffic lane widths, width from edge line to lip of kerb, and footpath width.

(b) Levels at the crown and at the line of lip of kerb and channel.

(c) Rural Roadworks:

(d) Dimensions detailing traffic lane widths and width of shoulder.

(e) Levels on the finished pavement, at the crown and at the edge of bitumen.

(f) Levels on the invert of the table drains.

(7) Workmanship guarantee

As part of the contractual requirements between the Developer and the Contractor, at the completion of the works, Council requires a certificate from the Contractor guaranteeing that the works have been constructed in accordance with the drawings and specifications approved for construction.

An acceptable form of certificate follows.

WORKMANSHIP GUARANTEE

Development description:

____

Development address/property legal description: ______________________________

Development application number (stage number): ______________________________

Name of developer: ____

I/We............................being a civil engineering construction firm (Contractor) and having been commissioned, by way of contract or otherwise, to carry out the construction of works comprising of:

Earthworks, Roads and Strom Water Drainage, Sewer Reticulation and Water Reticulation, Electrical and Telecommunications Services (add or delete as appropriate)

do hereby certify that:

The works have been constructed in accordance with the drawings and specifications of the project, and relevant Australian Standard Codes of Practices. During the course of construction, I/we have called for inspections and testing required in the documentation and the inspections and tests have met specifications in all respects. I/We further guarantee that the standard of workmanship between inspections has been maintained at all times and the materials used in the construction have been approved and are in compliance with the specifications and where required stamped by the manufacturer to guarantee their authenticity.

I/We hereby certify the works free of defect for a period of one (1) year.

Name:	....
Position:	....
Name of consulting company	....
Contact postal address	....
Contact phone number	....
Signature:	....
Date	....

Click here to download a copy of this form

(8) "Maintenance period" and "on Maintenance"

The period of time between the acceptance of the works "works completion" and the acceptance of the works "end of maintenance" is termed the "maintenance period". During the maintenance period the constructed work is deemed to be "on Maintenance". The length of time for the maintenance period will be as set out in the contract documentation and will generally be 12 months.

If for any reason during the "maintenance period" a defect of substantial proportions is discovered then Council reserves the right to extend the "maintenance period", for a further period from the date of correction of the defects.

(9) Close-out workshop inspection

Within 21 days of acceptance of the works “work vcompletion” the Contractor must notify the Council that the Developer’s Contractor is ready to participate in a close-out workshop. As part of the close-out workshop the work “on maintenance” is to be thoroughly inspected by the Council and / or Main Road’s inspector, all defects identified during the inspection will be recorded and agreed by the Contractor, Developer’s representative / Superintendent and inspectors.

Following this inspection, the Contractor and Council inspector will conduct a workshop to identify any necessary corrective work required to close-out any defects.

Decisions made at the workshop will be recorded by the Council Inspector and a copy of the workshop decision summary will be provided to the Developer’s representative / Superintendent.

(10) “End of maintenance” inspection

Acceptance of the works "end of maintenance" is acceptance of Council of the constructed infrastructure in a defects free condition.

The “end of maintenance” inspection will be carried out following the repair of all of the defects identified during the close-out Workshop inspection and expiration or the maintenance period. This final inspection will be attended by the Council inspector. Notice as detailed in Section 4 is required for the booking of "end of maintenance" inspection. If during this final inspection, the Council Inspector is satisfied that all the defects have been satisfactorily repaired and no new defects are evident in the works performed by the Contractor, the work shall be accepted “end of maintenance” and the maintenance period shall be deemed expired.

(11) What to expect at roadworks inspections

(a) Subgrade inspection

The subgrade is to be inspected and approved by the Council inspector prior to placing pavement material.

At the inspection the Council Inspector will inspect the following elements of the work and will:

(i) Confirm by visual inspection that the surface of the subgrade is free from organic material such as large tree roots and no “soft” or “boggy” areas are present.

(ii) Check the level and profile of the subgrade. Tolerances shall be in accordance with the approved specification. If necessary, the Contractor shall present the work in a manner such that the level can be verified.

(iii) Check that the required subgrade compaction (density) tests have been carried out in accordance with the approved specification. The subgrade compaction certificates are to be provided to the Council Inspector at the inspection.

(iv) If the subgrade is considered suspect the Council inspector will require a loaded water truck to traverse the subgrade at the time of the subgrade inspection and may request further compaction tests if it is considered necessary.

(b) Pre-seal pavement inspection

The pavement is to be inspected and approved by the Council’s Inspector prior to sealing.

The Council’s inspector will inspect the following elements of the work and will:

(i) Check the quality of the different courses of the pavement in accordance with the approved specification. This will be confirmed by the supply of the following pavement test certificates from a registered laboratory:

1. Compaction results for each course of pavement.
2. Grading, atterberg limits and a CBR test of each course of pavement material in accordance with the approved specification.

(ii) Confirm the total depth of pavement at the location of each base course compaction test. This depth is to be recorded on the compaction test certificate from the Soil Testing Officer and is to be not less than the design pavement depth. Any asphalt surfacing is not to be included in the pavement depth.

(iii) Check the level and profile of the finished pavement surface. Tolerances shall be in accordance with the approved specification. If necessary, the Contractor shall present the work in a manner such that the level can be verified.

(iv) Check the level and grade of the kerb and channel and / or table drains. This may require a runoff water flow test to be performed involving a release of water from a water truck to observe the drainage system is graded sufficiently. The tolerances shall be in accordance with the approved specification.

(c) Asphalt or bituminous surfacing

The bitumen or asphalt surfacing is to be inspected and approved by the Council Inspector prior to the acceptance of the works "works completion" inspection.

The Council inspector will inspect the following elements of the work and will:

(i) Confirm by visual inspection and the supply of bituminous spray sheets by the Contractor that the bitumen / binder type, aggregate sizes, spray rates and aggregate spread rates comply with the approved seal design. The Council Inspector will be looking for consistency in the spread of aggregate over the spayed bitumen.

(ii) Any variation to the approved seal design must be pre-approved by the Council Inspector and if requested by the Council Inspector may require an initial trial spray to be performed to prove the application rate. Should the spray show flushing on the initial trial it may be necessary to reduce the application rate.

(iii) Excess loose aggregate must be swept from the road surface and cleared from the kerb and channel and/ or table drains.

(iv) Where asphaltic concrete surfacing has been performed, the Contractor must supply test results on samples of the material supplied to the site taken at the asphalt plant together with field tests to confirm asphalt depth and percentage of voids filled.

(d) Pavement line marking

Where pavement line marking is to be completed, particularly involving passing and turning lanes at major intersections, such work is to be completed within 48 hours of surfacing. Where the surface to be line marked is a chip seal, then the surface is to be thoroughly swept to remove loose aggregate prior to line marking.

All pavement markings shall be in accordance with the approved specification.

Removal of line marking errors shall be carried out using sandblasting or water blasting methods, blacking out using paint will not be accepted.