

***DRAFT* State Highway
Geometric Design Manual**

Draft

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Transit New Zealand

State Highway Geometric Design Manual

The Transit New Zealand State Highway Geometric Design Manual has been developed over the last four years to capture the best practice geometric design standards and guidelines from a number of disparate documents.

The manual will be finalised through the next year and a half to June 2002, through the following stages. During this period the draft manual will be available on the Transit website.

- **Draft Manual Review Period** - to 31 March 2001

During this period designers are asked to review the material, before revision and finalisation of the Provisional Manual. The draft manual, and any revision submissions, will be reviewed by a Review Group. This group will make the decisions to resolve the issues and direct changes to the manual. Throughout this period, comments and issues, and revision submissions are encouraged and the draft manual updated appropriately. Your access to the review process is through contacting the Project Manager:

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- **Provisional Manual**

The revisions to the Draft Manual will be completed by 31 March 2001, by Transit. The Provisional Manual will be posted on the Transit website on 1 May 2001.

The manual will be submitted to the Transit Authority in April 2001 for approval as a provisional document for the period ending 30 June 2002 (or sooner depending on the extent of final revisions). **The provisional status will mean that all new design projects must comply with the requirements of the provisional manual.**

Throughout the year from 1 May 2001 to 31 March 2002, comments on the content of the manual will be encouraged. Any consequent updates will be done relative to urgency, with minor issues being dealt with in the final revision to be completed by 30 May 2002.

- **Final Manual**

The manual will be submitted to the Transit Authority for approval as a standard effective 1 July 2002, or sooner depending on the extent of final revisions.

Dr Dennis Davis
Traffic and Design Manager
Transit New Zealand

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1 Introduction

1. General

Road design standards are used as a means to achieve consistent and operationally effective roads. This Geometric Design Manual (the Manual) details the design standards and procedures which apply to Transit New Zealand's (Transit) state highway work to ensure that:

- a high degree of uniformity in road design and construction will be maintained on the state highway network, particularly across regional boundaries,
- designs reflect Transit's strategic plan for the state highway network.

This Manual reflects current engineering practice, embraces sound engineering principles and the latest technology in road engineering. It tends towards the conservative end of the range of design possibilities, is intended as a reasonable suggestion of limitations and is not a substitute for engineering knowledge, experience or judgement.

The design standards and procedures detailed in this manual *must* be used for all state highway work. However, conditions will sometimes be encountered where these cannot be fully implemented because of construction, financial or other constraints. In these situations formal approval *must* be sought from the Highway Strategy and Standards Manager to alter design details that do not comply with mandatory design standards and practices.

1.1.1 Mandatory Standards

Mandatory design standards are those considered essential to achievement of overall design objectives. Mandatory design standards are indicated by the use of the word '*shall*' or '*must*'.

1.1.2 Advisory Standards

Advisory design standards are also important but allow greater flexibility in application to accommodate design constraints or to be compatible with local conditions on resurfacing or rehabilitation projects. Advisory standards are identified by the use of the word '*should*'.

1.1.3 Permissive Standards

All standards other than mandatory or advisory are indicated by the use of the word '*may*'. These are permissive and no requirement for application is intended.

1.1.4 Design Check List

A design checklist for use by designers in the planning, design, and review of geometric plans for highway improvement projects is given in Appendix 1A. This should be used while:

- comparing alternatives in the planning stage,
- developing geometric plans,
- reviewing plans prepared by local agencies or their consultants, and
- identifying non-standard features requiring design exceptions

The checklist does not include all design standards and is not intended to be a substitute for the designer making the appropriate design decisions

1.1.5 Exceptions to Mandatory Design Standards

(a) General

The consistent application of design standards described in this Manual are most important to ensure optimal safety for the travelling public and those who work to construct, operate, and maintain the State Highways.

The purpose of the design exception process is to create a written record that documents the engineering decisions leading to the approval of each exception from a design standard. It is essential that adequate records are prepared and preserved to document such decisions and approvals.

Approval of exceptions from Mandatory Design Standards must be sought as early as possible in the project development process, particularly where the project concept and/or cost estimate depend on a potential design exception.

The Project Manager is responsible for identifying all nonstandard design features (both proposed and existing) and should not rely solely on reviews by others to make these findings.

Potential design exceptions *must* be discussed with the Highways Strategy and Standards Manager as soon as the need for an exception is identified.

(b) Requests for Design Exceptions

Once the Project Manager determines that there may be sufficient justification to approve a design exception, a formal request can be made. The following steps *must* be taken:

- (i) Prepare the request in the form of a draft Fact Sheet, in conformance with the outline in Appendix 1B.
- (ii) Submit the request to the Highways Strategy and Standards Manager for review. Incomplete drafts will normally not be accepted for review.
- (iii) Address all comments to the draft to the satisfaction of the individuals making the comments.
- (iv) Circulate the completed Fact Sheet for approval signatures. (See 'Approvals' in (e) below.)

Requests to perpetuate existing nonstandard design features within a project's work limits will be made in accordance with the above procedures - except when the Highways Strategy and Standards Manager determines that a different form of documentation is more appropriate.

(c) Integration with Project Development Process

All anticipated design exception approvals must be obtained prior to approval of the Project Scheme Assessment Report or any other project initiation document. The text of the project initiation report must include a brief description of the nonstandard features, as well as a reference to all approved Fact Sheets and their approval dates by Highways Strategy and Standards Manager. See 'Approvals' in (e) below.

If the need for a design exception is identified after approval of the project's initiation document, the documentation process just described must be followed and completed prior to approval of the next project development report. The need for a design exception must be referenced in the associated engineering document (Draft Project Report, Project Report, etc.).

During the construction phase of a project, Fact Sheets must be prepared by the designers to document any nonstandard features proposed. The Project Manager is responsible for processing the proposed design exception.

(d) General / Miscellaneous Requirements

- A single Fact Sheet should be prepared for projects that contain multiple design exceptions.
- Design exceptions on local roads for projects must be prepared by the local road controlling authority involved.
- Nonstandard features that are identified subsequent to the approval of an initial Fact Sheet require the preparation of an independent, "stand alone" Fact Sheet. This can be accomplished by writing a supplementary Fact Sheet if the original Fact Sheet is attached.

- Fact Sheets should not be attached to any project initiation or engineering reports. They should be summarised and referenced in appropriate reports.

(e) Approvals

The Fact Sheet outline shown in Appendix B2 gives the recommended format for the signature/cover sheet and how design exception details should be presented.

The responsibility for approval of all exceptions to Mandatory Design Standards, on State Highways as well as local roads within the State Highway road reserve, rests with the Highways Strategy and Standards Manager. This includes approval for any project that does not provide or maintain a minimum vertical clearance of 4.9 m.

Following Strategy and Standards Manager approval, a copy of the Fact Sheet must be placed on the regional project file. The signed original Fact Sheet approval letter must be filed in the Transit Head Office Project History File.

1.1.6 Exceptions to Advisory Design Standards**(a) General**

Approval of exceptions to Advisory Design Standards has been delegated to the Regional Managers.

(b) Documentation

Each region *must* formalise its procedures for documenting exceptions to Advisory Design Standards. The region-approved Advisory Design Standards Exception must generally cover the same type of project data and justification as that required for the Mandatory Design Standards Fact Sheet. All exceptions to Advisory Design Standards should be discussed with the Highways Strategy and Standards Manager.

(c) Recording

The signed original Advisory Design Standards Exception must be filed in the HO Project File. A backup copy must also be filed in the district's project file.

1.2 Safety

Safety is one of the most important features of a road. From initial planning to final construction, the safety of the finished road should be uppermost in the mind of the designer.

Excessive speed is one of the main causes of road crashes. Speeds are deemed to be excessive when drivers travel too fast for the prevailing conditions. Designers must recognise situations where high speeds can be expected as a result of normal driver behaviour and design these sections of road to a standard appropriate for their safe and efficient operation. Design speeds greater than the legal speed limit may be necessary in these situations.

Special care must also be taken when working in low speed environments where faster and more numerous driving decisions are required.

The transition sections between high and low speed environments also require careful design to ensure safe and efficient operating conditions.

Good practice combines all the elements of geometric road design into one harmonious whole which is:

- consistent with the speed environment, and
- does not present any surprises to drivers.

1.3 Design Consistency

The value of design consistency is the assurance that drivers are unlikely to encounter any unsafe abrupt change of alignment or cross-section which will create a sudden reduction in travel speed or roadway capacity.

To maintain a consistent alignment and travel speed, it is important that the same, or very similar, design speeds are used for the design of successive geometric elements.

Where a change in speed environment occurs the design speed for successive elements *must* not vary by more than 10 to 15 km/h. Refer to Sections 3.3 and 4.7.2 for more details.

To maintain consistent roadway capacity it is necessary to maintain:

- consistent lane, shoulder and clearance widths, as specified in Section 6 of this manual, and
- the number of traffic lanes relative to traffic volumes and road gradient, as recommended in the *Austrroads Guide to Traffic Engineering Practice - Part 2: Roadway Capacity*.

The adoption of the concepts of Road Hierarchy, Traffic Flow and Speed Parameters together with the design recommendations contained in other sections of this manual will also help ensure design consistency.

1.4 Related Publications and References

In the absence of direction by this manual American Association of State Highway and Transportation Officials (AASHTO), Austrroads and National Association of Australian State Roading Authorities (NAASRA) publications should be used as reference.

Some American state roading authorities have on-line versions of their road design manuals. These are based on the AASHTO recommendations and they may also be used as design references.

The various guidelines published by the Standards Associations of Australia and New Zealand, Transit, the Land Transport Safety Authority and the Transportation Association of Canada are also recognised and may be used to supplement this manual.

Publications and references which are relevant to this manual are:

American Association of State Highway Traffic and Transportation Officials 1994 (AASHTO):

A Policy on Geometric Design of Highways and Streets

California Department of Transportation (CALTRANS):

Highway Design Manual
(<http://www.dot.ca.gov/hq/oppd/hdm/hdmtoc.htm>)

Iowa Department of Transportation:

Design Manual - Metric
(<http://www.dot.state.ia.us/design/desman.htm>)

New Jersey Department of Transportation:

Roadway Design Manual - Metric
(<http://www.state.nj.us/transportation/cpm/RoadwayDesignManual/>)

Austrroads:

Guide to Traffic Engineering Practice - Parts 1 to 15
Guide to the Geometric Design of Rural Roads
Other relevant Austrroads publications.

National Association of State Roading Authorities (NAASRA):

Road Medians
Grade Separated Interchanges
Guide Policy for Geometric Design of Freeways and Expressways
Safety Barriers

Transit New Zealand (Transit):

Standards and Guidelines Manual
Manual of Traffic Signs and Markings
State Highway Control Manual
Highway Surface Drainage - Design Guide for Highways with a Positive Collection System: NRB 1977
Motorway Exits and Entrances, Geometric Details and Traffic Signs, Plan: TNZ 1/2000/77/7994/1

Transport Association of Canada:

Geometric Design Guide for Canadian Roads

Standards New Zealand:

AS/NZS 1158 : 1997 Road Lighting - Parts 1-3
NZS 6701 : 1982 Code of Practice for Road Lighting (Pedestrian crossing lighting)

1.5 The Resource Management Act 1991

The main purpose of the Resource Management Act 1991 is the sustainable management of New Zealand's natural and physical resources.

The principle of the Transit New Zealand Authority is to operate a safe and efficient State Highway system. This objective is consistent with the Resource Management Act 1991 because the roading network is a physical resource which must be sustainably managed.

This means that Transit is:

- required to avoid or mitigate the adverse effects on the environment of the development and use of the roading network, and
- needs to protect the roading network from adverse effects of adjacent resource development.

The construction, maintenance and use of the roading network can also have considerable detrimental effects on the environment. Concerns which may need to be addressed in roading work include:

- ecological and physical effects,
- heritage and aesthetic values, and
- social effects and the relationship with Maori culture and traditions

The publication *Transit New Zealand Planning Policy Manual* provides a balanced view of the interaction of the roading network and the environment.