

1 Design Statement

Table of Contents

1.1	Preliminary.....	1-3
1.2	Predesign Information.....	1-3
1.3	Design Statement Content.....	1-4
1.4	Responsibility, Endorsement and Certification.....	1-7
1.5	References	1-7

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1.1 Preliminary

The initial step in the design of each structure shall be the consideration of various possible types of bridge or other highway structure, and the preparation of a Design Statement. This shall be an engineering appreciation of the need for the new bridge, the factors which influence the design, the alternative forms the design can take, the reasons for selection of one of these alternatives as being more suitable than the others, and an assessment of the cost.

The Design Statement, once endorsed by Transit New Zealand, sets out the agreed form and nature of the structure to be designed during final design for construction. During final design, should the designer deviate significantly from the form and nature of structure set out in the Design Statement, a revised Design Statement shall be submitted for endorsement by Transit New Zealand.

A Design Statement shall be prepared for all new bridges and major culverts, bridge alterations, and other major highway structures such as retaining walls and sign gantries. A major culvert is defined as a culvert with a waterway area greater than 3.4 m². A major highway structure is defined as a structure with a construction value exceeding \$200,000, or where the contingent liability cost associated with failure could exceed \$970,000, or where there is potential for significant traffic disruption during construction resulting in traffic delay costs exceeding \$970,000. (Costs quoted are at a *Statistics New Zealand Producer's Price Index (Outputs)*⁽²⁾ Construction Index 1908 as for March 2003).

For a bridge or other highway structure to be designed under a design and construct contract, or offered as an alternative tender, a Design Statement shall be prepared for the specific structural form proposed. In the case of a design and build contract, the proposed solution, if varied from the specimen design, need only be compared to the specimen design. In the case of a tendered alternative design, the alternative design shall be compared against the conforming design. The Design Statement may take the form of being an amendment to, or update of, a previously existing Design Statement. The Design Statement should accompany the tender submission.

The Design Statement is to be addressed to the relevant executive officer of the road controlling authority. In the case of State Highway bridges, this is the Regional Manager, Transit New Zealand.

1.2 Predesign Information

(a) Scheme Assessment

Prior to a brief being issued for design of a structure, a Scheme Assessment will generally have been prepared, to establish the need, requirements and constraints on construction of the new structure. Depending on the situation, the Scheme Assessment may address a length of highway of which the structure is a part, or it may refer only to the structure itself.

The Scheme Assessment will generally establish preferred geometry for the alignment, define roadway and footpath widths (if any), and identify specific matters to be addressed during the design. It may be based on limited site

investigations, where unknown geological conditions might influence the feasibility of scheme options. Where appropriate, it will include input from other authorities such as a regional authority.

(b) Site Information

The designer shall ensure that there is sufficient site information to form the basis of the Design Statement. The Bridge Site Information Summary given in Appendix E is a suitable checklist. However, it is the designer's responsibility to ensure that the information is sufficiently comprehensive to enable sound judgement to be made on all aspects of the design. This applies particularly to subsurface and hydrological information, and if these or other data are not adequate, the designer shall obtain the necessary information before the Design Statement is finalised.

1.3 Design Statement Content

The Design Statement shall provide sufficient data to permit a full review of the proposal, and shall consist of the following sections:

(a) Introduction

Reasons for the construction of the bridge shall be given, and a general description of the site provided.

(b) Factors Which Influence the Design

All significant factors that affect the design shall be discussed. These include:

- Service requirements (e.g. traffic volume, pedestrians, cyclists, utilities to be provided for)
- Geometrics
- Hydrology
- Foundation conditions
- Constraints on span arrangement and clearances
- Constraints on construction methods
- Constraints on construction materials
- The interaction of construction with traffic flows
- Site seismic hazard, including subsoil conditions, and the potential for site instability or liquefaction
- Environmental considerations and constraints (including the influence these have on aesthetic requirements for the structure)
- Side protection requirements
- For a bridge over a road or railway, exposure to potential vehicle/train collision with the bridge supports or superstructure
- Access for inspection and maintenance
- Any territorial authority requirements additional to the requirements of Transit New Zealand.
- Climate change in terms of the influence on the intensity and frequency of precipitation and sea level for bridges and culverts serving at waterways, sea-coast and estuarine sites.

(c) Design Options

Generally, at least two design options shall be considered. Principal features of the design options considered shall be described, including:

- the structural form and its mode of behaviour
- how the design addresses each of the above factors influencing the design
- likely methods of construction
- construction materials and durability
- the tolerance of the structure to overloading under critical load conditions
- aesthetics of the structure, and their suitability for the location
- maintenance requirements.

In the event that an alternative design is tendered, the Design Statement for the alternative design shall identify the primary variance/s from the conforming design and the effect that each of these will have on durability, seismic performance, waterway design, structural integrity, ability of the structure to resist the loads specified in Section 3, and, where relevant, the ability of the bridge supports and superstructure to resist collision by vehicle and or train, as compared with the conforming design. Evidence shall be presented that shows the alternative design is of superior quality and performance compared with the conforming design.

An estimate of cost shall be given for each option, showing the total cost and cost per m² of overall deck area. The date of the estimate for each option shall be stated. For the purpose of economic comparison between options, including any differences in the approaches, the requirements of the *Project Evaluation Manual*⁽²⁾ shall be met, and includes consideration of future maintenance costs.

(d) Recommendation

An option shall be recommended for final design with supporting justification provided. This shall be the design that is the most appropriate solution and gives the best value for money, taking account of both construction and maintenance costs. This is not necessarily the cheapest. The designer shall also recommend such further investigation as is considered necessary for completion of the final design.

(e) Design Statement Drawings

The recommended option shall be shown on the Design Statement drawings. Other options considered may also be shown in less detail. The drawings of the recommended option shall include a plan, elevation and cross-section of the bridge showing all relevant geometric, traffic clearances (as appropriate), hydrological (as appropriate), foundation, structural layout, and side protection data. Seismic design features, materials, finishes, and features important to the structure's aesthetics, shall be identified. A locality plan shall also be included.

(f) Recommended Option - Additional Information

For the recommended option, the following shall also be stated or described:

Details of the Proposed Structure

- Proposed details relevant to the structural behaviour, including details related to the provision of seismic protection, accommodation of thermal and settlement effects, and articulation of the structure
- Proposed arrangements for inspection and maintenance
- Proposed detailing in respect to the aesthetic design of the structure.

Design Criteria

- Design codes and standards to be applied to the design
- Any proposed departures from design codes and standards, together with reasons for the departures – for Transit approval
- Proposed methods for dealing with aspects not covered by design codes or standards

Structural Modelling and Analysis

- Methods of analysis for the superstructure, substructure and foundations
- The form of analysis models
- Assumptions for calculation of structural stiffness
- Soil parameters and earth pressure coefficients adopted for the modelling of soil-structure interaction and for design of soil retaining structures.

Ground Conditions and Foundations

- Extent of geotechnical investigations undertaken and proposed
- Acceptance of the geotechnical interpretive report recommendations, or reasons for departures
- Description of the strata in which founding, and proposed allowable or limiting bearing pressures for end bearing and lateral bearing, and skin friction on piles
- Differential settlement to be allowed for in design
- Anticipated ground movements or settlements due to embankment loading, etc.
- Results of groundwater tests and any counteracting measures proposed
- Categorisation of the site subsoil conditions for earthquake loading derivation.

Aesthetics of the Structure

- Where required by the contract or design brief, for structures that are expected to have a significant visual impact on their environment, perspective drawings, a photomontage, or a scale model shall be provided.

1.4 Responsibility, Endorsement and Certification

Each Design Statement shall be approved, signed and dated by a senior design representative who has the authority to sign on behalf of the consultancy or contractor providing the design service. The names of the author(s) of the Design Statement shall also be included on the cover page. Space shall be left at the end for endorsement and comments by Transit New Zealand's officer.

On completion of the final design for the structure, the designer shall supply certification to Transit New Zealand that the design complies with the Design Statement and any subsequent amendments agreed with Transit New Zealand's officer.

1.5 References

- (1) _____, *Producers Price Index (Outputs)*, Department of Statistics, published quarterly.
- (2) _____, 1997, *Project Evaluation Manual*, Manual No.PFM2, Transfund New Zealand, Wellington