

When reference is made to other parts of the Austroads Guide to Road Design or the Austroads Guide to Traffic Management, the reader should also refer to Transport and Main Roads related manuals:

- Road Planning and Design Manual (RPDM), and

Where a section does not appear in the body of this supplement, the Austroads Guide to Road Design – Part 1 criteria is accepted unamended.

This supplement:

- has precedence over the Austroads Guide to Road Design – Part 1 when applied in Queensland
- details additional requirements, including accepted with amendments (additions or differences), new or not accepted, and
- has the same structure (section numbering, headings and contents) as Austroads Guide to Road Design – Part 1.

The following table summarises the relationship between the Austroads Guide to Road Design – Part 1 and this supplement using the following criteria:

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5 Design Process

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5.2 Process elements | Accepted with amendments |

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1 Scope of the guide to road design

1.1 Introduction

Differences

The title of Section 1.1 has been amended to “Introduction” rather than “Status”.

Additions

The department’s Road Planning and Design Manual (RPDM) is the supplement to the Austroads Guide to Road Design and has been developed to help meet the strategic requirements and business objectives that set the policy and framework for the planning and design of new roads and existing roads to be upgraded in Queensland.

The Department of Transport and Main Roads’ (the “department”) vision for Queensland state controlled roads is “Connecting Queensland — delivering transport for prosperity”, and the blueprint for delivering on the government’s objectives and the department’s strategic direction is contained in the current Transport and Main Roads Strategic Plan.

The RPDM and Austroads Guide to Road Design combine to form the department's primary technical reference for the planning and design of road infrastructure. However, when matters out of the ordinary are encountered, the subject will need to be examined in more detail by relevant experts. The following list of technical documents should be initially reviewed for relevant information in this situation (they are also listed in order of priority):

- other departmental technical documents (located on www.tmr.qld.gov.au via Business and Industry)
- Austroads publications and Australian Standards
- Lay, M.G. – Handbook of Road Technology
- design guides and/or manuals from other Australian states
- American Association of State Highway and Transportation Officials (AASHTO) – A Policy on Geometric Design of Highways and Streets
- Geometric Design Guide for Canadian Roads (especially the chapters on Philosophy and Design Consistency, and
- United Kingdom’s Design Manual for Roads and Bridges.

Other international design guides may be consulted where they address a particular issue in a more comprehensive way than those documents listed above. Other references are provided in the RPDM.

1.2 Purpose

Additions

The RPDM:

1. defines the department's practice for the road infrastructure
2. takes precedence over the Austroads Guide to Road Design when applied in Queensland
3. details additional requirements, including accepted with amendments (additions or differences), new or not accepted, and
4. has the same structure (section numbering, headings and contents) as *Austroads Guide to Road Design*.

Planning and design tasks need to apply the RPDM with engineering judgement (when required), and tailor each design to the particular circumstance.

When clarification of any part of the RPDM and *Austroads Guide to Road Design* is required, the relevant department specialist (from Engineering & Technology Branch) should be consulted.

The major test for the reasonableness of a standard adopted for a particular project is that of a context sensitive design. Planners and designers should always place this test on the conclusions that they have drawn from applying the RPDM and *Austroads Guide to Road Design*, and make sensible adjustments to ensure that the project outcome incorporates context sensitive design.

For any department projects, where non-compliance with the design requirements of the RPDM and *Austroads Guide to Road Design* is proposed, the Registered Professional Engineer of Queensland (RPEQ) shall certify that they consider the design and its associated mitigating treatments (if any) reasonable to implement on the road network. Also the department must consent to the use of the proposed design and its associated mitigating treatments (if any). At the same time advice must also be sent to the Manager (Road Geometric Standards) of the Engineering and Technology Branch.

### 1.3 Application

*Additions*

The RPDM and *Austroads Guide to Road Design* are as comprehensive as possible in addressing the range of parameters and issues affecting the planning and design of roads, particularly those related to geometry. To that end, relevant sections of previously published information have been included where feasible. However, to avoid undue repetition and duplication, cross-referencing to other department documents has been included where appropriate.

The terminology convention adopted to provide a platform for developing a uniform understanding of the department’s processes and the terminology used in the various preconstruction processes are defined in the *Preconstruction Processes Manual*. It is important that planners and designers develop a common understanding to avoid any misconceptions when performing planning and design activities on the department’s projects.

### 2 Context of the road design process

*Additions*

‘The Effect of Combining Geometric Minima - Findings from Case Studies’ paper by Dr Owen K. Arndt, Julie K. Peters and Ricky L. Cox provides a foundation in the reader’s understanding of this issue. The following summarises the key points from the paper.

The following list consists of four sets of geometric minima features that should generally be avoided, especially if they are combined with any of the listed subcategories (this is even more important if there are any inter-related design exceptions):

1. A tight horizontal curve radius or tight compound horizontal curve with:
   a) a tight crest curve, especially if the horizontal curve or compound curve starts after a crest curve
   b) inadequate perception of sight distance to the horizontal curve
c) inadequate perception of a compound curve  
d) a hazardous roadside (for example large trees, deep v-drains, steep fills close to the roadside)  
e) insufficient or adverse superelevation  
f) long drainage paths on the road surface  
g) a floodway  
h) a narrow carriageway (for example narrow bridges, culverts, grids)  
i) a steep downgrade, or  
j) an intersection.

2. A small radius vertical crest curve size with:  
a) a small radius horizontal curve or compound curve  
b) a narrow carriageway  
c) a hazardous roadside (for example large trees, deep v-drains, steep fills close to the roadside)  
d) a floodway just after the crest curve  
e) a likelihood of hazards on roadway (for example stock, fallen rocks), or  
f) an intersection.

3. A narrow bridge or culvert (one-lane or two-lane of substandard width) or floodway with:  
a) limited visibility  
b) steep downgrades leading to it  
c) a small radius horizontal curve or compound curve, or  
d) being located just after a small radius crest curve.

4. Limited sight distance with:  
a) a small radius horizontal curve or compound curve  
b) a narrow carriageway  
c) a floodway, or  
d) a minor leg of an unsignalised intersection.

It is recommended that when undertaking works to existing roads that all combinations of geometric minima are identified. The number of geometric minima at these locations should be reduced, especially if any of the following apply:  
• there already is a crash history  
• one or more of the parameters is known to have a strong link with safety, or  
• one or more of the geometric minima are design exceptions.

Where it is impractical to remove all of the geometric minima, mitigating measures should be incorporated into the design.
2.1 Road planning and design

**Difference**

The title of Section 2.1 has been amended to “Road planning and design” rather than “Road Planning”.

**Additions**

This section will also include an overview of road design.

The department is committed to working across the whole of government to deliver integrated outcomes to Queenslanders. In many cases it will mean that the objectives and policies of other departments will have to be considered in the planning decisions taken. Consultation with those departments is essential to ensure that planners and designers consider all factors in the planning process.

The following Queensland Government documents may have an impact on decisions for projects and must be implemented where applicable:

1. The Department of Infrastructure, Local Government and Planning has published the ‘State Planning Policy’ and the associated guidelines on its website, and
2. Department of Environment and Heritage Protection has published its regulation and policies on its website.

2.2 Project Purpose

**Additions**

When undertaking a particular project, the requirements of the investment strategies, link strategies and the Transport and Main Roads Strategic Plan must be incorporated. These will be determined in the early phases of the project and must be carried through in the detailed design to ensure the integrity of the project.

2.3 Road safety

**Differences**

The title of Section 2.3 has been amended to “Road safety” rather than “Road Safety and Road Design”.

2.3.1 Safety strategy

**New**

The department has developed a document titled “Safer Roads, Safer Queensland – Queensland’s Road Safety Strategy 2015-21”. It should be referred to for an overview of the department’s strategies and guiding principles associated with road safety.

From a network planning perspective, the Australian National Risk Assessment Model (ANRAM) is being developed by Austroads to quantify the level of road safety risk across an entire road network.

2.3.2 Safety concepts

**New**

Hauer (1999) proposed a clear distinction between two kinds of safety to analyse situations, namely:

- substantive safety (is the measured or expected crash frequency and severity), and
nominal safety (is produced by a design that complies with design criteria, warrants and guidelines, and sanctioned design procedures).

Substantive safety is a matter of degree. A road in use cannot be safe; only safer or less so. What level of substantive safety is appropriate is therefore governed by considering what level of safety is attainable with the resources available. In contrast, a road can be nominally safe, meaning that it conforms to design criteria, warrants and guidelines, and sanctioned design procedures. Whether a road that is nominally safe is always (or even usually) substantively safer than a road that is not nominally safe cannot be said definitively (from Hauer (1999)).

2.3.3 Designing for road construction site safety

New

Designs should ensure the site is readily accessible by construction personnel and equipment, and that this can occur safely in the presence of other traffic. The worksite should be separated from the general traffic (as reasonably as possible).

Proper allowance for the safe movement of traffic (including pedestrians and cyclists) through both the worksite and the completed project must be designed into the project. The sequencing of the works during construction should allow for the:

- efficient and safe traffic movement through the worksite at all stages of the construction, and
- easy and safe pedestrian and cycle movement through and/or around the site.

Signage and reduced speed limits for road works may also be necessary; reference should be made to the Manual of Uniform Traffic Control Devices (MUTCD).

Hazards are to be managed in accordance with the RPDM and the Guide to Road Design Part 6: Roadside Design, Safety and Barriers.

3 Road design philosophy and principles

3.1 Introduction

Additions

Most design guidelines and design criteria in the RPDM and Austroads Guide to Road Design are based on theoretical safety models (that is, most are not derived from relationships based on objective safety evidence). Relating road design parameters to crash rates by research is a very difficult and time consuming process and many studies have not been particularly successful in identifying relationships. Nevertheless, useful guidance on the effect of changes in standards on crash rate has been achieved through research (for example, shoulder widths, horizontal curve radius).

In developing design guidelines and design criteria, a range of circumstances must be considered and the result is a balance between competing demands to produce a context sensitive design. Many road design criteria have been developed from the laws of physics, empirical data and/or objective safety evidence and provided to designers for application to their specific problems.

3.2 Road design guidelines

Additions

Guidelines provide information and background material to assist the designer in choosing the appropriate dimensions for the elements of the design. However, the range of combinations of elements is large and these can apply to a large range of circumstances (for example, local rural road...
to major urban motorway). The RPDM and Austroads Guide to Road Design must therefore be general - it cannot take account of specific site circumstances, but it does provide guidance to the designer to assist deciding on the minimum design effort for each circumstance.

To a large extent, the RPDM and the Austroads Guide to Road Design incorporates significant amounts of data from research and experience gained over a period of time by the department and other Australian road authorities. However, this must be generalised, as circumstances will vary between sites. A sensible mix of application of the RPDM and Austroads Guide to Road Design, and the practitioner's experience is required to gain the best result (that is, a context sensitive design).

3.2.2 Application of guidelines

Additions

"The challenge to the designer is to achieve the highest level of safety within the physical and financial constraints of a project. The challenge requires the designer to go beyond the minimum levels of design to find the desirable level for each project" (AASHTO, 1997).

The crucial element is the appropriate combination of design criteria for each road element, which requires engineering judgement and experience to be applied by the designer. Wherever possible, this judgement and experience should be based on objective assessment of the potential crash rate, particularly compared with other sections of the road link being designed.

In the past, the complexity of design gave rise to the development and use of standard values for the various elements to be used in various sets of defined circumstances, in order to simplify the process. This approach is not always appropriate, although it allows people of limited experience to achieve an acceptable design in many circumstances. Where more complex combinations of circumstances occur designers require considerable skills and experience to enable them to choose the optimum solution.

The RPDM and Austroads Guide to Road Design recognise the importance of judgement and experience, and provides designers with the background to the methods adopted and the reasons for the approach to selecting design elements. A wide range of dimensions for various design parameters (that is, the 'Design Domain') is provided with comment on the circumstances for their use. The decision on the combination of values to adopt is one to be made in the context of the complex range of issues that apply in individual circumstances. The competing alternatives must be properly considered within the framework of the particular case to ensure that the solution is a context sensitive design (refer to Section 3.3). The final design is the sum of all decisions taken and judgements made during the design process.

In the following quotation about geometric road design, the term 'standard' refers to the design criteria and their design domain.

"Design dimensions that do not meet standards do not necessarily result in unacceptable design – dimensions that meet standards do not necessarily guarantee an acceptable design. In assessing the quality of a design, it is not appropriate simply to consider a checklist of standards. The design has to be reviewed with judgement; standards merely assist the reviewer in making those judgements" (Louis, 2002).

Adopting lower order values for all elements in combination at a particular location will not generally give a satisfactory result. The resulting design might be hazardous and/or have operational difficulties. Where the lower order value is adopted for one element, it is usually required that a better than lower order value be used for others to compensate (for example, wider pavement where a crest vertical curve of low standard must be adopted). As a further example, if a vehicle has to stop on a minimum
radius horizontal curve with restricted sight distance, the kinetic friction associated with locked wheel braking on wet roads (part of the stopping distance model) is accompanied by a reduction in available side friction. This means that many drivers are unable to control the direction of their vehicle unless they brake in a manner that requires a longer stopping distance (Olsen et al, 1984; Fambro, D., Fitzpatrick, K., Koppa, R., 1997). Experience and judgement must be used in these cases.

Experience is, however, more than a ‘gut feel’ on the designer’s behalf. It must be developed from objective application of principles and measurements of performance over a period of time. It is not enough to merely have completed a project - its performance must be measured objectively over an appropriate period of time. The other path to depth of understanding is through objective research of the issues using appropriate techniques and matching of data to actual circumstances and performance.

If judgements are to be made, they must be able to be justified on the basis of real data and performance in circumstances similar to those prevailing at the site of the design in question. Judgements have to be made on the value of improving the standard of a road and the impact this might have on the ability to make improvements elsewhere on the road system. These judgements are usually made on the basis of the level of safety of the road in question, and the analysis of benefits and costs resulting from the proposed improvements. Environmental, cultural heritage and social impacts are also major considerations.

The above discussion is applicable for designs in both ‘greenfield’ and ‘brownfield’ sites (definitions are provided below):

A broad definition adapted from Austroads and NSW Roads and Maritime Services for a greenfield site is:

A greenfield site is a location on which a new road is being built where there is no development that prevents the use of design values predominately within the guidelines relating to Normal Design Domain (NDD). Accordingly, the road alignment is relatively unrestricted in terms of the geometry that can be used. These sites are generally away from existing roads and do not need daily traffic control. At such sites all associated road infrastructure must be provided and this often involves quite major work.

A broad definition (Australian Road Research Board (ARRB) 2012) for a brownfield site applicable to Queensland conditions is:

A brownfield site is one where infrastructure, such as the road pavements; utilities, such as power lines, telecommunication lines, water and sewer services; drainage systems, vegetation and the access to abutting or nearby properties has been in place for some time. Removing, altering or adjusting this existing infrastructure can be very expensive and so often, the retention of this infrastructure is required to minimise the costs of the work. There are also many cultural, heritage or environmental issues to be considered.

A further constraint on a brownfield site may be the need to retain all or part of the road in service during the course of the works. These requirements can then place limitations or constraints on the design.
3.3 Context sensitive design

Differences

The title of Section 3.3 has been amended to “Context sensitive design” rather than “Context-sensitive Design”. Context sensitive design has also been referred to as ‘fit for purpose’ design or ‘flexible’ design.

Additions

In Queensland, planners and designers should always aim to produce context sensitive designs.

A context sensitive design is one that matches the way it will be used (for example, matches how a road will be driven). It is not a solution generated by making unrealistic design assumptions (for example, choosing a design speed that is unrealistically high or low).

For roads, the basis of producing a context sensitive design is that the standard adopted for a project reflects the proper purpose of the road in question. The basic purpose determines the level of standard appropriate to that road. For example, a highway provides a connection between major centres giving a high level of service to the traffic on the road; it is a vital part of the economy of the area and is more important for its traffic carrying function than for property access. On the other hand, a local road is primarily for the purpose of access to property and connection to the higher order elements of the road system; it can be a lower speed road with less generous features than the highway counterpart.

However, having determined what the appropriate purpose is, the design standards of the elements have to be in accordance with the accepted design practices as defined in the RPDM and Austroads Guide to Road Design. That is, the application of the principles of design does not change. Anything less than this means the solution is not a context sensitive design.

The challenge for any road design is to develop a design solution that takes account of the competing expectations, interests and alternatives and the trade-offs that might be needed. It is important that this, and consideration of the following issues, occurs from the concept stage onward.

3.4 Geometric consistency

3.4.1 General

Additions

An important component of reducing or eliminating uncertainty is design consistency. This consistency should be applied over long lengths of road links and as far as possible, over a wide geographic area. The more consistent the designs are, the greater the contribution of the designer to reducing crashes on the road system.

Fuller and Santos (2002) explores in detail the effect of human behaviour and limitations in approaching the driving task. Designers should take note of the following:

- Drivers do not always operate at their optimal level of competence – their performance may be degraded because of several factors (for example, fatigue, stress, poor motivation, and low level of attention or arousal), and
• Task performance can be considered on three levels - skill based, rule based and knowledge based:
  o Skill based performance is so well learned that a person performs the task automatically.
  o Rule based performance is guided by a set of rules such as the rules of the road (for example, a ‘Stop’ sign ahead invokes a learned behaviour of slowing down and stopping at the sign), and
  o Knowledge based performance has no rules to guide the driver and actions are taken on the basis of experience of the situation confronting the driver.

“Where events are such that there is no rule to guide behaviour (e.g. there is a novel problem with which the driver has to deal) reference must be made to his or her knowledge of the vehicle, the highway or traffic system, the behaviour of other road users or even of basic principles, to enable formulation of an appropriate solution as to what to do. This is known as knowledge based level of performance. This knowledge base grows with experience so that experienced drivers have recourse to a relatively extensive knowledge base compared to novice drivers. Thus the latter are likely to produce a higher proportion of wrong ‘solutions’ when faced with a novel situation” (Fuller and Santos, 2002).

These factors demonstrate the vulnerability of drivers to the driving task and the importance of providing an environment where normal expectations are met and a learned response will be appropriate. One way of providing this type of environment is to provide consistency in the design of the road.

“Therefore, other things being equal, the more predictable the roadway and its characteristics, the easier the driving task and the easier it is to use safely. The implication for the highway engineer is that the design of road features should take account of road-user expectations” (Fuller and Santos, 2002).

Consistency is a fundamental issue in the development of link strategies. Once the various dimensions have been established, they should be applied consistently (for example, lane and shoulder widths, clear zone arrangements, road edge guide posts, signing conventions, intersection treatments).

An example of providing consistency is to use, where possible, a consistent intersection layout/treatment on a link.

Actual crash history can provide insight into the design consistency of a road and this history should be used on existing roads as the basis of any review of consistency.

Further, safety on roads is closely related to the driver’s ability to anticipate events and react to them. Perception and reaction times are critical to the development of sight distance criteria and the other elements that rely on this parameter. In this, the driver’s expectations play a major part. Perception and reaction times for matters that accord with a driver’s expectations are less than those that are needed when the road ahead does not conform to the driver’s expectations.

Designers should account for this by reducing or eliminating uncertainty or the unexpected for drivers (or by allowing for increased perception and reaction times).
3.4.3 Design speed

Differences

Delete the last paragraph of Section 3.4.3 in *Austroads Guide to Road Design - Part 1*.

3.4.4 Driver workload

Additions

Designers should make allowance for longer reaction times where a section of road with minimal alerting features changes to a situation requiring a higher state of driver alertness. Some guidelines (based on Fuller and Santos (2002)) to assist are:

- Avoid low driver alertness inducing road alignments (typically a straight alignment, with unchanging landscaping). Medium complexity helps maintain activation. One device to use is to provide specific “aiming points” for drivers. Note that this can usually be readily achieved with curvilinear alignment.
- Consider the needs of fatigued and drowsy drivers (for example, provide rest areas and audible edge lines).
- Avoid designs that place the driver in prolonged high stimulus states (for example, too much critical information on a fast road section).
- Avoid things that compete for, or distract, the driver’s attention when critical information is being presented (for example, other light sources near traffic signals; advertising near directional signs, hazard signs, merges on motorways, diverges on motorways – that is relocate all which is not directly related to the merge/diverge to reduce driver distraction from this area of critical decision making).
- Avoid driver information overload (for example, avoid excessive signing).
- Avoid memory related errors by providing the necessary information close to the required decision making areas rather than relying on the driver to store it in their head.
- Design road features to take account of driver expectations.
- Avoid incorrect speed expectations by using speed guidance at critical road segments.
- Consider controlling the effects of speed adaptation (for example, if not appropriately designed drivers may approach the first off-motorway curves and intersections at a higher speed than they planned).
- Employ practices of error management: prevention, tolerance and recovery (for example, provide a forgiving roadside environment, refer to RPDM Volume 3 Parts 6 and 6B).
- Aim for error prevention and error tolerance.
- Provide only necessary helpful information, and
- Increase feedback to drivers regarding the quality of their performance (which may only be feasible where variable message signing is available).

In addition, designers should consider the requirements of motorcycle riders. Motorcycle riders require constant attention to the road and its environment and are more likely to be subject to information overload than car drivers.
Motorcycle riders have to attend to:

- keeping the motorcycle upright (road surface, road alignment, wind conditions, stability when braking)
- anticipating the actions of other road users who may not expect a motorcycle
- navigating without the assistance of a map or passenger, and
- withstanding direct exposure to the elements.

The additional tasks are more likely to lead to stress and overload and the consequences of a mistake are more severe than for other motorists.

The complexity of the motorcycle task means that riders are only capable of absorbing limited amounts of information in addition to the needs of traffic monitoring and vehicle control. Designs must therefore provide appropriate information; at the same time limiting it to that which is necessary for the particular situation.

Furthermore, in areas where driver workload is high, vulnerable road users (such as, motorcyclists, pedestrians and cyclists) may be overlooked by other road users. Considerations to limit driver workload will have benefits on limiting multiple vehicle crashes involving vulnerable road users, which have a higher risk of high severity crashes occurring.

An example of the application of these principles is in the design of rural intersections over an extended length of the road system. It is necessary to provide consistency of experience as the driver traverses the route. Therefore, the dimensions of the elements of the intersection (for example, tapers and length of auxiliary lanes) should be consistent. Further, the layout of the intersection should be the same for similar circumstances. This might mean that a higher level of treatment should be applied at an isolated intersection to ensure consistent behaviour of drivers.

For example, if most intersections on a road link are of the Channelised Right (CHR) type then a driver might be caught unaware by a vehicle turning right at an isolated Basic Right (BAR) type (possibly resulting in a rear end collision or overtaking crash). Greater perception and reaction times could be required in such cases to ensure that drivers perceive the different conditions, but it is usually more appropriate to change this intersection type into a short CHR for consistency.

3.5 Design domain

New

The Design Domain concept was introduced into the Geometric Design Guide for Canadian Roads (Transportation Association of Canada (TAC), 1999) to provide an approach where the designer is required to select design criteria from a range of values, considering the benefits and costs of the selected criteria. This approach places an emphasis on developing appropriate and cost-effective designs rather than providing a design that simply meets “standards”.

As shown in Figure 3-1, the design domain consists of the following two elements:

1. Normal Design Domain (NDD), and
2. Extended Design Domain (EDD).

Additional information is also located within Austroads Guide to Road Design – Part 2, Commentary 7 (including Figure C7 1: Conceptual diagram).
Figure 3-1 – The design domain

Notes:
1. Each design domain is for an individual design parameter such as lane width, horizontal curve radius, vertical curve size and so on.
2. This graph shows an arbitrary line. However, when properly drawn it is anticipated to exhibit similar properties, that is a similar profile (in general) and on a continuum (that is, an unbroken line).
3. All design parameter values that are located within the Design Exception range must be fully documented with a defendable engineering justification.

Source: Based on Transport Association of Canada (1999).

In Figure 3-1 the lower regions of the domain represent criteria that would generally be considered to be less safe, less efficient but usually less expensive than those in the upper regions of the domain. The decision on the values to adopt should be made using objective data on the changes in cost, safety or levels of service caused by changes in the design together with a benefit cost analysis. Such data is not always available and the RPDM provides guidance to designers on the potential effect of changes in design of the elements involved.

With the example in Figure 3-1 values towards the upper end of the domain will tend to be selected, for a particular parameter, for the following:
- on roads with high traffic volumes
- when other parameters at the same location are approaching their respective lower order values
- where little additional cost is required (to provide the higher value), and/or
• where a significant crash history exists at a particular location.

Conversely, values towards the lower end of the domain will tend to be selected, for a particular parameter, for the following:

• where significant additional cost is required (to provide a higher value)
• where there is no crash history at a particular location
• where the use of a lower order value is reasonable, defendable and the logic of both of these aspects is documented
• when other parameters at the same location are above their respective lower order values, and/or
• on roads with low traffic volumes.

Using this concept provides some benefits to the designer:

• It is more directly related to the road design process since it places a greater emphasis on developing appropriate and cost-effective designs rather than merely following prescriptive "standards”.
• It reflects the continuous nature of the relationship between service, cost and safety and changes in the design dimensions - the designer must consider the impacts of trade-offs throughout the domain and not just where a “standard” threshold is crossed, and
• It provides an implied link to the "factor of safety” - a concept commonly used in civil engineering design processes where risk and safety are important.

_Austroads Guide to Road Design - Part 2_, Figure 2.2, illustrates how the design domain concept might be applied to a single design parameter, shoulder width. Selection of a value within the design domain will depend on a trade-off between the various benefits and costs. In other cases, values for several design parameters must be selected, these parameters working together to optimise the design.

In practice, the concept of a design domain with an upper and lower limit (that is, bound) with a continuous range of values in between may not be practical or desirable. For example, the lengths of transitions are usually rounded to multiples of 20 m for the convenience of set out calculations. In some cases, there may be no upper bound other than that imposed by practicality or economics and the upper bound is defined by typical values found in practice or by the threshold of cost-effective design. With some design parameters, such as the coefficient of side friction, higher values represent a lower order of service. However such parameters still have a design domain and the benefits gained from having to make decisions on values still apply.

The designer must take account of the nature and significance of controls and constraints. Often, the designer will not be able to choose design dimensions that will satisfy all of the controls and constraints and compromise (that is, trade-offs) will be required. These are engineering decisions that call for experience, insight and a good appreciation of community values.

Some design criteria are set by policy (for example, vertical clearance to structures), while others may be little more than suggestions. Some are chosen on the basis of safety, some on service or capacity, while others are based on comfort and aesthetic values. The judicious choice of design parameters is very important in the design process and it is important that designers have a good appreciation of the background to, and derivation of, the parameters being used. By using this knowledge and understanding, and having regard for community values, a designer will be able to produce a design to the required level of service and safety with acceptable economy.
For many elements, a range of dimensions is given in the RPDM and Austroads Guide to Road Design, and the designer has the responsibility to choose an appropriate value for a particular situation. A designer with economy uppermost in mind may be tempted to apply the lower order value in the range on the basis that so long as the value is within the accepted range, the design is satisfactory. This may, or may not, be the case.

The designer might conclude that it is appropriate to use lower order values for design parameters and this is not necessarily a bad decision. However, if this course of action is followed, the consequences of the action need to be thoroughly understood, particularly with regard to safety but also with regard to costs, benefits and level of service. It is necessary to consider ameliorating measures (for example, traffic control devices) at the same time as the geometric design. If a design involves compromise, it might be better to compromise several elements a little rather than to compromise one element excessively. The design must be balanced.

This highlights the need for the proper combination of elements and the effect of decisions on one of them by decisions on others. For example, where it has been necessary to adopt a lower order value for one element, it might be necessary to compensate by being more generous with an associated element. The design domain approach clarifies the extent of trade-offs and highlights the interrelationship between the various elements of design. It encourages a holistic approach to the design.

### 3.5.1 Normal design domain

**New**

The Normal Design Domain (NDD) is the part of the design domain that is generally considered to provide a high level of safety for an individual road design parameter. As shown in Figure 3-1, it usually contains a range of values for an individual road design parameter. Generally, it is utilised on new roads where there are no constrictions that create unreasonable cost increase to the overall project. The extents of the Normal Design Domain (NDD) are usually based on the experience and judgement of practitioners, even where the relationship with safety has been identified by research.

These extents can change over time with current subjective thinking (for example, Austroads decreased the eye height value from 1.15 m to 1.05 m, which in turn required Austroads to increase the minimum size crest vertical curves).

All NDD decisions should be appropriately documented. NDD values can be assumed to be documented by the project documents (drawings and specifications) and the RPDM and Austroads Guide to Road Design.

### 3.5.2 Extended design domain

**New**

The Extended Design Domain (EDD) is the part of the design domain that is generally considered to provide an acceptable level of safety for an individual road design parameter. As shown in Figure 3-1, it usually contains a range of values for an individual road design parameter. Generally, it is utilised on existing roads where there are constrictions that make it unreasonable to adopt a NDD value. The extents of the EDD are also based on the experience and judgement of practitioners, even where the relationship with safety has been identified by research.

Improving existing roads is relatively expensive, particularly improving the geometry. Furthermore, the cost differential between upgrading a road design parameter to a level within the NDD compared to a level within the EDD is usually high within these cases. In contrast, the relative cost differential...
between providing a road parameter that conforms to the NDD compared to the EDD is likely to be much less for a new road at a “greenfield” site. An existing road also represents a significant prior investment. Therefore, the focus when restoring existing roads should be to optimise the asset to maximise the investment already made and to be made while still providing adequate safety.

In the case of a major re-alignment on a low volume road, the use of design parameters in the EDD will be applicable, as generally NDD is more suited to roads with moderate to high traffic volumes.

Designers should be aware that simply adopting lower order values for a parameter (including EDD values) for several design criteria may produce an unsafe and/or unsatisfactory result. For example, combining a minimum radius horizontal curve with a minimum radius crest curve and a minimum carriageway width may be a hazard to road users; even though individually they “comply”, in combination they may produce an undesirable result. Where a lower order value is adopted for one geometric element it is usually desirable to adopt a value that is above the lower order value for other elements (for example, increase the pavement width to allow vehicles to manoeuvre on an absolute minimum radius vertical curve). This philosophy is particularly relevant when applying the EDD concept.

All EDD decisions should be appropriately documented. EDD values have already been subjected to rigorous analysis and the documentation is about recording the circumstances that required such values to be used (in addition to the NDD documentation requirements).

### 3.5.3 Design exceptions

**New**

Design exceptions (DE) are most likely to occur due to challenging terrain; constrictions due to existing infrastructure, services, property boundaries, environmental conditions, cultural heritage and community expectations; and so on.

**Before any design exception is adopted it is necessary to demonstrate that the adoption of a design exception/s provides for a reasonable level of safety.** This shall be fully documented in a design exception report and provided to the department. Further requirements can be found within the RPDM content associated with the *Austroads Guide to Road Design Part 8: Process and Documentation*.

Wherever a DE is adopted, appropriate measures should be taken to mitigate any adverse effects of the exception.

Designers should recognize, however, that design exceptions have the potential to negatively affect highway safety and traffic operations. For this reason, consideration of a design exception should be deliberative and thorough and a clear understanding of the potential negative impacts should be developed.

If the decision is made to go forward with a design exception, it is especially important that measures to reduce or eliminate the potential impacts be evaluated and, where appropriate, implemented.

(Stein and Neuman, 2007 - *Mitigation Strategies for Design Exceptions* – page 1).
This document (Stein and Neuman, 2007 page 67) provides a listing of possible mitigation treatments as well as some case studies. It cautions that:

Every design exception location is unique. The recommended approach is to consider the mitigation strategies presented -- as well as other ideas and new approaches. If available, consult current research to gain additional information. Then customize one or more strategies to address the unique concerns and site conditions at the design exception location.

Potential mitigation strategies and features are developed in several of the documents listed in the references. Specific values for the mitigation effects of various countermeasures (or mitigation strategies) are provided in Oxley et al (2004). Further useful information is included in National Cooperative Highway Research Program (NCHRP) Synthesis 432 (2012). The NCHRP Report 500 guidelines are a potential source of information on suitable mitigation strategies for a range of design exceptions.

3.5.4 Pilot projects

New

A description and some details on pilot projects can be found within the RPDM content associated with the Austroads Guide to Road Design Part - 8: Process and Documentation. The RPEQ will need to confirm if there is additional departmental requirements associated with pilot projects.

3.6 Road design classes

New

The primary purpose of Road Design Classes is to assist designers who are working on a road design by providing a table (Table 3-1) that outlines the typical design parameters/elements that are assessed (and their associated minimum design criteria).

There are four road design classes (Classes A, B, C and D). The road design classes generally reflect the level of investment and intervention being undertaken on the road network. Furthermore, the classes generally sets the department’s expectations with respect to relevant design criteria’s design domain, such as the Normal Design Domain (NDD), Extended Design Domain (EDD) and Design Exceptions (DE).

Consequently, the design approach is different for each road design class.

3.6.1 Design class selection and definitions

New

The selection of the appropriate design class should be made in the strategic planning stage or as early as possible in the project planning stage. The purpose of the design class is to clarify the scope of works, departmental responsibility and individual responsibilities. It aims to set the framework for mutual understanding between the project manager, supervising/certifying engineer and designers with respect to elements of project scope, the level of geometric design analysis, level of intervention and need for documentation, justification and RPEQ certification.

It is critical that designers firstly identify the most appropriate design class for a given project before applying criteria from the RPDM and Austroads Guide to Road Design. This is because not all of the design criteria in the RPDM and Austroads Guide to Road Design need to be applied for each design class. For example, design criteria for horizontal and vertical curve size and carriageway width will not normally be applied on a Design Class D project (such as a partial shoulder sealing project). Refer to
the fourth column of Table 3-1 to identify relevant geometric parameters to be assessed for each design class.

Figure 3-2 indicates a conceptual process for selecting design classes. The project could be in response to long term corridor planning or a recent natural disaster such as flooding. There are likely to be funding constraints identified prior to the commencement of the design process which must be considered.

**Figure 3-2 – Conceptual process on selecting the design class for a project**

Table 3-1 lists all four design classes (A, B, C and D) along with the expected geometric design requirements. The table provides examples of projects that relate to a particular Design Class.

Sometimes, the appropriate design class is not clear cut. Other times, a project will have parts that are clearly one class with other parts clearly another. However, it is the overall level of intervention of the completed project, and the effect on future operating speeds and operational safety, that will set the dominant design class and expected treatment.
### Table 3-1 – Road design classes

<table>
<thead>
<tr>
<th>Road Design Class</th>
<th>Project Types</th>
<th>Geometric Changes</th>
<th>Geometric Parameter/Element Assessed#</th>
<th>Minimum Design Criteria for Assessed Parameter/Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>New road, or Complex, high risk and/or relatively expensive project involving modification to an existing road. This may include: • duplication of existing road • 500 m realignment of an existing road • new climbing/overtaking lane, or those that contain intersection/s • interchange/major intersection, or • upgrade to motorway standard.</td>
<td>New alignment or major modification to an existing road</td>
<td>All</td>
<td>NDD (if a greenfield site) EDD* (if a brownfield site) In an exceptional circumstance a DE may be used, where NDD and EDD* cannot be utilised.</td>
</tr>
<tr>
<td>B</td>
<td>Restoration project (road including intersection) involving increases to the earthworks footprint for most of the project length (that results in the driver speed increasing by 5 km/h or more). This may include: • significant increase in seal width (including sealing unsealed shoulders) • shoulder widening (sealed/unsealed) • structural overlay with widening • &lt; 500m realignment of an existing road • climbing/overtaking lane with no intersection and with minimal earthworks. • 'non-complex' roadworks associated with bridge replacement, or • sealing an unsealed road.</td>
<td>Major cross-sectional change including road widening</td>
<td>All</td>
<td>EDD* DE may be used, where prohibitively expensive to justify EDD* or NDD.</td>
</tr>
<tr>
<td>C</td>
<td>Restoration project (road including intersection) where the earthworks footprint does not change or there is localised marginal change to the footprint (that does not result in the driver speed increasing by 5 km/h or more). This may include: • structural overlay • increase in seal width (including sealing an unsealed shoulder) • shoulder widening (sealed/unsealed) • minor intersection improvements (for example, adding short channelised right turn treatments) • upgrade/retrofit of road safety barriers • batter flattening/reshaping, or</td>
<td>Surface profile changes that do not involve road widening</td>
<td>i. Crossfall ii. Superelevation iii. Flow path depths iv. Verge width and sight distance requirements, if upgrade/retrofit road safety barriers v. Geometric elements associated with a significant crash history (in spite of existing appropriate mitigating devices).</td>
<td>For geometric parameters (i) - (iii): EDD* For geometric parameters iv): a. EDD* otherwise NDD b. DE if prohibitively expensive to justify. For geometric element (v): a. Remove hazard (1st preference) b. NDD (2nd preference), c. EDD* with suitable mitigating devices. For other geometric parameter/element, retain DE.</td>
</tr>
</tbody>
</table>
### Road Design Class A

Design Class A projects are significant projects that are complex, high risk and/or relatively expensive. This design class could be for greenfield or brownfield sites. These projects have a requirement for a high level of consultation, investigation, rigour and control. They also require an assessment of all geometric elements.

It is not normal practice to have Design Exceptions (DE) within a greenfield project.

Complex brownfield projects may involve the extensive use of Extended Design Domain (EDD), and the retention of one or more DE because of the difficulty and cost of upgrading them. Where practical, DE should be upgraded to conform to EDD (if it exists) or NDD.

### Road Design Class B

Design Class B projects are of medium risk and less complex and usually less expensive than Design Class A projects. They require an assessment of all geometric elements in order to check the adequacy of the existing and restored road sections.

Projects involving a pavement overlay and/or pavement widening, the aim should be to bring DEs involving sight distance and cross section width into EDD – otherwise the DE will be locked in for another 20 or more years due to the substantially enhanced pavement asset.
However any decision to upgrade a road section will be influenced by factors such as:

- crash history
- constructability and traffic management constraints
- project constraints, and
- cost (for example, it may not be cost effective to increase the size of a vertical curve through a major rock cutting).

Examples of specific instances where Design Exceptions should be upgraded include:

- Horizontal curves with:
  - a crash history and which already have the appropriate signage, safety barriers or run-out areas, or
  - an unsatisfactory combination of other design parameter minima.
- Intersections with deficient sight distance – experience shows it will end up being rebuilt sooner rather than later.
- Crests – these should be brought into EDD when:
  - minimal earthworks are required (for example, less than a 1 m cut is required)
  - rehabilitation or reconstruction of the existing pavement is required, or
  - there is an unsatisfactory combination of other design parameter minima.

Road Design Class C

As outlined in Table 3-1, DEs for geometric elements such as crossfalls, superelevation, and flow path depths at curve transitions within Road Design Class C projects are normally expected to be upgraded. Normally, all other geometric elements comprising a DE (if known) are not expected to be upgraded. However, the following is required on all Class C projects:

- Review and upgrade signage if necessary to comply with the Manual of Uniform Traffic Control Devices (Queensland) (MUTCD).
- Comply with the departmental policy on road safety auditing of projects.
- Seek to improve the geometry of any feature that has a significant crash history in spite of appropriate mitigating treatments already in place, and
- Mitigate geometric elements with a known crash history by:
  - clearing roadside hazards
  - updating/installing safety barriers and so on
  - providing additional signage, and/or
  - applying a speed limit reduction, if justified in accordance with Section 4 of the MUTCD.

For full shoulder sealing projects, it is desirable to be able to demonstrate that any DE (or any other geometric parameter for that matter) is not made worse. With these projects, it is desirable to undertake an assessment of all geometric elements in order to determine if there is any adverse effect due to increased operating speeds as a result of changed driver or rider perception of the road (for example, problem horizontal curves).
Examples where a road could be made less safe with Design Classes C or D include:

- a seal width increase that results in the 85th percentile speed of the road rising above the geometric elements of the existing road, and/or
- a seal width increase that is implemented by significantly steepening the batters within the existing formation.

**Road Design Class D**

Design Class D projects have the lowest risk, complexity and are usually the less expensive. Examples may include pavement rehabilitation, or pavement rehabilitation with a minor or profile correcting overlay (where no earthworks/formation widening is required), or minor drainage and/or the maintenance of road safety barriers (limited to only replacing end treatments and existing components: no change to the points of redirection nor lateral offset is accommodated in Design Class D).

**3.7 Functional classification and use**

**New**

The department has the Priority Road Network (PRN) Investment Guidelines and other documents that assist with planning of route upgrades, such as the State-controlled Priority Road Network Investment Guidelines (May 2011).

Motorways are state-controlled roads that are declared as a motorway under Section 27 of the Transport Infrastructure Act 1994 by the Minister administering the Land Act. Motorways are generally high speed, high volume roads with full control of access; and grade separated multi-lane roads with no property access allowed. Legislation allows the department to preclude certain classes of vehicles from using a declared motorway providing appropriate signage is applied. These characteristics lead to the need for high standards producing a very safe driving environment.

Where a road has all of the characteristics of a motorway and performs the function of a motorway, the design should be in accordance with the requirements of the above paragraph and the rest of RPDM and the Austroads Guide to Road Design: regardless of whether the road has been declared as a “Motorway” under the legislation.

Rural arterial roads make up the majority of the state controlled road network. The department’s investment strategies for these roads are focused on maximising benefits for all areas serviced by achieving appropriate standards across the whole road network. Over investment in any area will affect the department’s ability to upgrade other areas to an appropriate standard. The interim and vision standards in the investment strategies focus on carriageway and seal widths. Other requirements could be contained in the link strategies. Where neither the investment nor link strategies define standards, they should be derived through an iterative process that examines the entire road link, or at least consistent sections that are selected from obvious changes in character such as topography. Designers should pay particular attention to changes in character along the road to ensure suitable transitions between them and to ensure “no surprises” to motorists. Within the general term “rural arterial”, a range of sub-categories is used to differentiate between the different functions of the various parts of the network. These are:

- National Land Transport Network (Road)
- the State Strategic Road (SSR) network
- Regional Road (RR) network
• Local Road of Regional Significance (LRRS) network.

The National Land Transport Network (Road) includes nationally important road links that are determined by the Minister under the National Land Transport Act 2014.

The State Strategic Road (SSR) network includes the principal intra-state highways and major developmental roads, providing intra-regional links, and links to interstate and National Land Transport Network (Road). This network is crucial to the efficient movement of people and goods throughout Queensland and its performance impacts directly on the economic performance of the State. This network requires an overall state-wide perspective catering to long distance movements and linking major economic regions within and external to Queensland.

The Regional Road (RR) network caters for movements that link economic areas within the region to one another and to economic areas in adjacent regions. It is a network of roads essential for the development of the regional economy and is therefore planned within a regional context.

The Local Roads of Regional Significance (LRRS) network makes up the rest of the system and completes access to major commercial centres throughout Queensland. These roads provide for movement between commercial centres within and adjacent to districts and provide access to the Regional Road (RR) and State Strategic Road (SSR) networks. There are therefore a wide range of circumstances in which Local Roads of Regional Significance are located and consequently a wide range of possible approaches to the standard of road to be adopted depending on its location and function.

The investment strategies together with the link strategies will define the general standard to be applied to specific projects in order to meet the defined objectives. Investment strategies have been developed for:

• National Land Transport Network (Road) - previously National Network Road Links

• State Strategic Roads (SSRs)

• Regional Roads (RRs).

Suitable design criteria for the development and maintenance of links in the network are provided in the “Statement of Intent” (that is the Executive Summary of the Link Strategy). These documents should be consulted when establishing the requirements for individual projects. The primary issue is to provide a consistent standard over significant lengths of road between obviously appropriate points of change in terrain, function, land use and so on. The selected design criteria should reflect the intent of the link strategies. Where no link strategy exists, the standard of the link should be consistent.

Consistent means that there are no surprises for the driver and the road becomes “self-explaining”, for example isolated features that are below the standard of the adjacent road should be considered for removal when restoration takes place. It also means that changes in the standard of the road should be located where the driver can see the change in adequate time to make allowance for that change.

**Designers must justify and document any decision to retain isolated lower standard features.**

This includes features that are within the Extended Design Domain and features that are inconsistent with the contiguous road sections.
4 Design Considerations

4.1 Risk management and value engineering

All jurisdictions recognise that road design must adopt a risk management approach to the development of the designs, perhaps regardless of whether the values used are within the generally accepted standards or not. It is especially important if the values used are exceptions. Stein and Neuman (2007, p. 16) note:

Agencies are confronted with two fundamental types of risk when dealing with design exceptions. The first involves the risk of the solution not performing as expected. The second involves the risk concerning the agency’s ability to defend itself against potential legal actions as a result of its decisions.

These risks can be addressed by adopting a rigorous approach to developing the design and recording the decisions made and the reasons for them.

For example RTA NSW (2007) requires a value engineering assessment of its projects in conjunction with the risk assessment. The focus of this assessment is to review each element of a project to establish whether the associated capital expenditure represents the best use of scarce community resources.

This RTA Guide also defines the situations for various levels of design (Section 2.9) into:

- Retain Existing Design (RE)
- Evaluate Upgrade Design (EU)
- Full Design (FD).

In addition, a Permitted Variation from the limiting values defined by the Road Design Guide may be approved after a risk and value engineering assessment of the impacts of the variation. Adoption of such a variation may also require various mitigation measures to be adopted.

Tabulations of the design elements that may be involved against the expected type of works and the design strategy (RE, EU or FD) to be used are provided. This is, in some ways, similar to the “Design Classes” adopted by the department.

For risk management refer to the department’s policies and procedures. OnQ Project Management acknowledges and integrates these processes as part of the risk management knowledge area.

Cox (2004 slide 17) also notes with respect to risk management and assessment:

- 2004 Queensland Supreme Court decision (Theden) – “The assessment of risk ought properly to be taken from an assessment of the configuration rather than any crash statistics”.

- This would indicate that it is not reasonable to rely on a lack of crashes when there are low traffic volumes.

- EDD does not rely on a lack of crashes, but on a reasonable level of capability.

Austroads (2010a) and Austroads (2010b) provide objective data on crash risk and crash risk reduction factors. These publications may be useful in assessing the relative merits of proposed works to improve safety and in assessing the relative differences between implementing projects with full EDD standards and those with design exceptions.
5 Design process

5.1 General

Differences
The design process to be applied is outlined in the department’s Preconstruction Processes Manual.

5.2 Process elements

Differences
The process elements to be applied is outlined in the department’s Preconstruction Processes Manual.

5.2.1 Land use/transport/environmental planning

Additions

Land use

Refer to the Department of Infrastructure, Local Government and Planning for the latest information on planning.

Transport

The Transport Coordination and Delivery Plan sets departmental strategy and direction to deliver on the government’s objectives of a 10-year horizon. It provides a clear strategic framework for making decisions to achieve the government’s vision for the transport system and is supported by:

- criteria for making decisions about spending on transport
- long-term objectives and performance indicators for the transport system
- guiding principles that inform policy, planning and decision making
- a simple governance structure with clear accountabilities
- the annual strategic plan provides strategic business priorities and objectives.

Further documents that planning and design teams need to be aware of are (but not limited to):

- Queensland Transport and Roads Investment Program
- Transport Infrastructure Act 1994
- Transport Planning and Coordination Act 1994
- Transport Planning and Coordination Regulation 2005.

Environmental

The department’s Environmental Processes Manual provides the governance for environmental assessment and management of transport infrastructure projects undertaken by the department.

Cultural heritage

Cultural heritage (both Indigenous and European) issues must be identified and their impact must be considered in the planning and design process. For initial guidance on matters related to indigenous cultural heritage reference must be made to the Cultural Heritage Process Manual.

5.2.2 Community consultation and engagement

Differences
The title of Section 5.2.2 has been amended to “Community consultation and engagement” rather than “Public Consultation”. Delete the first sentence and last paragraph of Section 5.2.2 in *Austroads Guide to Road Design – Part 1*.

**Additions**

The road system has direct and indirect impacts on the entire community. It is important to consider the views of all stakeholders for a project to deliver successful outcomes. The department is committed to conducting honest, fair and respectful engagement with the community. Furthermore, the primacy of the public interest is acknowledged and any conflict of interest issue will be resolved or appropriately managed in favour of the public interest. Communication Services has developed the “Communication plan and material approval standard (April 2014)” to assist with community engagement, consultation and other communication activities.

Stakeholders are individuals, groups and organisations who are likely to be affected by and/or have an interest in the department’s decisions and actions. These include communities, industry, businesses and government.

Stakeholders therefore include, but are not limited to, affected and adjoining Indigenous Australians, local communities and groups, landowners, industry bodies, users of the facility, all levels and areas of government, public utility plant (PUP) authorities and so on. The identification and involvement of stakeholders throughout all phases will help to ensure that all issues and needs are identified and considered and will lead to outcomes with a high degree of support and ownership.
References

Transport and Main Roads publication references refer to the latest published document on the departmental website (www.tmr.qld.gov.au).

Additions


Austroads (2010b), Road Safety Engineering Risk Assessment Part 6: Crash Reduction Factors (Report AP-T151/10)

ARRB (2012). SP1705 Progress Report No.5: Safe System Design Principles for Brownfield Sites


Louis, L. (2002). Design standards and approach to "Fit for Purpose"


Department of State Development, Infrastructure and Planning (2014). State Planning Policy, Brisbane, QLD

Department of Transport and Main Roads (2014). Communication plan and material approval standard, Brisbane, QLD


Department of Transport and Main Roads (2013). Environmental Processes Manual, Brisbane, QLD

Department of Transport and Main Roads (2013). Guidelines for Road Design on Brownfield Sites, Brisbane, QLD

Department of Transport and Main Roads. Manual of Uniform Traffic Control Devices, Brisbane, QLD

Department of Transport and Main Roads. Preconstruction Processes Manual, Brisbane, QLD

Department of Transport and Main Roads. Road Planning and Design Manual, Brisbane, QLD

Department of Transport and Main Roads. Safer Roads, Safer Queensland, Queensland’s Road Safety Strategy 2015-21, Brisbane, QLD

Department of Transport and Main Roads (2011). State-controlled Priority Road Network Investment Guidelines, Brisbane, QLD

Department of Transport and Main Roads. Strategic Plan 2016-2020, Brisbane, QLD

Department of Transport and Main Roads. Traffic and Road Use Management Manual (TRUM), Brisbane, QLD

Department of Transport and Main Roads (2013). Transport Coordination and Delivery Plan, Brisbane, QLD


**Legal Case**

Theden v Nominal Defendant [2004] QSC 310
Commentary 4

Differences

Commentary 4 is modified to the following:

The traditional approach to design techniques is described in Geometric Design Guide for Canadian Roads. Traditionally, road design standards have provided the basic dimensions for road design practice. These ‘standards’ were not intended to be rigid, or applied uniformly in all cases. Different road agencies placed different emphases on quality of service, cost, environmental issues and road safety. Such differences are matters of policy.

A road safety audit seeks to highlight vulnerabilities in a design that may contribute to an increased risk to all road user groups and under a Safe System approach the focus of this is the risk of death and serious injury. The findings of a road safety audit are presented as a means to improve the safety of a road design, and this may be achieved in any number of ways, or indeed, it may be deemed the identified risk is acceptable given the constraints on the road designer.

Commentary 5

Additions

Figure 3-3 illustrates the mean collision (that is, crash) rate versus mean speed difference between successive geometric elements, for example, tangent to curve.

![Figure 3-3 - Mean collision rate versus mean speed difference between successive geometric elements](source: Figure 1.4.5.1 from the Transport Association of Canada (1999).

Commentary 6

Differences

Commentary 6 is modified to the following:

The diagram was sourced from Queensland’s Department of Transport and Main Roads in 2005.