Highway structures design guide

This design guide sets out the NZ Transport Agency's design requirements for all permanent highway structures on the state highway network. It also sets out the Transport Agency's design requirements for earthworks, including natural slopes, embankments and cuttings.

NZ TRANSPORT AGENCY
WAKA KOTAHI

New Zealand Government

Highway structures design guide

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More information

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Document management plan

1) Purpose

This management plan outlines the updating procedures and contact points for the document.

2) Document information

Document name	*Highway structures design guide*
Document number	-
Document availability	This document is located in electronic form on the NZ Transport Agency's website at www.nzta.govt.nz.
Document owner	National Structures Manager
Document sponsor	National Manager Network Outcomes
Prepared by	Beca Ltd, Auckland; and Network Outcomes, NZ Transport Agency

3) Amendments and review strategy

All corrective action/improvement requests (CAIRs) suggesting changes will be acknowledged by the document owner.

	Comments	Frequency
Amendments (minor revisions)	Updates to be notified to users by publication of a technical advice note placed on the NZ Transport Agency's website.	As required.
Review (major revisions)	Periodic updates will be undertaken where amendments fundamentally changing the content or structure of the guide or new technology resulting from research or ongoing refinement have been identified.	As required.
Notification	All users that have registered their interest by email to hip.feedback@nzta.govt.nz will be advised by email of amendments and updates.	Immediately.

4) Distribution of this management plan

Copies of this document management plan are to be included in the NZ Transport Agency intranet.

Record of amendments

This document is subject to review and amendment from time to time. Amendments will be recorded in the table below.

Changes since the previous amendment are indicated by a vertical line in the margin. The date of issue or amendment of a page appears in the header on each page. This page will be updated each time a new amendment is released.

Amendment number	Description of change	Effective date	Updated by
0	*Highway structures design guide* 1st edition published.	May 2016	Nigel Lloyd

Foreword

The NZ Transport Agency's purpose is to deliver transport solutions for a thriving New Zealand. We are specifically responsible for the following four functions:

- helping to plan land transport networks, bringing a national perspective
- providing access to and use of the land transport system
- managing the state highway network, and
- investing in land transport.

Structures are an important component of the land transport system. These structures include not only the more obvious bridges, tunnels, subways and culverts that convey vehicular traffic, cyclists and pedestrians but also:

- retaining walls, coastal and river protection works, earthworks and other geotechnical structures that enable links to be built in New Zealand's challenging and diverse landscape
- stormwater systems, lighting columns and masts, noise walls and security fences that are integral part of the highway network enabling it to function both safely and with reduced adverse environmental impacts
- intelligent transport system (ITS) structures, signs, sign gantries and traffic signals that provide traffic information to network users to enable them to optimise their journey.

This *Highway structures design guide* is a new document. It brings together the structural design information for all highway structures, providing cross references to other publications and giving new design information where necessary. The guide complements other longstanding design documents, including the agency's *Bridge manual*.

Structures technology remains an area of ongoing research and refinement. This guide will be reviewed and amended in whole or in part from time to time. Comments from practitioners are welcome.

Kevin Reid
National Manager Network Outcomes – Highways and Network Operations
NZ Transport Agency

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Contents

1.0 Introduction

1.1 Purpose and function

This *Highway structures design guide* sets out the NZ Transport Agency's (the Transport Agency's) design requirements for all permanent highway structures on the state highway network. It also sets out the Transport Agency's design requirements for earthworks, including natural slopes, embankments and cuttings.

The primary function of the *Highway structures design guide* is:

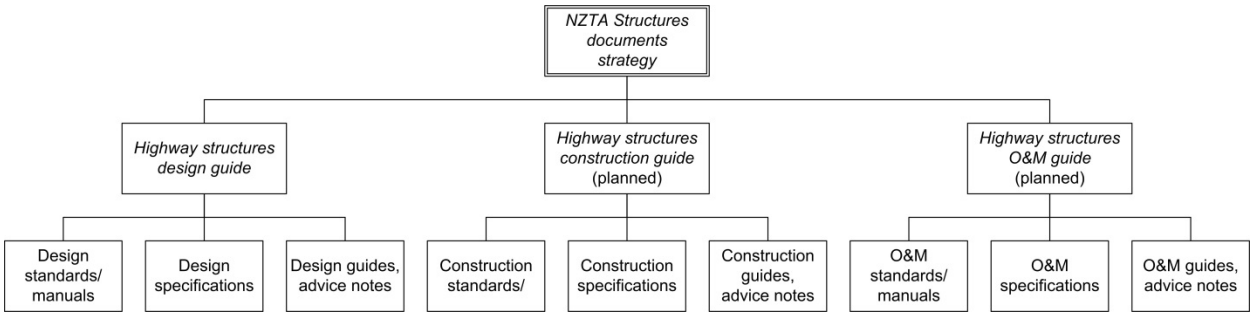
- to define design requirements for highway structures on the state highway network that are consistent with the NZ Transport Agency's primary purpose of promoting an affordable, integrated, safe, responsive and sustainable land transport system.

Secondary functions are:

- To provide design guidelines for highway structures for use by other road controlling authorities throughout the road transport network that are consistent with the NZ Transport Agency's primary purpose.
- To interpret Building Act 2004 requirements for the design of highway structures and to set out the intended means of compliance of highway structures with the *Building code*(1).
- To provide the NZ Transport Agency's design requirements for structures that are not Transport Agency owned, but are present within the state highway road reserve.

The relationship of the *Highway structures design guide* to other documents within the NZ Transport Agency structures document hierarchy is illustrated in figure 1.1.

Figure 1.1: NZ Transport Agency structures document hierarchy



1.2 Scope

The scope of the *Highway structures design guide* is as follows:

- design and construction process requirements, including requirements for structure options reports, structure design statements and technical approval, for design and construction review and for certification
- design, construction and handover documentation requirements

1.2 continued

- a summary of Building Act 2004 requirements for the design of highway structures, including *Building code*[(1)] and building consent requirements
- design requirements for new structures including design philosophy, non-structural requirements, structural design requirements and *Building code*[(1)] compliance requirements
- design requirements for alterations to existing structures
- requirements for evaluation of existing structures.

The *Highway structures design guide* provides comprehensive design requirements for the following types of road structure (including their foundations, where applicable):

- bridges carrying road and/or pedestrian/cyclist traffic, in which the main supporting members are of reinforced or prestressed concrete, structural steel, timber or aluminium utilising beam or arch action, and spanning up to 100m
- pedestrian and cyclist subways
- stock underpasses
- all culverts or multiple culverts with a total waterway area equal to or exceeding 3.4m² (major culverts)
- culverts with waterway area less than 3.4m² (minor culverts)
- retaining wall systems including gravity walls, cantilever walls, mechanically stabilised earth walls and anchored walls
- sign support structures (including those for large and overhead signs)
- intelligent transport system (ITS) equipment support structures
- lighting columns and masts
- traffic signal and speed camera poles
- roadside barriers
- noise barriers
- security and safety fences and barriers
- piped stormwater system elements
- earthworks (natural slopes, embankments and cuttings), whether associated with or separate from significant structures.

The *Highway structures design guide* provides partial design requirements for the following road structure types (remaining requirements will need to be agreed with the Transport Agency, or other road controlling authority as appropriate, on a project or structure specific basis):

- bridges constructed of materials other than those listed above and/or having spans greater than 100m
- suspension or cable-stayed bridges
- coastal and river protection works
- buildings
- tunnels
- other structures.

The *Highway structures design guide* also provides the Transport Agency's design requirements for structures that are not Transport Agency owned, but are present within the state highway road reserve.

1.3 Precedence

The Transport Agency's specific requirements for a particular project will be stated in the contract documents for that project. Where the stated requirements conflict with those of this guide, the project specific requirements shall take precedence.

1.4 Definitions

Term	Definition
Structure	A body or assemblage of bodies in space to form a system capable of supporting loads. A construction or framework of identifiable elements which give form and stability.
Highway structure	Any structure owned by the Transport Agency, within the state highway road reserve shall be considered to be a highway structure. Also referred to as a road structure.
Structural design	Designing for strength and stability, and also for serviceability and durability. By definition, a structure requires structural design. (Note that the design of other roading asset elements including earthworks and road pavements also includes aspects of structural design.)
Structural	As used in structural design. Pertaining to structural behaviour.
Design requirements for structures	All of the requirements that apply to the design of a structure, many of which derive from its function. They include, but are not limited to, the structural design requirements. Some 'design' requirements are in fact construction requirements, but because they are communicated via the construction documentation prepared during design they can be regarded as design requirements.

1.5 Categorisation of highway structures

The Transport Agency categorises highway structures for various purposes.

This *Highway structures design guide* applies to all highway structures. The *Technical approval, review and certification procedures* set out in section 2 categorise highway structures for the purpose of the procedures.

For inspection purposes, NZTA S6 *Bridges and other significant highway structures inspection policy*(2) categorises highway structures as 'bridges', meaning structures which directly support state highway traffic, and 'other significant highway structures', being other highway structures considered to be significant enough to warrant inspection under NZTA S6(2). By omission, NZTA S6(2) creates a third category of minor structures to which NZTA S6(2) does not apply, and for which inspection requirements are covered separately.

1.6 Acknowledgements

The significant assistance provided by Beca Limited in the preparation of this manual is acknowledged.

The assistance provided by Opus International Consultants Limited, the Ministry of Business, Innovation and Employment and suppliers in the review of this manual is acknowledged.

2.0 Technical approval, review and certification procedures

The design and construction of highway structures and earthworks is required by the NZ Transport Agency to comply with specific technical approval, review and certification procedures.

Technical approval procedures consist of the preparation of structure options reports and structure design statements that are submitted to the Transport Agency at distinct stages in the project cycle, and acceptance of these documents by the Transport Agency. It is intended that technical approval is complete before detailed design is commenced.

Review procedures consist of the review of designs and construction by design reviewers and construction reviewers respectively.

Certification procedures require the certification of designs, design reviews, construction and construction review by those responsible.

For the purpose of these procedures, structures and earthworks are categorised according to their level of complexity. Technical approval and review requirements vary with category.

The procedures are independent of those required to demonstrate compliance with the *Building code*(1), which are described in section 4. It is anticipated, however, that the procedures and associated documents required by the Transport Agency will assist in demonstrating *Building code*(1) compliance.

Detailed requirements for technical approval, review and certification of highway structures and earthworks are set out in appendix A.

Note that the technical approval, review and certification procedures detailed in this *Highways structures design guide* were previously contained in appendix F of the Transport Agency's *Bridge manual* 3rd edition(3) and prior to that section 1 of the *Bridge manual* 2nd edition(4).

3.0 Documentation requirements

3.1 Design documentation

3.1.1 Preliminary structure options reports, structure options reports and structure design statements

Preliminary structure options reports, structure options reports and structure design statements are required for many structures and earthworks as part of the technical approval process (see section 2 and appendix A). Requirements for these documents are given in appendix A.

The delivery of these documents shall comply with the specific project requirements.

Where the contract documentation for a project requires a project preliminary design philosophy statement, design philosophy statement and/or design report, the corresponding preliminary structure options report, structure options report or structure design statement shall be appended and need not be duplicated within the project document.

During final design, should the design deviate significantly from the form or nature of the structure or the design standards or procedure set out in the design statement, a revised design statement shall be submitted for acceptance by the Transport Agency.

For highway structures and earthworks for which the technical approval procedures outlined in section 2 and appendix A do not require a technical approval document to be submitted, the project design philosophy statement or design report need not address the structure or earthworks other than confirming that the requirements of this *Highway structures design guide* will be met or stating any proposed departures from the requirements of this guide.

3.1.2 Design calculations

At the completion of design, the design calculations and all associated design information shall be compiled in a well organised and indexed format. All information shall be recorded in a secure and readily accessible system and retained in that system for at least 10 years.

3.1.3 Resource consents, building consents and third party correspondence

Copies of resource consents, building consents, relevant third party correspondence and other relevant correspondence shall be provided to the Transport Agency when received and with the project handover documentation (see 3.3).

3.1.4 Design and design review certificates

Requirements for design and design review certificates are given in appendix A.

Copies of these certificates shall be provided to the Transport Agency when the certification takes place and also with the project handover documentation (see 3.3).

3.2 Construction documentation

3.2.1 Construction drawings

Construction drawings shall be prepared in accordance with the following requirements:

- drawings for structures shall be prepared in accordance with AS/NZS 1100.501 *Technical drawing – Structural engineering drawing*[5]
- drawings for all structures shall state the key standards adopted for the design of the structure

3.2.1 continued

- the drawing set for a significant structure shall include a list of all drawings applicable to the structure
- drawings shall incorporate accepted draughting practice and shall be completed in accordance with the appropriate design standards to an appropriate scale
- drawing sheets shall be logically sequenced and cross-referenced
- individual drawing details of similar elements shall be used in preference to the use of tables and notes, particularly for reinforcing details.

3.2.2 Construction specifications

Construction specifications shall:

- reference all relevant Transport Agency specifications and other appropriate standards with modifications as agreed with the Transport Agency
- ensure the contractor is responsible for the development, implementation and management of a quality plan in accordance with the specified Transport Agency quality specification
- specify the standards to be met by all materials used to construct the works and the construction methods and standard of workmanship required, together with all testing and inspection and records of the same required to demonstrate that the structure has been constructed in accordance with the drawings and specifications
- include construction requirements that are contained within the Transport Agency's design requirements documents (such as the *Bridge manual*[3]), as listed in this guide, unless agreed otherwise with the Transport Agency
- address any construction requirements (see below) not incorporated in the construction drawings.

3.2.3 Construction requirements to be incorporated into drawings or specifications

a. General

Construction requirements for structures in this context are those requirements or constraints that apply to the construction process that are additional to the requirement to complete the structure in accordance with the drawings and specifications. Note that sometimes construction requirements become design requirements, and if so they should be identified in the design statement.

b. Strength and stability during construction

Structures are required to comply with clause B1 of the *Building code*[1] during construction or alteration as well as when complete. Designers shall clearly convey to the constructor via the drawings and specifications the assumptions made with regard to construction sequence and methodology and the temporary works required to ensure adequate strength and stability during construction. Responsibilities for strength and stability at all stages during construction shall be clearly outlined.

c. Temporary works requirements

Where construction will involve significant temporary works (including significant excavations), the construction specifications shall clearly set out the requirements for design, checking and certification of the temporary works.

d. Continuity of service requirements

Often existing structures will be required to remain in full or partial service during construction of a new structure.

Where continuity of service requirements will affect the form and nature of the structural solution, these shall be noted in the design statement for the structure.

3.2.3 continued

Any continuity of service requirements shall be conveyed to the constructor via the construction drawings and specifications.

e. Requirements arising from statutory and other agreements

Requirements arising from statutory and other agreements, including consents granted under the Resource Management Act 1991, property agreements, landowner agreements and stakeholder agreements that apply during construction may affect construction methodologies. Any applicable requirements shall be noted in the design statement, and conveyed in the construction specifications.

f. Requirements arising from historic heritage impact assessments

Requirements arising from historic heritage impact assessments may affect construction methodologies. Any applicable requirements shall be noted in the design statement, and conveyed in the construction specifications.

3.3 Handover documentation

3.3.1 Required handover documentation

For all structures, relevant consents and certificates shall be provided at project handover, including:

- building consents and code compliance certificates (where applicable)
- design, design review, construction and construction review certificates required by section 2 and appendix A.

For minor structures, the asset owner information required by Transport Agency minimum standard Z/15 – *Asset owner's manual*[6] and professional services guideline PSG/15 – *Asset owner's manual*[7] shall be provided at project handover. This includes:

- as-built construction drawings
- design details of any proprietary structures or systems provided
- maintenance requirements
- resource consents and conditions.

For 'bridges' and 'other significant highway structures' as defined in NZTA S6[2], the following information shall be provided at project handover (note this incorporates the requirements of Z/15[6] and PSG/15[7]):

- bridge structural input forms (applies to 'bridges' only)
- descriptive input forms
- significant structure asset management information
- design statements (where required by section 2 and appendix A)
- significant structure supplementary as-built records.

Delivery of handover documentation (ie timing) shall comply with project-specific requirements.

3.3.2 As-built drawings

As-built drawings shall consist of the construction drawings, updated to reflect all significant as-built variations, including defects and their rectification.

As-built drawings shall be prepared in accordance with the Transport Agency's professional services guideline PSG/9 – *Delivery of as-built documentation*[8], and certified as being a correct record by the contactor and construction reviewer.

3.3.3 Bridge data system input forms

Structural and descriptive input forms shall be completed in accordance with the *NZ Transport Agency bridge data system (BDS) user guides*[9], and certified by the designer as being correct.

3.3.4 Significant structure asset management information

Significant structure asset management information shall be provided for all 'bridges' and 'other significant highway structures' as defined in NZTA S6[2]. It shall include all information necessary for routine management of the structure, including:

- brief description of the structure, including high-level design standards
- inspection requirements
- detailed maintenance requirements
- access provisions
- details of proprietary systems such as bridge bearings and expansion joints
- proposals for replacement of replaceable items
- specific on-going management issues
- third party correspondence and other correspondence relevant to the on-going management of the structure
- copies of relevant resource consents
- ongoing resource consent requirements including monitoring and other compliance requirements.

Significant structure asset management information shall be provided on a structure by structure basis to facilitate separation for structures management purposes. Where the information is provided as part of a project asset owner's manual, it shall be in the form of appendices to a high level document. It shall be approved for issue by the construction reviewer.

3.3.5 Design statement

Any structure design statement provided for a 'bridge' or 'other significant highway structure' during the design phase shall be reviewed at the completion of construction to confirm that it accurately reflects the completed structure, updated if necessary, approved by the designer and provided as part of the project handover documentation.

3.3.6 Significant structure supplementary as-built records

The purpose of significant structure supplementary as-built records is to provide a record that can be used by the Transport Agency in the future, in conjunction with the as-built drawings, significant structure asset management information and design statement, to reassess capacity, investigate defects, design modifications and/or retro-fits and carry out demolition.

The records shall include the following:

- methods of construction (where it impacts on completed works and is not detailed on as-built drawings)
- materials used – eg mix designs and material specifications
- material and other test results, as compiled summaries or actual test certificates, depending on the importance/relevance of the information
- construction records – eg pile installation records, post-tensioning records, grouting records, concrete pour records; may be in the form of summarised records, otherwise actual records shall be included
- as-built data – where not on as-built drawings or other handover records
- project specifications where they contain relevant information not shown on as-built drawings or in the above

3.3.6 continued

- details of significant defects and resulting remedial actions where not completely described on the as-built drawings
- any specific requirements to be considered during demolition of the structure.

The records for each structure shall be separate and where applicable shall be an appendix to the project construction report, to facilitate later separation for structures management purposes. They shall be approved for issue by the constructor and construction reviewer.

Significant structure supplementary as-built records shall be provided on a structure by structure basis to facilitate separation for structures management purposes. Where the information is provided as part of a project construction report, it shall be in the form of appendices to a high level document. The information shall be approved for issue by the construction reviewer.

3.4 Copyright and intellectual property

In general terms, the ownership of intellectual property of designs as defined in the Transport Agency's manuals SM030 *State highway professional services contract proforma manual*[10] and SM031 *State highway construction contract proforma manual*[11] (for design and construct and early contractor involvement procurement models) follows these principles:

i. All new intellectual property is jointly owned by the client and the consultant (or contractor) other than as detailed in item (iv). The two parties grant to each other an unrestricted license to copy or use such new intellectual property and each party is free to make whatever use they wish of the new intellectual property.

ii. All pre-existing intellectual property remains the property of the original owner. The two parties grant to the other license to use the relevant pre-existing intellectual property for the purpose of undertaking the works.

iii. The consultant (or contractor) confirms that in using the intellectual property (new or pre-existing) and in undertaking the works they will not infringe any intellectual property or other rights of any third party.

iv. The ownership of data and factual information collected by the consultant (or contractor) and paid for by the client will, after payment by the client, lie with the client.

Note that the requirements of the SM032 *State highway maintenance contract proforma manual*[12] Networks outcomes contract are different in that all new intellectual property that is developed, commissioned or created under or in connection with the contract will be owned by the client, unless they are not predominantly for or connected to the performance of the works but have general industry application.

Note that particular intellectual property requirements for any project will be explicitly defined in the contract procurement documentation.

4.0 Building Act 2004 and *Building code* requirements

4.1 Building Act 2004 and *Building code* compliance of highway structures

Most, if not all, highway structures are *buildings* in terms of the Building Act 2004, and for the purpose of this *Highway structures design guide* it is assumed that all highway structures are *buildings* in terms of the Act.

(For a full definition of the meaning of *building* see sections 8 and 9 of the Act. In brief, a *building* is a "temporary or permanent movable or immovable structure, (including a structure intended for occupation by people, animals, machinery or chattels)". From various references throughout the Act and the *Building code*(1) it is clear that minor structures such as fences, walls, poles, paths, tanks and culverts are considered to be *buildings*. The *Building code*(1) classifies *buildings* under seven categories. The 'ancillary' category applies to a "building or use not for human habitation and which may be exempted from some amenity provisions, but which are required to comply with structural and safety-related aspects of the *building code*". Examples given include bridges, fences, jetties, masts, paths, platforms, pylons, retaining walls, tanks, tunnels and dams. It is concluded that highway structures are 'ancillary buildings'.)

All building work (includes work for, or in connection with, the construction, alteration, demolition or removal of a *building*) is required by the Act to comply with the *Building code*(1). (Construct in this context includes to design, build, erect, prefabricate and relocate a building.) *Building code*(1) compliance is thus a requirement for the construction or alteration of all highway structures that are *buildings*, and has been assumed in this guide to be a requirement for all highway structures.

Building code(1) clauses B1 Structure and B2 Durability apply to all *buildings* and contain the primary structural requirements of the *Building code*(1).

Many *Building code*(1) clauses are clearly intended to apply to buildings in the normal sense and are not applicable to highway structures. However clause F4 Safety from falling applies to some highway structures, and clause E1 Surface water and clauses C1 to C6 Protection from fire may apply in some cases. Clause D1 Access routes is considered to be not applicable to highway structures (it covers the movement of people into, within and out of buildings and functional requirement D1.2.1 is clearly stated as not being applicable to ancillary buildings). However the *Compliance document for New Zealand building code clause D1 Access routes*(13) or parts thereof may sometimes be used to define additional requirements for a road structure, in particular approaches to footbridges and subways.

Compliance with *Building code*(1) clauses can be achieved via the MBIE (Ministry of Business, Innovation and Employment) acceptable solutions and verification methods, or via alternative solutions (see section 3.0 of the *New Zealand building code handbook*(14)).

4.1 continued

The MBIE acceptable solutions and verification methods set out accepted means of compliance with the *Building code*[1] clauses. As an example, one accepted means of compliance with clause B1 Structure described in the *Acceptable solutions and verification methods for New Zealand building code clause B1 Structure*[15] is *New Zealand building code* verification method B1/VM1[15], consisting of the use of various standards including the AS/NZS 1170 *Structural design actions* series[16], NZS 3101.1&2 *Concrete structures standard*[17],NZS 3404 *Steel structures standard*[18], NZS 3603 *Timber structures standard*[19] and AS/NZS 1664.1 *Aluminium structures*[20] together with some modifications deemed necessary by MBIE. A design which complies with the acceptable solutions and verification methods is deemed to be code compliant.

An alternative solution is a means of compliance with the performance requirements of the *Building code*[1] that differs from those offered by the acceptable solutions and verification methods. An alternative solution must achieve compliance "to the satisfaction of the building consent authority". The *Bridge manual*[3] is intended to be an alternative solution for *Building code*[1] clauses B1 and B2 for the structure types covered by the *Bridge manual*[3].

This *Highway structures design guide*s states the intended means of *Building code*[1] compliance for each structures type, for the *Building code*[1] clauses that are normally applicable to highway structures.

4.2 Building consent requirements for highway structures

Building work for some, but not all, highway structures that are buildings will require building consents (note that compliance with the *Building code*[1] is required irrespective of whether a building consent is required). Sections 41 and 42A and Schedule 1 of the Building Act 2004 (Schedule 1) list building work exempt from requiring a building consent.

Table 4.1 sets out current understanding of which highway structures require building consents for 'building work', together with the basis for exemption, where applicable. Exemptions noted refer to Schedule 1.

Note that repairs and maintenance for all buildings are generally exempt under exemption 1 of Schedule 1. Replacement of components and assemblies is also generally exempt, but not complete or substantial replacement of any component or assembly contributing to the building's structural behaviour.

Design Statements shall note whether a building consent is considered to be required.

Work that requires a building consent should subsequently receive a code compliance certificate. Work that does not require a building consent will not receive a code compliance certificate.

Included in the Schedule 1 exemptions is exemption 2, which allows a territorial or regional authority to exempt building work from the requirement to obtain a building consent if the authority considers that a consent "is not necessary for the purposes of the Act", because either the work is "likely to comply with the building code" or "if the completed work does not comply with the building code, it is unlikely to endanger people or any building". The Transport Agency project manager and the designer should consider whether the work in question may qualify for exemption 2, and if so, discuss this with the consenting authority.

Table 4.1: Current understanding of building consent requirements

Structure type	Current understanding of building consent requirements
Bridges for road traffic, pedestrians and cyclists (also decks, platforms and boardwalks etc)	Required - except where it is not possible for a person to fall more than 1.5m even if the bridge collapses (exemption 24).
Pedestrian/cyclist subways or stock underpasses	Required
Culverts	Most 'major culverts' (waterway area greater than or equal to 3.4 m^2) will require a building consent. It should be assumed a consent is required unless agreed otherwise with the Transport Agency. Most 'minor culverts' (waterway area less than 3.4 m^2) will not require a building consent (exempt under exemption 29 – simple structure owned or controlled by a NUO or other similar organisation). Note that sometimes the headwalls and wingwalls associated with a culvert may require a building consent (see requirements for retaining walls above).
Retaining walls (including seawalls)	Required - except where wall retains not more than 1.5m and does not support any surcharge (exemption 20), or where wall is in a rural zone, retains not more than 3.0m, is more than its own height from boundary or building and is designed or reviewed by a chartered professional engineer (exemption 41).
Earthworks	Not required
Rockfall and debris control structures	Required
Piped stormwater system elements (pipes, manholes, chambers)	Exempt under exemption 29 – simple structure owned or controlled by a NUO or other similar organisation.
Signs and sign supports	Exempt under exemption 25 if the sign surface area does not exceed 6 m^2 and the sign does not exceed 3m in height above the supporting ground level or exemption 39 if the sign has been designed or reviewed by a chartered professional engineer. Otherwise required.
Height restriction gantries	Exempt under exemption 26
Lighting supports (all heights)	Exempt under exemption 29 – simple structure owned or controlled by a NUO or other similar organisation.
Masts for traffic signals, speed cameras, CCTV etc	Exempt under exemption 29 – simple structure owned or controlled by a NUO or other similar organisation.
Roadside or median traffic barriers	Exempt under exemption 29 – simple structure owned or controlled by a NUO or other similar organisation.
Walls (free-standing) – including noise barriers	Required
Fences and hoardings	Exempt (exemption 21) if height does not exceed 2.5m above the supporting ground. Otherwise required.
Buildings	Required
Road tunnels	Required
Other	As given by Schedule 1

4.3 Building Act 2004 requirements for alterations to highway structures

Section 112 of the Building Act 2004 requires that a building consent must not be granted for an alteration (includes rebuilding, repair, enlargement and extension) of an existing *building* (or part of a *building)* unless the consent authority is satisfied that after the alteration, the *building* will:

a. comply as nearly as is reasonably practicable with *Building code*[(1)] provisions that relate to means of escape from fire and access and facilities for persons with disabilities; and

b. either:

   i. if it complied with the other provisions of the *Building code*[(1)], it will continue to comply with those provisions; or

   ii. if it did not comply with the other provisions of the *Building code*[(1)], it will continue to comply to at least the same extent as before the alteration.

For most highway structures, only (b) above will be relevant. This means that a road structure can be extended or upgraded without triggering a requirement for the existing structure to be upgraded to new structure standards. (A common interpretation is that the new portion of an extended structure is required to meet new structure standards).

4.4 Building Act 2004 requirements for earthquake-prone structures

Section 122 of the Building Act 2004 states that a *building* is earthquake-prone for the purpose of the Act if, having regard to its condition and the ground on which it is built, and because of its construction, the *building*:

a. will have its ultimate capacity exceeded in a moderate earthquake (defined in regulations as an earthquake that would generate shaking at the site that is of the same duration, but one-third as strong as the shaking that would be used to design a new *building* at that site); and

b. would be likely to collapse causing injury or death to persons in the building or to persons on any other property, or damage to any other property.

Territorial authorities have powers under Section 124 of the Act, if satisfied that a building is earthquake-prone, to prevent people from approaching the building and require work to be carried out to reduce or remove the danger.

The Act does not explicitly state requirements that apply if a building that is to be altered proves to be earthquake prone – for example, whether earthquake strengthening can be required as a condition of a building consent, and if so, to what standard. It is understood that a common interpretation is that earthquake strengthening is not automatically triggered by alteration, even if the building is earthquake prone.

Note that at the time of writing of this *Highway structures design guide*, the Building (Earthquake-prone Buildings) Amendment Bill is before parliament seeking to amend the Building Act 2004 with reference to earthquake-prone buildings. It is proposed in the Bill that a new section 133AA is to be added to clause 23 of the Building Act 2004 to exclude various structures from the earthquake prone provisions of the Act, including bridges, tunnels, retaining walls that are not integral to the structure of a building and fences.

5.0 Design requirements for new highway structures

5.1 General design requirements applicable to all structure types

5.1.1 Urban design and landscape requirements

The Transport Agency's policy and guidance for urban and landscape design for highway projects are set out in the following documents:

- *Bridging the gap: Urban design guidelines*[21]
- *Landscape guidelines*[22]

These documents describe the urban and landscape design process to be followed for highway projects, including the development of urban and landscape design frameworks for urban projects and large or complex projects. They also provide specific guidance on the urban and landscape design associated with many types of highway structure.

The design of highway structures shall be integrated with the urban and landscape design of the project, and shall be informed by the specific guidance provided in the above documents.

For some types of structures, further requirements are described in the following sub-sections of this document and the documents referenced therein. For bridges, urban design requirements including process requirements are set out in the *Bridge manual*[3].

5.1.2 Heritage requirements

An assessment of the need for specific heritage, cultural and archaeological considerations shall be undertaken as part of any project planning. Guidance is provided in the Transport Agency's *Historic heritage impact assessment guide for state highway projects*[23].

Avoiding or minimising the loss of cultural and historic heritage may influence the design and construction of highway structures.

5.1.3 Requirements arising from statutory and other agreements

Design and construction requirements for highway structures may arise from statutory and other agreements, including consents, property agreements, landowner agreements and stakeholder agreements.

Such requirements shall be included in the design statement for the structure, where applicable.

5.1.4 Safety in design

The Transport Agency's ZH/MS/01 *Safety in design minimum standard for road projects*[24] shall be adopted for the safety in design processes to be utilised on state highway projects. The processes may result in additional or modified design requirements for highway structures.

5.1.5 Inspection and maintenance requirements

For all types of highway structure, consideration shall be given during the design process to safe access to the structure for inspection and maintenance. The intended access shall be described in the structure design statement, where applicable. Refer also to section 2.1.9 of the *Bridge manual*[3].

Additionally, consideration shall be given to how structures affect access for maintenance of other components of the highway asset, including landscaping.

5.1.6 Requirements for supplier design components

Some components of highway structures may be designed by the supplier. Some examples are bridge bearings and expansion joints, precast concrete pipes and rectangular culvert units and lighting poles.

5.1.6 continued

The design requirements for supplier designed components shall be clearly described by the primary designer in the project drawings and specification. It shall be the responsibility of the primary designer to ensure that the design requirements are consistent with the overall project and structure design requirements, to clearly demarcate the design responsibilities and describe the design interfaces and to ensure that the technical approval and certification procedures of section 2 are fulfilled.

5.1.7 Anti-graffiti measures

The requirements for anti-graffiti finish set out in clause 4.12.9 of the *Bridge manual*[3] shall apply to all highway structures except those listed below:

- stock underpasses
- culvert interiors
- fences constructed of mesh

Other graffiti deterrence or prevention measures should also be considered. These include design of structures to prevent unauthorised access, using planting to shield structures and the use of textured surfaces.

5.1.8 Asset identification signs

Requirements for asset identification signs are set out in SM051 *Location referencing management system (LRMS) manual*[25].

Bridges, major culverts, tunnels, stock underpasses and subways are to be given bridge structure number (BSN) signs.

Minor culverts shall be provided with culvert markers.

5.1.9 Design requirements for structures during construction

The NZ Transport Agency's primary purpose of promoting an affordable, integrated, safe, responsive and sustainable land transport system applies to all of the Transport Agency's activities including construction.

Structures are required to comply with Clause B1 of the *Building code*[1] (see previous section) during construction or alteration as well as when complete.

For all structures, consideration shall be given by the designer to the strength and stability of the incomplete structure at various stages during construction and the design events to be considered during construction.

As a minimum, the requirements of AS/NZS 1170.0[16] to design for wind and earthquake loads with an annual probability of exceedance (APOE) of 1/100 shall apply, together with design for construction live loads and the loads imposed by construction equipment.

Where construction is to take place adjacent to or over areas accessible by the public, such as operating carriageways, or adjacent to other property, design for lower APOE (higher return periods) may be appropriate.

Additional requirements for specific structure types may be stated in the documents referred to in the following sub-sections.

The structure design statement, where required, shall propose the standards to apply during construction, and whether the resulting loads are to be resisted by the incomplete structure, or by temporary works, or both.

Designers shall clearly convey to the constructor via the drawings and specifications the assumptions made with regard to construction sequence and methodology and the temporary works required to ensure adequate strength and stability during construction. Responsibilities for strength and stability at all stages during construction shall be clearly outlined.

5.2 Bridges

This section covers bridges carrying road and/or pedestrian/cyclist traffic, in which the main supporting members are of reinforced or prestressed concrete, structural steel, timber or aluminium utilising beam or arch action, and spanning up to 100m. It also covers associated retaining structures and safety barrier systems.

5.2.1 Design philosophy and non-structural design requirements

These are set out in section 2 of the *Bridge manual*[3].

5.2.2 Structural design requirements

These are set out in the *Bridge manual*[3].

5.2.3 *Building code* compliance

Building code[1] compliance is required and intended to be achieved as follows:

- Clause B1 Structure – via *Bridge manual*[3] as an alternative solution
- Clause B2 Durability – via *Bridge manual*[3] as an alternative solution
- Clause F4 Safety from falling – via MBIE acceptable solutions and verification methods and/or the *Bridge manual*[3] as an alternative solution. (The *Bridge manual*[3] contains requirements for barriers for footpaths and cycleways that refer to *New Zealand building code* acceptable solution F4/AS1[26]. For situations where people may be occasionally be present the *Bridge manual*[3] presents some alternative solutions, and thus is an alternative solution).

Where compliance with other *Building code*[1] clauses is judged to be necessary, this shall be stated in the structure design statement and a means of compliance proposed.

5.3 Non-typical bridges

This section provides partial design requirements for road and/or pedestrian/cyclist bridges in which the main supporting members are of materials other than reinforced or prestressed concrete, structural steel, timber or aluminium, and/or utilise other than beam or arch action, and/or span more than 100m.

Remaining requirements will need to be agreed with the Transport Agency on a project or structure specific basis.

5.3.1 Design philosophy and non-structural design requirements

These are as for typical bridges and are set out in section 2 of the *Bridge manual*[3].

5.3.2 Structural design requirements

Structural design requirements shall be stated in the structure design statement and agreed with the Transport Agency. To the extent appropriate, the requirements shall follow those contained in the *Bridge manual*[3].

5.3.3 *Building code* compliance

The proposed means of compliance with clauses B1, B2 and F4 and other *Building code*[1] clauses as judged to be necessary shall be stated in the structure design statement for agreement with the Transport Agency.

5.4 Subways

This section covers subways for pedestrians and cyclists and associated ramps, headwalls and wingwalls. It does not cover requirements for subways for equestrians and for operations and maintenance personnel; requirements for these structure types shall be agreed with the Transport Agency, noting that many of the requirements can be expected to be similar to those set out below.

5.4.1 Design philosophy and non-structural design requirements

Design philosophy (including design working life and importance level) shall be as given in section 2.1 of the *Bridge manual*[3] for a bridge on the same route.

The design of subways for pedestrians and cyclists shall follow the guidance given in:

- the Transport Agency's *Bridging the gap: Urban Design Guidelines*[21]
- the Austroads *Guide to road design* part 6A Pedestrian and cyclist paths[27].

The former shall take precedence where a conflict exists.

a. Design for use by people with disabilities

   Subways should normally be designed to be suitable for use by people with disabilities. The requirements of the *New Zealand building code* acceptable solution D1/AS1[13] shall apply to gradients, landings, surface finish and handrails for both ramps and nominally level sections. Exceptions should be specifically agreed with the Transport Agency. Where stairs are to be provided in addition to access suitable for use by people with disabilities, the requirements for common stairs contained in *New Zealand building code* acceptable solution D1/AS1[13] shall apply.

b. Cover and backfill material

   Subways shall desirably be provided with a minimum cover of 600mm. In cases where this results in unacceptable approach geometry and extent, the cover may be reduced, with specific provision made for services and measures to reduce pavement cracking and settlement at the road/structure interface including the provision of settlement slabs unless they can be demonstrated to not be necessary.

   Where the cover is 1.5m or less, subbase material (as per TNZ M/3 *Subbase aggregate*[28] or similar approved) should be used as backfill above the subway up to pavement subgrade level. In situations where the cover is greater than 1.5m bulk fill may be used as backfill material provided it meets the requirements as outlined in TNZ F/1 *Specification for earthworks construction*[29].

c. Length and safety barriers

   The length of a subway as a minimum shall allow for the full width of the traffic lanes and shoulders required for a road carrying the expected AADT 30 years ahead unless otherwise agreed by the Transport Agency, plus the road safety barriers required to protect road users from the hazard presented by the subway approaches. Where mowable batters are present, provision should be made where practicable for 3.0m wide off-carriageway access for maintenance vehicles. Where the presence of the subway results in the need for barriers that would not otherwise be present, consideration should be given to the possibility of extending the subway to run from boundary to boundary of the state highway to minimise the resulting hazard.

5.4.1 continued

Safety barriers must be provided to protect road users from any hazards created as a result of the subway and associated works (ie drop-offs created by the subway approaches) in accordance with the requirements of the Austroads *Guide to road design* part 6 Roadside design, safety and barriers[30]. Any safety barriers provided are to be in accordance with NZTA M23 *Specification for road safety barrier systems*[31] (or the *Bridge manual*[3] as appropriate) and must consider the effect on required road sight distances. Bridge hazard markers are to be installed either side of the subway in accordance with the *Manual of traffic signs and markings* part 2 Markings section 5 Delineation and hazard markers[32].

For security and safety fencing on headwalls and wingwalls, refer to 5.19.

d. Drainage and watertightness

Subways shall be watertight as required to suit any internal finishes to be applied and to the extent that no running water, dripping or weeping of water, beading of water or significant visible damp patches are apparent on the roof, walls and floor.

Drainage and suitable falls shall be provided so that no ponding of water can occur on the subway floor. Drainage shall be by gravity if at all possible. The design and detailing of the drainage system including pipes, sumps and pumps if required, shall be such as to facilitate easy inspection and maintenance.

5.4.2 Structural design requirements

Structural design requirements for both the subway and associated earth retaining structures and ramps are as set out in the *Bridge manual*[3].

5.4.3 *Building code* compliance

Building code[1] compliance is required and intended to be achieved as follows:

- Clause B1 Structure – via *Bridge manual*[3] as an alternative solution
- Clause B2 Durability – via *Bridge manual*[3] as an alternative solution

Where compliance with other *Building code*[1] clauses is judged to be necessary, this shall be stated in the structure design statement and a means of compliance proposed.

5.5 Stock underpasses

This section covers stock underpasses.

Reference should be made to the templates for stock underpass construction agreements and stock underpass use agreements contained within the *State highway control manual*[33].

5.5.1 Design philosophy and non-structural design requirements

This section provides guidance on requirements in key areas.

a. Design life and importance level

The design working life of the stock underpass structure and associated structures within the road reserve (including retaining structures for approach ramps) shall be in accordance with the *Bridge manual*[3] – ie 100 years.

The importance level of the stock underpass and associated walls shall be as specified for bridges in table 2.1 of the *Bridge manual*[3].

5.5.1 continued

b. Location

The stock underpass is to be located at least 20m from any road intersection or pedestrian crossing point. The 20m shall be measured from the side road tangent point on the state highway to the closest point of the underpass structure within the road reserve. A minimum separation of 50m should be achieved from any existing structures (such as bridges and culverts).

Consideration should be given to seasonal ground water levels in the area and locations with high groundwater with no gravity outfall should be avoided. Locations at the bottom of hills and gullies where the stock underpass may be required to act as a stormwater culvert should be avoided.

In the event site constraints result in the above requirements not being met the Transport Agency will consider specific locations on a case by case basis.

c. Alignment

Any new stock underpasses are to be aligned as close as practicable to 90° to the centreline of the highway and may not be installed at an angle less than 45°.

d. Cover

Cover of at least 600mm from the top of the underpass structure to the finished road level at all points along the stock underpass is recommended. Additional cover shall be provided where necessary to accommodate existing utility services, future services where there is a policy or agreement to do so and existing or planned longitudinal stormwater drainage.

Reduced cover may be considered where the existing road is made up of a rigid pavement or site constraints restrict the depth at which the stock underpass can be installed.

Where the specified cover is less than 600mm the designer must provide an alternative pavement design and measures to reduce pavement cracking and settlement at the road/structure interface including the provision of settlement slabs unless they can be demonstrated to not be necessary.

e. Backfill material

Where the cover is 1.5m or less subbase material (as per TNZ M/3[28] or similar approved) should be used as backfill above the stock underpass up to pavement subgrade level. In situations where the cover is greater than 1.5m bulk fill may be used as backfill material provided it meets the requirements as outlined in TNZ F/1[29].

f. Grade

The stock underpass is to be installed at a longitudinal grade of at least 0.25% to prevent stormwater and effluent ponding within the structure. If the proposed grade is greater than 10% the designer must provide adequate mitigation against movement of the overlying fill material in the down-slope direction along the length of the underpass structure. However it should be noted a longitudinal grade this steep is unlikely to be suitable for use by stock and vehicles.

5.5.1 continued

g. Length

The minimum length of a stock underpass installed under a state highway is 17m. The length provided must allow for the proposed road carriageway (traffic lanes and shoulders), footpaths, cycle paths and equestrian paths where present, 3.0m off-road maintenance access beyond the edge of seal on both sides of the road and road safety barriers where required. Consideration shall be given to extending the stock underpass to run from boundary to boundary of the state highway to maximise safety performance, noting that this may avoid the need for barriers.

h. Drainage

Drainage sufficient to drain the stock underpass shall be provided to prevent creating a water hazard within or adjacent to the road reserve. Consideration should be given to treatment requirements of any stormwater discharge as any runoff entering the structure will be mixed with effluent and sediment.

Drainage shall be by gravity if at all possible. The design and detailing of the drainage system including pipes, sumps and pumps if required, shall be such as to facilitate easy inspection and maintenance and to be durable.

Adequate protection shall be provided to prevent scour on any earthworks batters that support the road or other infrastructure within the road reserve.

i. Utility services

Any new stock underpass must accommodate any existing utility services present within the extent of works. Approval shall be obtained from the relevant services owners for any diversions or changes to their service and to make sure they are adequately protected during construction. Provision shall be made for future utility services where there is a policy or agreement to do so.

j. Road safety barriers and hazard markers

Safety barriers must be provided to protect road users from any hazards created as a result of the stock underpass and associated works (ie drop-offs created by the underpass approaches) in accordance with the requirements of the Austroads *Guide to road design* part 6[30]. Any safety barriers provided are to be in accordance with NZTA M23[31] (or the *Bridge manual*[3] as appropriate) and must consider the effect on required road sight distances. Bridge hazard markers are to be installed either side of the stock underpass in accordance with the *Manual of traffic signs and markings* part 2 section 5[32].

k. Fencing

For security and safety fencing on headwalls and wingwalls, refer to 5.19.

Suitable stock-proof fencing (in accordance with 5.19) should be installed to control stock movement when entering and leaving the stock underpass and prevent stock accessing the roadside. Any fencing within the road reserve should be installed behind barriers or constructed with frangible posts.

5.5.2 Structural design requirements

Structural design requirements for the stock underpass and for associated earth retaining structures are set out in the *Bridge manual*[3].

Stock underpasses shall be detailed to address the durability issues posed by the presence of stock effluent. Steel underpass structures shall have a watertight concrete invert or alternative durability measures. Reinforced concrete exposed to stock effluent shall be detailed for a minimum exposure classification for durability purposes of *Building code*[1] clause B2.

Precast concrete units making up a stock underpass shall be robustly connected to ensure the structure remains intact in the event of ground settlement over the life of the structure.

The potential for flotation of the stock underpass shall be considered.

5.5.3 *Building code* compliance

Building code[1] compliance is required and intended to be achieved as follows:

- Clause B1 Structure – via *Bridge manual*[3] as an alternative solution
- Clause B2 Durability – via *Bridge manual*[3] as an alternative solution

Where compliance with other *Building code*[1] clauses is judged to be necessary, this shall be stated in the structure design statement and a means of compliance proposed.

5.6 Major culverts

This section covers all culverts or multiple culverts with a total waterway area equal to or exceeding 3.4m², including associated headwalls and wingwalls and safety barrier systems.

5.6.1 Design philosophy and non-structural design requirements

These are set out in section 2 of the *Bridge manual*[3].

5.6.2 Structural design requirements

These are set out in the *Bridge manual*[3].

5.6.3 *Building code* compliance

Building code[1] compliance is required and intended to be achieved as follows:

- Clause B1 Structure – via *Bridge manual*[3] as an alternative solution
- Clause B2 Durability – via *Bridge manual*[3] as an alternative solution
- Clause F4 Safety from falling – via MBIE acceptable solutions and verification methods and/or the *Bridge manual*[3] as an alternative solution. (The *Bridge manual*[3] contains requirements for barriers for footpaths and cycleways that refer to *New Zealand building code* acceptable solution F4/AS1[26]. For situations where people may be occasionally be present the *Bridge manual*[3] presents some alternative solutions, and thus is an alternative solution.)

Where compliance with other *Building code*[1] clauses is judged to be necessary, this shall be stated in the structure design statement and a means of compliance proposed.

5.7 Retaining walls

This section includes gravity walls, cantilever walls, mechanically stabilised earth walls and anchored walls.

It also covers associated safety barrier systems.

5.7.1 Design philosophy and non-structural design requirements

These are set out in section 2 of the *Bridge manual*[3].

5.7.2 Structural design requirements

These are set out in the *Bridge manual*[3].

5.7.3 *Building code* compliance

Building code[1] compliance is required and intended to be achieved as follows:

- Clause B1 Structure – via *Bridge manual*[3] as an alternative solution
- Clause B2 Durability – via *Bridge manual*[3] as an alternative solution
- Clause F4 Safety from falling – via MBIE acceptable solutions and verification methods and/or the *Bridge manual*[3] as an alternative solution. (The *Bridge manual*[3] contains requirements for barriers for footpaths and cycleways that refer to *New Zealand building code* acceptable solution F4/AS1[26]. For situations where people may be occasionally be present the *Bridge manual*[3] presents some alternative solutions, and thus is an alternative solution).

Where compliance with other *Building code*[1] clauses is judged to be necessary, this shall be stated in the structure design statement and a means of compliance proposed.

5.8 Coastal and river erosion protection works

This section provides partial design guidance for the design of erosion protection works to structures and embankments supporting state highways which are subject to potential erosion effects from sea and river action. This guidance and any further requirements shall be confirmed by the Transport Agency on a project or site specific basis.

This section includes protection works such as revetment armouring (eg rock rip rap, gabions, mattresses, tetrapods), retards, groynes, guidebanks and other armouring devices and training works. It does not include walls or similar structures, but may include protection works to such structures. Erosion protection works are not structures, but are addressed in this guide due to the significance of their performance for the roading network and for adjacent structures.

Coastal and river erosion protection works will generally require a resource consent. An integrated design approach is therefore sought, as works within coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins are subject to a high level of environmental regulation. The design shall reflect requirements under the Resource Management Act and the NZ Coastal Policy Statement, to avoid, remedy or mitigate adverse effects.

5.8.1 Design philosophy and non-structural design requirements

The design philosophy and design requirements shall generally follow the principles outlined in section 2 of the *Bridge manual*[3] for slopes, including in particular the basis of design set out in clause 2.1.3. However as the *Bridge manual*[3] does not specifically address the particular requirements of coastal and river protection works, consideration shall be given to any additional requirements considered necessary and an integrated design approach is sought due to a high level of environmental regulation.

Design for climate change effects shall be in general accordance with clause 2.3.2(c) of the *Bridge manual*[3].

a. River erosion protection works

   The design of river erosion protection works shall generally comply with the guidance provided in *Bridge scour*[34].

   Where the use of gabions or reno mattresses are proposed to be used as scour protection works, the design shall comply with the design procedure given in appendix F of *Countermeasures to protect bridge piers from scour*[35].

   An additional reference is *Bridge scour and stream instability countermeasures*[36].

b. Coastal erosion protection works

   The following effects shall be considered and the specific requirements agreed with the Transport Agency:

   - the effects of storm surges on high tide levels
   - the combined effects of storm surge, high tides and fluvial flooding
   - tsunami effects in areas considered to be vulnerable to tsunami.

   For sheltered coastal conditions (for example a harbour), design wave heights, periods and wave climate can be estimated using the *Coastal engineering manual*[37]. For exposed or complex coastal environments (such as the ocean), a site specific study of wave climate shall be undertaken.

   For the design of coastal protection works, guidance given in the following may be adopted:

   - *The rock manual – The use of rock in hydraulic engineering*[38]
   - *Coastal engineering manual*[37].

5.8.2 Structural design requirements

Not applicable.

5.8.3 *Building code* compliance

Not applicable, except when associated with structures, in which case refer to the requirements for the structure.

5.9 Earthworks

This section covers the stability of slopes, embankments and cuttings, being included in the definition of 'soil structures' in the *Bridge manual*[3] and are included due to the significance of their performance for the roading network and for adjacent structures.

5.9.1 Design philosophy

This is set out in sections 2 and 6 of the *Bridge manual*[3].

5.9.2 Structural (stability) design requirements

These are set out in section 6 of the *Bridge manual*[3].

5.9.3 *Building code* compliance

Not applicable, except when associated with structures, in which case refer to the requirements for the structure.

5.10 Rockfall and slope debris control structures

This section gives partial design requirements for structures intended to prevent rocks and other slope debris from encroaching onto carriageways.

5.10.1 Design philosophy and non-structural design requirements

The design philosophy and non-structural design requirements shall be specifically agreed with the Transport Agency and shall generally follow the principles outlined in *Technical guideline for rockfall protection structures*[39] and *Rockfall: Design considerations for passive protection structures*[40] in relation to passive rockfall protection structures.

For the use of concrete barriers to detain rockfall and slope debris, the requirements of TAN 15-14 *Concrete barriers used to temporarily detain rockfall and slope debris*[41] shall be adopted.

5.10.2 Structural design requirements

To be specifically agreed with the Transport Agency including design working life.

General guidance is available in *Technical guideline for rockfall protection structures*[39].

Anchors and rock bolts shall comply with the requirements of section 6.6.6 of the *Bridge manual*[3].

5.10.3 *Building code* compliance

Compliance with all applicable clauses of the *Building code*[1] is required.

Compliance will normally be achieved via alternative solutions. Guidance can be found in appendix A - Regulatory considerations of *Rockfall: Design considerations for passive protection structures*[40].

5.11 Minor culverts

This section covers all culverts or multiple culverts with a total waterway area less than 3.4 m² and their associated headwalls and wingwalls.

5.11.1 Design philosophy and non-structural design requirements

Refer to NZTA P46 *NZ Transport Agency state highway stormwater specification*[42] for design philosophy and non-structural design requirements for minor culverts and their associated headwalls and wingwalls.

(Note that additional design guidance to supplement the requirements of NZTA P46[42] is under development and will be added to this guide as a future amendment.)

5.11.2 Structural design requirements

The structural design of reinforced concrete and corrugated metal pipe culverts shall be in accordance with section 4.10 of the *Bridge manual*[3].

Pipes shall be constructed of one of the materials listed in NZTA F3 *Specification for pipe culvert construction*[43]. The use of alternative materials requires the specific agreement of the Transport Agency.

For concrete pipes produced to AS/NZS 4058 *Precast concrete pipes (pressure and non-pressure)*[44], the term "service life" may be considered to be equivalent to design working life.

The structural design of pipe culverts made of other materials listed in NZTA F3[43] shall be in accordance with AS/NZS 2566.1 *Buried flexible pipelines* part 1 Structural design[45].

Culvert headwalls and wingwalls shall be designed as retaining walls in accordance with the *Bridge manual*[3]. Importance level for the walls shall be the greater of that determined for the culvert or that determined from table 2.2 of the *Bridge manual*[3]. For importance level 1 and 2 walls, the design working life may be reduced to 50 years with the specific agreement of the Transport Agency.

Pipe culvert construction shall be in accordance with NZTA F3[43].

5.11.3 *Building code* compliance

Building code[1] compliance is required and intended to be achieved as follows:

- Clause B1 Structure:
  a. for pipes made of reinforced concrete and corrugated metal, and for headwalls – via the *Bridge manual*[3] and its referenced standards as an alternative solution
  b. for pipes made of other materials listed in NZTA F3[43] – via the standards referenced in NZTA F3[43] as an alternative solution (noting that the same standards are referenced by *New Zealand building code* acceptable solution B1/AS1[15]).
- Clause B2 Durability:
  a. for pipes made of reinforced concrete and corrugated metal and for headwalls – via the *Bridge manual*[3] and its referenced standards as an Alternative Solution.
  b. for pipes made of other materials listed in NZTA F3[43] – via the standards referenced in NZTA F3[43] for those materials, as an alternative solution.

5.12 Stormwater systems

This section covers structural elements of piped stormwater systems including pipes, manholes, cesspits, associated grates and covers. It does not cover stormwater systems on bridges, which are covered in the *Bridge manual*[3] (clause 4.12.3).

5.12.1 Design philosophy and non-structural design requirements

a. General

Refer to NZTA P46 *NZ Transport Agency state highway stormwater specification*[42] for design philosophy and non-structural design requirements for stormwater systems.

(Note that additional design guidance to supplement the requirements of NZTA P46[42] is under development and will be added to this guide as a future amendment.)

b. Subsoil drainage

Subsoil drainage shall be provided in accordance with NZTA F2 *Pipe subsoil drain construction*[46], at all locations where the finished pavement is below the adjacent ground level (refer to section 8 of the Austroads *Guide to road design* part 5A Drainage – road surface, networks, basins and subsurface[47] for further guidance). The ground level shall be classified as the higher of the existing or the future level. Subsoil drainage shall also be provided at all other locations including embankment situations unless the granular pavement layer is 'day-lighted' (ie a pavement with a feathered edge).

Subsoil drainage shall be designed and constructed to ensure that pavement materials (stabilised subgrade, sub-base and base course) remain unsaturated, ie the ground water table shall remain below the base of the stabilised subgrade. Subsoil drains shall be designed and constructed to prevent clogging for the duration of the pavement design life.

The maximum subsoil pipe run shall be 90m and shall terminate at a stormwater management structure. Acceptable stormwater management structures shall generally include manholes, sumps and culvert headwalls only. Where the discharge must be at the side of an embankment, the outlet shall be protected with a concrete surround, and fitted with a vermin grill.

At the upstream end of each run of pavement subsoil drain a rodding and/or flushing point shall be installed to allow flushing/rodding of each run of pavement subsoil drain.

All subsoil drains and all flushing/rodding points shall be recorded and as-built records drawn and electronically recorded.

Swale subsoil drains shall have a designed backfill that assists in the prevention of long-term clogging and shall be geotextile wrapped.

5.12.2 Structural design requirements

For pipe elements of stormwater systems under carriageways, including shoulders and adjacent areas accessible to permitted overweight vehicles, structural design requirements shall be as for minor culverts (see 5.11.2). For pipe elements in areas not accessible to permitted overweight vehicles, structural design requirements shall be as for minor culverts except that overload traffic loading (HO-72) need not be considered.

Grates and covers on cesspits and manholes in carriageways including shoulders and adjacent areas accessible to heavy vehicles shall be Class D (heavy duty) to AS 3996 *Access covers and grates*[48].

5.12.2 continued

Manhole and cesspit elements (excluding grates and covers) in carriageways including shoulders and adjacent areas accessible to permitted overweight vehicles shall be demonstrated by the supplier to be adequate for the normal and overload traffic (HN-HO-72) design loading set out in the *Bridge manual*[3]. This shall include both vertical loads and horizontal soil pressures, including those generated by vehicle wheel loads. Specific design shall be in accordance with the *Bridge manual*[3] and referenced standards, unless specifically agreed otherwise with the Transport Agency. Testing of manhole components in accordance with AS 4198 *Precast concrete access chambers for sewerage applications*[49] using Class D loading from AS 3996[48] will be accepted as a means of demonstrating adequacy for vertical loading.

Manhole and cesspit elements (excluding grates and covers) in areas outside carriageways accessible to heavy vehicles, but not permitted overweight vehicles, shall be demonstrated by the supplier to be adequate for the normal traffic loading (HN-72) set out in the *Bridge manual*[3].

Durability for concrete elements shall be established in accordance with NZS 3101[17] or AS/NZS 4058[44]. Durability for manholes constructed of other materials shall be established by a means agreed with the Transport Agency.

5.12.3 *Building code* compliance

Building code[1] compliance is required.

Compliance for pipe elements of stormwater systems is intended to be achieved as for minor culverts.

For other elements compliance is intended to be achieved as follows:

- Clause B1 Structure – via the *Bridge manual*[3] and its referenced standards or AS 3996[48] or AS 4198[49] as an alternative solution
- Clause B2 Durability – via the *Bridge manual*[3] and its referenced standards or AS 3996[48] as an alternative solution.

5.13 Signs and sign support structures

This section covers the design of signs, supports and foundations for overhead signs and large and small roadside signs. The design of ITS equipment and associated support structures is covered separately in 5.14.

5.13.1 Design philosophy and non-structural design requirements

Refer TNZ P/24 *Performance based specification for traffic signs*[50] for philosophy and non-structural design requirements for signs, their supports and their foundations.

In accordance with TNZ P/24[50]:

- signs, supports and foundations for overhead signs shall be designed for a 50 year life with an importance level of 2
- signs, supports and foundations for large roadside signs (signs with face area greater than 4.7m² shall be designed for a 25 year life with an importance level of 2
- signs, supports and foundations for small roadside signs (signs with face area less than or equal to 4.7m²) shall be designed for a 10 year life with an importance level of 1.

The Road Safety Manufacturers Association *RSMA compliance standard for traffic signs*[51] is an approved means of compliance with TNZ P/24[50]. This document includes post and foundation selection charts for small signs.

For requirements for electronic warning signs refer NZTA P32 *Specification for electronic warning signs on state highways*[52]. For sign supports and foundations this document refers to TNZ P/24[50] and the *RSMA compliance standard for traffic signs*[51].

All signs mounted above carriageways shall provide a vertical clearance between underside of sign and road surfacing of 6.0m, with appropriate provision for overlays and foundation settlement (typically 100mm). Vertical clearance of 6.2m shall be provided to primary structural elements of sign support structures.

5.13.2 Structural design requirements

Structural design shall comply with TNZ P/24[50] and the *Acceptable solutions and verification methods for New Zealand building code clause B1 Structure*[15] and *clause B2 Durability*[53].

The design of sign supports shall include design for the effects of fatigue.

Corrosion protection for sign supports shall provide a time to first maintenance of the design working life or 25 years, whichever is the lesser.

Thermal metal spray systems shall be seal coated as recommended in AS/NZS 2312[54].

Unless agreed otherwise with the Agency, portal type sign gantries shall be designed for the greater of the initial sign coverage or sign coverage of 80% of the carriageway width.

Serviceability limit state deflections of sign support structures under wind load shall not exceed h/20 at the top of the sign.

Where a sign is mounted on another structure, any fixings that are not easily replaceable (eg cast-in bolts) shall be designed and detailed for the greater of the sign design working life and the design working life of the supporting structure.

5.13.3 *Building code* compliance

Building code[1] compliance is required and intended to be achieved as follows:

- Clause B1 Structure – via *Acceptable solutions and verification methods for New Zealand building code clause B1 Structure*[15]
- Clause B2 Durability – via *Acceptable solutions and verification methods for New Zealand building code clause B2 Durability*[53].

Note that TNZ P/24[50] requires design loads to comply with AS/NZS 1170[16] and hence is consistent with this requirement. The post and foundation designs for small signs in the *RSMA compliance standard for traffic signs*[51] are consistent with this requirement.

Note that the Building Act 2004 does allow *buildings* to have a life of less than 50 years (refer section 113 of the Act). Where a *building* is intended to have a life of less than 50 years the nominated life is termed the specified intended life.

5.14 ITS equipment support structures

This section covers support structures and associated foundations for CCTV (closed-circuit television) cameras, variable message signs (VMS), lane control signals (LCS), ramp metering signals and advance warning signs (AWS).

5.14.1 Design philosophy and non-structural design requirements

Refer to the Transport Agency's ITS Specification *Civil and structural requirements* (ITS-01-04)[55] for design philosophy and non-structural design requirements for ITS equipment support structures.

5.14.2 Structural design requirements

As above.

5.14.3 *Building code* compliance

Building code[1] compliance is required and intended to be achieved as follows:

- Clause B1 Structure – via *Acceptable solutions and verification methods for New Zealand building code clause B1 Structure*[15]
- Clause B2 Durability – via *Acceptable solutions and verification methods for New Zealand building code clause B2 Durability*[53].

The ITS specification refers to these documents.

5.15 Lighting columns and masts

This section covers the design of lighting columns and masts, including their foundations.

5.15.1 Design philosophy and non-structural design requirements

Refer to NZTA M26 *Specification for lighting columns*[56] for design philosophy and non-structural design requirements for lighting columns.

Note that NZTA M26[56] does not cover:

- columns with provision for attachment of flags and/or banners unless specifically allowed for
- high mast lighting (generally over 16m)
- CCTV camera columns
- lighting columns fed by overhead supply
- joint use columns for lighting and electricity distribution, telecommunications, traffic signals or tramway services.

Columns with provision for the attachment of flags and/or banners shall comply with all requirements of NZTA M26[56], but shall in addition be specifically designed to accommodate the additional loads imposed by the flags and/or banners using a design methodology agreed with the Transport Agency. Information provided by the designer shall clearly describe the dimensions of the flags and/or banners for which the column has been designed.

Requirements for high mast lighting shall be specifically agreed with the Transport Agency, but are expected to incorporate the relevant requirements of NZTA M26[56].

Requirements for CCTV camera columns are contained in 5.14.

Requirements for lighting columns fed by overhead supply shall be specifically agreed with the Transport Agency, but are expected to incorporate the relevant requirements of NZTA M26[56]and the relevant requirements of the electricity or line company.

Requirements for joint use columns for lighting and traffic signals are contained in 5.16. Requirements for other joint use columns shall be specifically agreed with the Transport Agency, but are expected to incorporate the relevant requirements of NZTA M26[56].

5.15.2 Structural design requirements

As above. Where a lighting column is mounted on another structure, any fixings that are not easily replaceable (eg cast-in bolts) shall be designed and detailed for the greater of the column design working life and the design working life of the supporting structure.

5.15.3 *Building code* compliance

Building code[1] compliance is required and intended to be achieved as follows:

- Clause B1 Structure – via *Acceptable solutions and verification methods for New Zealand building code clause B1 Structure*[15]
- Clause B2 Durability – via *Acceptable solutions and verification methods for New Zealand building code clause B2 Durability*[53].

NZTA M26[56] refers to AS/NZS 1170[16], NZS 3404[18] and NZS 3101[17] and is thus consistent with the MBIE documents.

5.16 Traffic signal and speed camera poles

In addition to 'ordinary' vertical traffic signal and speed camera posts, this section covers traffic signal mast arms (vertical section and outreach arm used to support traffic signals and associated equipment above the roadway), joint use mast arms (traffic signal mast arms that incorporate a lighting outreach assembly) and joint use signal poles (traffic signal poles that incorporate a lighting outreach assembly). In the following, 'poles' refers to all of the above.

Coverage includes the foundations of the above structures.

ITS equipment and associated support structures are covered in 5.14.

5.16.1 Design philosophy and non-structural design requirements

Refer to NZTA P43 *Specification for traffic signals*[57] for design philosophy and non-structural design requirements for traffic signal and speed camera poles.

5.16.2 Structural design requirements

As above.

5.16.3 *Building code* compliance

Building code[1] compliance is required and intended to be achieved as follows:

- Clause B1 Structure – via *Acceptable solutions and verification methods for New Zealand building code clause B1 Structure*[15]
- Clause B2 Durability – via *Acceptable solutions and verification methods for New Zealand building code clause B2 Durability*[53].

5.17 Road safety barriers

This section covers permanent road safety barrier systems. In some situations road safety barriers also provide safety from falling. This function is covered in section 5.19

5.17.1 Design philosophy and non-structural design requirements

These are set out in NZTA M23 *Specification for road safety barrier systems*[31].

For road safety barrier systems on structures requirements are set out in NZTA M23[31] and the *Bridge manual*[3].

In 'off-structure' situations where a barrier system is provided with a foundation because proximity to the edge of an embankment or slope renders usual 'off-structure' solutions unsuitable, the barrier system shall be considered to be on a structure and designed in accordance with the *Bridge manual*[3].

5.17.2 Structural design requirements

These are set out in NZTA M23[31] and the *Bridge manual*[3] – see above.

Barriers not on structures do not require specific structural design for vehicle impact loads – their adequacy is established on an accepted system basis.

5.17.3 *Building code* compliance

Building code[1] compliance is required and intended to be achieved for clauses B1 Structure and B2 Durability via NZTA M23[31] and (for barriers on structures) the *Bridge manual*[3] as alternative solutions.

5.18 Noise barriers

This section provides requirements for noise barriers and their foundations.

5.18.1 Design philosophy and non-structural design requirements

Design philosophy and non-structural requirements are set out in NZTA P40 *Specification for noise mitigation*[58], and the *NZTA State highway noise barrier design guide*[59].

It is noted that non-structural design requirements may dictate the form and materials used.

Design working life shall be 50 years. Importance Level for the determination of wind and seismic loading shall be taken as 2.

5.18.2 Structural design requirements

Structural design shall follow the guidance given in NZTA P40[58] and the *NZTA State highway noise barrier design guide*[59], with the following clarifications:

- Structural design shall be in accordance with *New Zealand building code* verification method B1/VM1[15] and supporting standards and *New Zealand building code* acceptable solution B2/AS1[53].
- Design life shall be 50 years, without replacement of any components.
- For steel elements and connections, minimum time to first maintenance shall be 40 years for inaccessible elements and 25 years for accessible elements. Coatings shall be selected in accordance with AS/NZS 2312[54]. Assessment of accessibility shall take into account the existence or otherwise of access including access agreements to the non-highway side of the barrier.
- Steel primary members shall be designed for the fatigue effects of wind loading.
- Connections not readily accessible for inspection shall be detailed to reduce vulnerability to interference.
- Adequate durability for timber noise barriers shall be established by reference to *New Zealand building code* acceptable solution B2/AS1[53], giving a 50 year life. It is noted that this will require as a minimum the use of hot-dipped galvanised fixings, and in some cases the use of stainless steel fixings.

5.18.3 *Building code* compliance

Building code[1] compliance is required and intended to be achieved as follows:

- Clause B1 Structure – via *Acceptable solutions and verification methods for New Zealand building code clause B1 Structure*[15]
- Clause B2 Durability – via *Acceptable solutions and verification methods for New Zealand building code clause B2 Durability*[53].

5.19 Security and safety fences and barriers

This section provides requirements for permanent security and safety fences and barriers and their foundations.

Security fences and barriers are provided to discourage, restrict or prevent access. Examples include low fences and rails, close-boarded or paling type timber fences, steel mesh security fences, stock fences, deer fences and predator proof fencing. Such fences are often, but not always, located on road boundaries. Security fences are sometimes required around vegetation areas to meet consent conditions.

Safety fences and barriers described in this section are provided to safeguard people from injury caused by falling. Safety fences and barriers provided to give safety from falling are usually, but not always, located on structures. They include safety fences and barriers for pedestrians, cyclists and equestrians utilising paths and roads and also fences and barriers safeguarding the general public (eg on viewing platforms and retaining walls adjoining public areas). They also include safety fences or barriers provided primarily to safeguard inspection and maintenance personnel and emergency personnel, in areas not generally intended to be accessed by the public (eg on bridge decks without footpaths and at the top of retaining walls). Sometimes safety from falling fences and barriers are not located on structures (eg they may be located at the top of steep slopes).

A fence or barrier may provide both security and safety from falling.

This section does not cover roadside (traffic safety) barriers and railings, or noise barriers, which are covered by other sections of this guide (and sometimes perform safety from falling and/or security functions in addition to their primary purpose). It also does not cover debris screens and anti-throw screens, the requirements for which are contained in the *Bridge manual*[3].

5.19.1 Design philosophy and non-structural design requirements

a. Urban and landscaping design factors

   Fences and barriers can have a significant impact on the urban and landscaping design outcomes of a project, and these outcomes shall be taken into account in the location, form, detailing and finish of fences and barriers. For further guidance refer to 5.1.

b. Safety fences and barriers on structures

   Requirements for pedestrian, cyclist and equestrian barriers on structures (ie on the outer edge of paths on structures) are given in the *Bridge manual*[3]. This includes requirements for the pedestrian, cyclist and equestrian portion of combination barriers (combined traffic and pedestrian, cyclist or equestrian barriers) used on the outer edge of paths on structures also carrying traffic. The *Bridge manual*[3] also gives requirements for barriers providing safety from falling from retaining walls adjacent to other public areas.

   The *Bridge manual*[3] requirements for both the above situations include meeting the requirements of clause F4 Safety from falling of the *Building code*[1], by utilising *New Zealand building code* acceptable solution F4/AS1[26]. The *Bridge manual*[3] gives guidance (in B2.4) regarding choice of barrier type (general or vertical bar type) for different situations.

5.19.1 continued

The *Bridge manual*[3] also gives guidance on the provision of safety from falling on structures where people may occasionally be present. These include bridges without footpaths and retaining walls, on which inspection, maintenance and emergency personnel, and also pedestrians in a remote rural environment, may be present. Again, the requirements of clause F4 must be met. However, the utilisation of *New Zealand building code* acceptable solution F4/AS1[26] is not mandatory in these situations and an alternative solution may be appropriate. In such situations, it can be assumed that small children are not likely to be present.

Fences and barriers shall be provided to provide safety from falling on structures intended for public use that are not covered by the *Bridge manual*[3] (for example on a viewing platform) in accordance with the requirements of clause F4, and utilising *New Zealand building code* acceptable solution F4/AS1[26].

c. Safety fences and barriers not on structures

Safety from falling barriers shall also be provided to footpaths intended for public use and other public areas in the following off-structure situations:

i. where required by the Transport Agency's *Pedestrian planning and design guide*[60]

ii. wherever the ground level at a distance 1.5m from the edge of the path or used area is more than 1.0m below path level

iii. wherever a serious falling hazard to the user exists within 1.5m of the edge of the path or used area

iv. in any other situation where a serious hazard is considered to be present.

In these situations, barriers shall conform with *New Zealand building code* acceptable solution F4/AS1[26]. Examples of other public areas covered by this requirement are viewing areas and stopping areas. It is noted that in some cases, security fences can be used to define public areas and prevent proximity to a falling hazard that would otherwise require a safety from falling barrier.

Consideration shall also be given, through a risk assessment approach, to the need for safety from falling protection in off-structure situations where there may be the occasional presence of people (as defined in clause B2.9 of the *Bridge manual*[3]). This shall take into account the frequency and nature of inspection and maintenance activities, and also the likelihood of public access to the area. As a minimum, barriers for safety from falling should be provided adjacent to paths or areas used for regular inspection and maintenance purposes or in emergency situations, wherever a serious falling hazard to the user exists within 1.5m of the edge of the path or working area. Such barriers shall be as detailed in clause 6.6.1(c) of the *Bridge manual*[3].

For the purpose of the above, the top of a slope steeper than 35° (1V:1.5H) and abrupt drops of more than 2.0m shall be considered to constitute a serious falling hazard. Abrupt drops of less than 2.0m may also constitute a serious falling hazard requiring provision of a barrier, depending on the fall height and nature of the impact surface, and an assessment shall be made of whether such drops do constitute a serious hazard. Guidance in this regard may be obtained from SNZ HB 8630 *Tracks and outdoor visitor structures*[61].

d. Safety barriers on bicycle paths

Safety barriers shall be provided on bicycle paths in the situations recommended by the Austroads *Guide to road design* part 6A[27], and shall follow the recommendations of the guide with regard to type, height and form.

5.19.1 continued

On paths intended for both pedestrian and cyclist use barriers shall be provided as required for both types of users.

e. Approval of barrier provision for safety from falling

The proposed extent and type of barriers to be provided for safety from falling shall be summarised for each project and approved by the Transport Agency.

f. Security fences and barriers

The *State highway control manual*[33] outlines in section 2.2.3.G requirements for fencing adjacent to state highways.

Security fences and barriers, including stock fences, shall be designed in accordance with best practice and shall be 'adequate' taking into account their intended purpose. Factors such as climbability, the type of stock to be contained and the safety of adjacent users of the road reserve shall be considered.

Any requirements contained in statutory and other agreements including consents, property agreements, landowner agreements and stakeholder agreements shall be incorporated.

Guidance regarding the appropriate form of security barriers and fences may be obtained from the following sources:

- Fencing Contractors Association of New Zealand website[62]
- Schedule 2 to the Fencing Act 1978 (reprinted July 2014) (noting that the descriptions contained therein are dated)

g. Other safety considerations for fences and barriers

Fences and barriers provided for security or safety from falling purposes may themselves create safety hazards. Consideration shall be given to CPTED (Crime prevention through environmental design) and Safety in design (see 5.1).

Fences and barriers that could be impacted by a vehicle should be detailed so as to be effectively frangible (passively safe) so that after a vehicular impact, the vehicle occupants are unlikely to suffer injuries.

h. Design life

Elements of fences and barriers that are not easily replaceable (typically posts and foundations as a minimum) shall be designed for a 50 year life, and to give a life to first maintenance of at least 15 years. Elements that are easily replaceable shall have a life to first maintenance or replacement of at least 15 years, but shall be designed for wind loads appropriate for a 50 year life.

The assessment of whether an element is easily replaceable, and of the required life to first maintenance of elements, shall take into account the ease and safety of access, and whether traffic management is required, and shall be agreed with the Transport Agency for each project. Boards and palings on timber fences shall not in general be considered to be 'easily replaceable'.

In situations where the cost of providing a 50 year life for timber barriers and fences appears excessive and not to represent "value for money", a specified intended life for durability purposes of 25 years may be adopted with the agreement of the Transport Agency.

Fence and barriers shall be considered to be importance level 1 structures for the purpose of determining wind, snow and earthquake loads.

5.19.1 continued

i. Pool fencing

It shall be noted that fencing meeting the requirements of the Fencing of Swimming Pools Act 1987 is unlikely to be adequate for roading corridor purposes, and the term 'pool fencing' should not be used when specifying. (The term 'welded panel fencing' is suggested for prefabricated panels formed by welding steel wires or sections together.)

5.19.2 Structural design requirements

a. Safety fences and barriers

Structural design requirements for pedestrian, cyclist and equestrian barriers on major structures (ie bridges, major culverts and retaining walls) and the pedestrian, cyclist and equestrian portion of combination barriers on such structures are given in the *Bridge manual*[3].

Other fences and barriers providing safety from falling, either on structures not covered by the *Bridge manual*[3], or in off-structure situations, shall be designed in accordance with the *New Zealand building code* verification method B1/VM1[15]. The following occupancies shall be used in determining minimum imposed actions on barriers from table 3.3 of AS/NZS 1170.1[16]:

- barriers on structures or areas that may be utilised for viewing purposes, or other situations where the public may congregate, but that are not susceptible to overcrowding – C1/C2
- other barriers accessible to the public – C3
- barriers for access and safe working by operating, inspection, maintenance or servicing personnel – B,E (as for fixed platforms, walkways, stairways etc). (Note that where a barrier is provided at the bottom of a slope on which personnel are working consideration shall be given to the provision of a barrier designed for C3 loading)
- barriers on structures or areas susceptible to overcrowding – C5.

Where a fence or barrier is provided that is of greater than minimum height (eg a security fence that also provides safety from falling) the recommendations of the MBIE document *Guidance on barrier design*[63] shall be followed when applying the safety from falling loadings.

b. Security fences and barriers

Security fences and barriers shall be designed for wind loads in accordance with *New Zealand building code* verification method B1/VM1[15]. Stock fences need not be specifically designed for imposed loading, but their adequacy shall be established by reference to best practice. Where robustness and resistance to vandalism is considered particularly important in security fences preventing access by people (for example to motorway corridors), security fences shall be designed as a minimum for the same loadings as C3 occupancy barriers providing safety from falling. The adequacy for imposed loading of other security fences and barriers preventing access by people shall be established by reference to best practice.

c. Durability

Durability requirements for barriers on structures covered by the *Bridge manual*[3] are contained in that document.

5.19.2 continued

Durability for timber fences and barriers and timber components of other fences and barriers shall normally be established by reference to *New Zealand building code* acceptable solution B2/AS1[53]. It is noted that this will require as a minimum the use of hot-dipped galvanised fixings, and in some cases the use of stainless steel fixings.

In cases where a 25 year design life has been adopted, adequate durability shall be established by reference to SNZ HB 8630[61].

Durability for coated metal components and their fixings for fences and barriers not covered by the *Bridge manual*[3] shall be established by reference to AS/NZS 2312[54], AS/NZS 4534 *Zinc and zinc/aluminium-alloy coatings on steel wire*[64] and good practice. In some environments standard hot-dipped galvanised finish will not be adequate and additional or higher quality coatings will be required. Where fixings are of a different material to the components they fix, precautions shall be taken to prevent galvanic corrosion occurring.

Durability for other materials shall be established by reference to appropriate guidance agreed with the Transport Agency.

5.19.3 *Building code* compliance

Building code[1] compliance is required for all fences and barriers.

Compliance with clause B1 Structure is intended to be achieved via the *Bridge manual*[3] as an alternative solution for barriers on bridges, major culverts and retaining walls and, where possible, via the MBIE *Acceptable solutions and verification methods for New Zealand building code clause B1 Structure*[15] for other fences and barriers. The MBIE *Acceptable solutions and verification methods for New Zealand building code clause B1 Structure*[15] do not provide a path for establishing compliance for loading imposed by stock or people on security type fences. Compliance may be considered to be achieved by in-service history as an alternative solution, where this is available.

Compliance with clause B2 Durability is intended to be achieved via the *Bridge manual*[3] as an alternative solution for barriers on bridges, major culverts and retaining walls and, where possible, via the MBIE *Acceptable solutions and verification methods for New Zealand building code clause B2 Durability*[53] for other fences and barriers. Where this is not possible, other AS/NZS Standards, SNZ HB 8630[61] or in-service history may be used as an alternative solution.

Compliance with clause F4 Safety from falling shall be achieved via the MBIE *Compliance document for New Zealand building code clause F4 Safety from falling*[26] for all fences and barriers providing safety from falling from structures regularly used by the public. On structures where people may occasionally be present, compliance with F4 may be achieved by the alternative solutions described in the *Bridge manual*[3].

5.20 Buildings

This section provides partial requirements for all buildings (in the normal sense) that form a part of the operational roading asset. Examples include:

- tunnel control buildings
- weigh-station buildings.

Remaining requirements will need to be agreed with the Transport Agency on a project or structure specific basis.

5.20.1 Design philosophy and non-structural design requirements

To be specifically agreed with the Transport Agency, including design working life and importance level.

5.20.2 Structural design requirements

Expected to be usually as per *Acceptable solutions and verification methods for New Zealand building code clause B1 Structure*[15] and *clause B2 Durability*[53].

Any additional requirements shall be specifically agreed with the Transport Agency and documented in the structure design statement.

5.20.3 *Building code* compliance

Compliance with all applicable clauses of the *Building code*[1] is required.

It is intended that compliance will normally be achieved via the MBIE Acceptable Solutions and Verification Methods.

5.21 Road tunnels

This section provides partial design requirements for road tunnels.

Remaining requirements will need to be agreed with the Transport Agency on a project or structure specific basis.

For definition of road tunnel see the *NZ Transport Agency Guide to road tunnels*[65] section 1.3.

5.21.1 Design philosophy and non-structural design requirements

These shall generally be in accordance with the Austroads *Guide to road tunnels* part 2 Planning, design and commissioning[66], as modified by the *NZ Transport Agency Guide to road tunnels*[65].

They shall be confirmed via the technical approval procedures outlined in section 2 of this *Highway structures design guide*.

5.21.2 Structural design requirements

As above.

5.21.3 *Building code* compliance

Building code[1] compliance is required and intended to be achieved as follows:

- Clause B1 Structure – via the documents named above (and other overseas standards as necessary) as an alternative solution
- Clause B2 Durability – via the documents named above (and other overseas standards as necessary) as an alternative solution
- Clauses C1 to C6 Protection from fire – via the documents named above (and other overseas standards as necessary) as an alternative solution

Where compliance with other *Building code*[1] clauses is judged to be necessary, this shall be stated in the structure design statement and a means of compliance proposed.

5.22 Other structures

This section provides partial requirements for other highway structures (structures not otherwise covered by the preceding clause within section 5), such as urban art features.

5.22.1 Design philosophy and non-structural design requirements

These shall be specifically agreed with the Transport Agency, including design working life and importance level, and shall be documented in the structure design statement.

5.22.2 Structural design requirements

These shall be specifically agreed with the Transport Agency and documented in the structure design statement.

Requirements will generally be as per *Acceptable solutions and verification methods for New Zealand building code clause B1 Structure*[15] and *clause B2 Durability*[53].

5.22.3 *Building code* compliance

Compliance with all applicable clauses of the *Building code*[1] is required.

It is expected that compliance will normally be achieved via the MBIE Acceptable Solutions and Verification Methods.

6.0 Requirements for alterations to existing highway structures

6.1 General

Alterations shall include extensions (widening, lengthening or raising) or improvements (eg for traffic loading, seismic performance, side protection or durability) or any other works involving structural alterations.

All alteration work shall be undertaken in accordance with sections 2, 3 and 4 of this guide, unless otherwise agreed by the Transport Agency.

6.2 Design requirements

Where an existing road structure is to be altered, the minimum requirements shall be that:

- the new work complies with the requirements for a new structure set out in section 5 of this guide (and hence with the *Building code*[(1)])
- the altered structure will continue to comply with the new structure requirements set out in section 5 of this guide (and hence with the *Building code*[(1)]) to at least the same extent as before the alteration.

This will achieve compliance with the Building Act 2004 via section 112 of the Act.

The above is a minimum requirement. The Transport Agency may wish to simultaneously improve the existing portions of the structure, and shall be consulted to identify any requirements for specific alterations including:

- minimum seismic design requirements
- minimum safety barrier requirements
- any other improvements.

Where appropriate, departures from the requirements of this guide will be considered by the Transport Agency.

The structure options reports and structure design statement shall confirm the requirements for the altered structure.

7.0 Evaluation of existing highway structures

This section provides guidance for the evaluation of bridge live load capacity and evaluation of common physical risks.

Methodologies and criteria for any evaluation shall be specifically confirmed with the Transport Agency.

7.1 Live load capacity

Evaluation of existing bridges, major culverts, subways and stock underpasses for traffic load carrying capacity shall be carried out in accordance with section 7 of the *Bridge manual*[3].

The specific live load requirements for each structure shall be agreed with the Transport Agency.

7.2 Risk evaluation

Highway structures may be vulnerable to various physical risks, in particular:

- live load failure due to defects or deficiencies not readily identified by normal inspection procedures
- waterway induced failure due to floods, scour or waterway changes
- seismic failure.

Specific screening procedures have been developed to identify these risks as follows:

- live load risk – *Live load risk screening methodology*[67]
- waterway risk – *Development of a national bridge scour risk screening procedure*[68]
- seismic risk - *Seismic screening of bridges*[69].

8.0 Design requirements for non-Transport Agency structures present in state highway road reserve

8.1 Controls and processes

Structures that are not Transport Agency owned can be present within the road reserve. Examples include footbridges, rail bridges, pipe bridges and local authority bridges that cross state highways; retaining walls within the state highway road reserve that support rail tracks or buildings; buried structures that convey rail or materials under or alongside state highways; and utility structures. (Utility structures are defined in the *National code of practice for utility operators' access to transport corridors*(70). They include towers, poles, cabinets, posts, pipes, cables, chambers, drains, street furniture assets and other structures.)

Some of these structures are entitled under legislation to be present in the road reserve. Others are present at the discretion of the Transport Agency. In some cases the Transport Agency agrees to the construction of structures within the road reserve to meet a non-highway need, but assumes ownership of the structure – stock underpasses being one example.

In all cases where others desire the construction of a structure within the road reserve, the agreement of the Transport Agency as manager and operator of the state highway network must be obtained. All non-Transport Agency owned structures in the road reserve require a specific form of agreement, either through the national utilities code of practice or via a deed of grant and approval to work on the road. The processes and procedures that apply to the obtaining of such agreements, and standard templates for such agreements, are generally set out in chapter 2 of the *State highway control manual*(33). In any situation where the *State highway control manual*(33) does not set out the process and procedure to be followed, the National Manager, Network Outcomes shall be consulted. In all cases the Transport Agency has the ability to impose or request conditions, including the design requirements, maintenance strategy and maintenance agreement for the new structure.

To the extent that they are able to be imposed, the design statement requirements, design review requirements and certification requirements of section 2 of this guide and the documentation requirements of section 3 shall apply to non-Transport Agency structures. Structure design statements shall be endorsed by the Transport Agency.

Any modifications to non-Transport Agency structures, or any works which directly or indirectly affect a Transport Agency structure, shall be endorsed by the Transport Agency prior to work proceeding.

8.2 Design requirements

For new structures, the Transport Agency shall impose any minimum design requirements necessary to ensure that the performance of the state highway is not compromised by the presence of the structure. These requirements will be additive to the owner's requirements for the structure.

8.2 continued

The minimum requirements shall include those that would apply to a Transport Agency owned structure in the same physical relationship to the state highway that derive from the proximity to the state highway. For example, a bridge over the state highway carrying rail, pipes or a local road shall as a minimum meet the same clearance requirements, pier collision load requirements, urban design requirements and be designed for the same extreme event annual probabilities of exceedance as a Transport Agency owned bridge over the state highway.

The minimum requirements shall also include requirements that derive from the contents of or traffic supported by the structure to the extent that they pose risks to the continuing functionality of the state highway and the safety of its users. Examples are gas pipeline explosion or rail or road vehicles breaching the side protection of a bridge over the state highway.

The standard agreement templates contained within the *State highway control manual*[33] contain some standard design requirements. For example, appendix 2A is the template for the Schedule of reasonable conditions to be used when responding to a Corridor access request from a utility operator. Included in the general (standard) conditions in the template are requirements for utility structures within the trafficable part of the road to be designed for HN-HO-72 traffic loading, and overhead services to be erected with a clearance of 6.5m above the carriageway. Local and special conditions are able to be added.

Note that the structure design requirements shall be included in the structure design statement for endorsement by the Transport Agency.

All non-Transport Agency structures within the road reserve that are *buildings* in terms of the Building Act 2004 will need to comply with the *Building code*[1]. (Note, however, that some structures that form part of a network utility operator (NUO) system are excluded from the definition of *building* in the Building Act 2004 and are thus not required to comply with the *Building code*[1].)

8.3 Structures or earthworks adjacent to the road reserve

The performance of the state highway network may be potentially affected by the construction of structures or earthworks adjacent to the road reserve.

In such cases a common law right exists, and the Transport Agency will seek to ensure that the design standards used for such works are such that the operation of the state highway is not adversely affected. Again, the requirements that the Transport Agency desires are those that would apply to a Transport Agency owned structure or earthworks in the same physical relationship to the state highway that derive from the proximity to the state highway.

9.0 References

(1) Parliamentary Counsel Office (1992) Building Regulations 1992. Schedule 1 *The building code*. Wellington.

(2) NZ Transport Agency (2015) NZTA S6 *Bridges and other significant highway structures inspection policy*. Wellington.

(3) NZ Transport Agency (2013) SP/M/022 *Bridge manual* (3rd edition). Wellington.

(4) Transit New Zealand (2003) SP/M/022 *Bridge manual* (2nd edition). Wellington. Superseded.

(5) Standards Australia and Standards New Zealand jointly
AS/NZS 1100.501:2002 *Technical drawing – Structural engineering drawing.*

(6) NZ Transport Agency (2015) Minimum standard Z/15 – *Asset owner's manual*. Wellington.

(7) NZ Transport Agency (2015) Professional services guideline PSG/15 – *Asset owner's manual*. Wellington.

(8) NZ Transport Agency (2015) Professional services guideline PSG/9 – *Delivery of as-built documentation*. Wellington.

(9) NZ Transport Agency *Bridge data system (BDS)*
Descriptive guide part A (2006)
Structural guide part B (2009)

(10) NZ Transport Agency (2015) SM030 *State highway professional services contract proforma manual*. Wellington.

(11) NZ Transport Agency (2015) SM031 *State highway construction contract proforma manual*. Wellington.

(12) NZ Transport Agency (2015) SM032 *State highway maintenance contract proforma manual*. Wellington.

(13) Ministry of Business, Innovation & Employment (2011) *Compliance document for New Zealand building code clause D1 Access routes*. Wellington.

(14) Ministry of Business, Innovation & Employment (2014) *New Zealand building code handbook*. Wellington.

(15) Ministry of Business, Innovation & Employment (2014) *Acceptable solutions and verification methods for New Zealand building code clause B1 Structure*. Wellington.

(16) Standards Australia and Standards New Zealand jointly
AS/NZS 1170: _____ *Structural design actions.*
Part 0:2002 General principles
Part 1:2002 Permanent, imposed and other actions
Part 2:2011 Wind actions
Part 3:2003 Snow and ice actions
Part 5:2004 Earthquake actions – New Zealand (NZS 1170.5).

(17) Standards New Zealand NZS 3101.1&2:2006 *Concrete structures standard*.

(18) Standards New Zealand NZS 3404. _____ *Steel structures standard*.
Parts 1 and 2:1997
Part 1:2009 Materials, fabrication and construction.

(19) Standards New Zealand NZS 3603:1993 *Timber structures standard*.

(20) Standards Australia and Standards New Zealand jointly AS/NZS 1664.1:1997 *Aluminium structures*. Part 1 Limit state design.

(21) NZ Transport Agency (2013) *Bridging the gap: Urban design guidelines*. Wellington.

(22) NZ Transport Agency (2014) *Landscape guidelines* (final draft). Wellington.

(23) NZ Transport Agency (2015) *Historic heritage impact assessment guide for state highway projects*. Wellington.

(24) NZ Transport Agency (2014) ZH/MS/01 *Safety in design minimum standard for road projects* (draft version 1). Wellington.

(25) NZ Transport Agency (2004) SM051 *Location referencing management system (LRMS) manual*. Wellington.

(26) Ministry of Business, Innovation & Employment (2007) *Compliance document for New Zealand building code clause F4 Safety from falling*. Wellington.

(27) Austroads (2009) *Guide to road design*. Part 6A Pedestrian and cyclist paths, AGRD06A-09. Sydney, NSW, Australia.

(28) NZ Transport Agency (1986) TNZ M/3 *Notes on subbase aggregate specification TNZ M/3*. Wellington.

(29) NZ Transport Agency (1997) TNZ F/1 *Specification for earthworks construction*. Wellington.

(30) Austroads (2010) *Guide to road design*. Part 6 Roadside design, safety and barriers, AGRD06-10. Sydney, NSW, Australia.

(31) NZ Transport Agency (2009) NZTA M23 *Specification for road safety barrier systems*. Wellington.

(32) NZ Transport Agency (2010) *Manual of traffic signs and markings*. Part 2 Markings. Section 5 Delineation and hazard markers. Wellington.

(33) NZ Transport Agency (2013) SM012 *State highway control manual*. Wellington.

(34) Melville BW and Coleman SE (2000) *Bridge scour*. Water Resources Publications, LLC. Highlands Ranch, CO, USA.

(35) Transportation Research Board (2007) *Countermeasures to protect bridge piers from scour*. National Cooperative Highway Research Program report 593, Washington DC, USA.

(36) Federal Highway Administration (2009) *Bridge scour and stream instability countermeasures*, NHI-09-111. Washington DC, USA.

(37) US Army Corps of Engineers (2002) *Coastal engineering manual*. Washington, DC, USA.

(38) CIRIA, CUR, CETMEF (2007). *The Rock Manual – The use of rock in hydraulic engineering* (2nd edition), C683. CIRIA, London, United Kingdom.

(39) Christchurch City Council (2013) *Technical guideline for rockfall protection structures*. Christchurch.

(40) Ministry of Business, Innovation & Employment (2016) *Rockfall: Design considerations for passive protection structures*. Wellington. (In prep.)

(41) NZ Transport Agency (2015) TAN 15-14 *Concrete barriers used to temporarily detain rockfall and slope debris*. Wellington.

(42) NZ Transport Agency (2016) NZTA P46 *NZ Transport Agency state highway stormwater specification*. Wellington.

(43) NZ Transport Agency (2010) NZTA F3 *Pipe culvert construction*. Wellington.

(44) Standards Australia and Standards New Zealand jointly
AS/NZS 4058:2007 *Precast concrete pipes (pressure and non-pressure*.

(45) Standards Australia and Standards New Zealand jointly
AS/NZS 2566.1:1998 *Buried flexible pipelines*. Part 1 Structural design.

(46) NZ Transport Agency (2013) NZTA F2 *Pipe subsoil drain construction*. Wellington.

(47) Austroads (2013) *Guide to road design* part 5A Drainage – road surface, networks, basins and subsurface, AGRD05A-13. Sydney, NSW, Australia.

(48) Standards Australia AS 3996-2006 *Access covers and grates*.

(49) Standards Australia AS 4198-1994 *Precast concrete access chambers for sewerage applications*.

(50) NZ Transport Agency (2008) TNZ P/24 P*erformance based specification for traffic signs*. Wellington.

(51) Road Safety Manufacturers Association (2010) *RSMA compliance* standard for traffic signs. Auckland.

(52) NZ Transport Agency (2011) NZTA P32 *Specification for electronic warning signs on state highways*. Wellington.

(53) Ministry of Business, Innovation & Employment (2014) *Acceptable solutions and verification methods for New Zealand building code clause B2 Durability*. Wellington.

(54) Standards Australia and Standards New Zealand jointly
AS/NZS 2312: _____ *Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings.*
Part 1:2014 Paint coatings
Part 2:2014 Hot dip galvanizing
Part 3 Thermally sprayed metallic coatings (In prep.).

(55) NZ Transport Agency (2013) ITS Specification *Civil and structural requirements* (ITS-01-04). Wellington.

(56) NZ Transport Agency (2012) NZTA M26 *Specification for lighting columns*. Wellington.

(57) NZ Transport Agency (2016) NZTA P43 *Specification for traffic signals*. Wellington. (In prep.)

(58) NZ Transport Agency (2012) NZTA P40 *Specification for noise mitigation*. Wellington.

(59) NZ Transport Agency (2010) *NZTA State highway noise barrier design guide*. Wellington.

(60) NZ Transport Agency (2009) *Pedestrian planning and design guide*. Wellington.

(61) Standards New Zealand SNZ HB 8630:2004 *Tracks and outdoor visitor structures*.

(62) Fencing Contractor's Association of NewZealand website.
Last accessed 27 May 2016.
<http://fencingcontractors.co.nz/>

(63) Ministry of Business, Innovation & Employment (2012) *Guidance on barrier design*. Wellington.

(64) Standards Australia and Standards New Zealand jointly
AS/NZS 4534:2006 *Zinc and zinc/aluminium-alloy coatings on steel wire*.

(65) NZ Transport Agency (2012) *NZ Transport Agency Guide to road tunnels*. Wellington.

(66) Austroads (2015) *Guide to road tunnels*. Part 2 Planning, design and commissioning, AGRT02-15. Sydney, NSW, Australia.

(67) Beca Ltd (2016) *Live load risk screening methodology*. Wellington. (In prep.)

(68) Opus International Consultants Ltd (2007) *Development of a national bridge scour risk screening procedure*. Wellington.

(69) NZ Transport Agency (1998) SM110 *Seismic screening of bridges*. Wellington.

(70) NZ Utilities Advisory Group (2015) *National code of practice for utility operators' access to transport corridors*. Wellington.

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Appendix A Technical approval, review and certification procedures

A1 Introduction

This appendix gives the 'technical approval', review and certification procedures required by the NZ Transport Agency (the Transport Agency) for highway structures on state highways. Use of the procedures by other road controlling authorities may be considered appropriate.

The procedures consist of the submission of proposals for agreement by the Transport Agency and the subsequent provision and acceptance of certificates confirming that the design complies with the agreed structure design statement and the construction works are in accordance with the design.

The procedures have been developed from previous requirements of the Transport Agency and BD 2 *Technical approval of highway structures*(1) produced by the UK Highways Agency. They were previously published as appendix F to the *Bridge manual*(2).

The technical approval procedures as described in this appendix require the development of structure options reports and structure design statements, that are submitted to the Transport Agency at three distinct stages in the project cycle, and the acceptance of these documents by the Transport Agency before detailed design is commenced. Technical approval is a continuing exercise that should start at an early stage of development of proposals.

Certification is then required in the form of design, design review, construction and construction review certificates. These confirm that the design has been implemented in accordance with the structure design statement (or the Transport Agency's standards or specifications for simpler structures) and the construction has been implemented in accordance with the design.

These technical approval, review and certification requirements are separate to any requirements to demonstrate compliance with the *Building code*(3) to external agencies where this is required. It is however anticipated that the documents required for technical approval, review and certification will assist in that process.

Figure A1 indicates the various steps required for technical approval, review and certification.

A2 Technical approval requirements

A2.1 Scope

The technical approval procedures, as described in this appendix and summarised in A1, apply to the highway structures listed below. Certification requirements are discussed in A5. The requirements for any reviews are given where relevant throughout this appendix.

a. bridge, stock underpass, pedestrian subway supporting a state highway

b. culvert or multiple culverts with a total clear opening (waterway area) greater than 3.4m² ("major culvert")

A2.1 continued

c. critical small culvert

d. bridge over or adjacent to a state highway, including footbridge and cycle bridge

e. overhead crossing of state highway carrying conveyor or utility service

f. earth retaining structure (including reinforced/strengthened soil/fill structures) where the effective retained height, ie the level of the fill at the back of the structure above the finished ground level in front of the structure, is greater than 1.5m or the structure is associated with a bridge

g. critical river and coastal protection works

h. portal and cantilever sign and/or signal gantry

i. cantilever mast for traffic signal and/or speed camera

j. lighting column

k. high mast for lighting (generally more than 16m in height, ie the vertical distance from top of post to bottom of flange plate)

l. mast for camera, radio and telecommunication transmission equipment

m. fence greater than 2.5m in height

n. noise wall

o. large roadside highway signs (with panel area greater than 4.7m^2)

p. small roadside highway signs on posts of more than 7m in height, ie the vertical distance from top of post to bottom of flange plate or top of foundation whichever is the lesser.

In all cases the technical approval process shall include stability of the ground in which the structure is located. The procedures shall also apply to the stability of slopes not affecting bridges.

A2.2 Category of structures

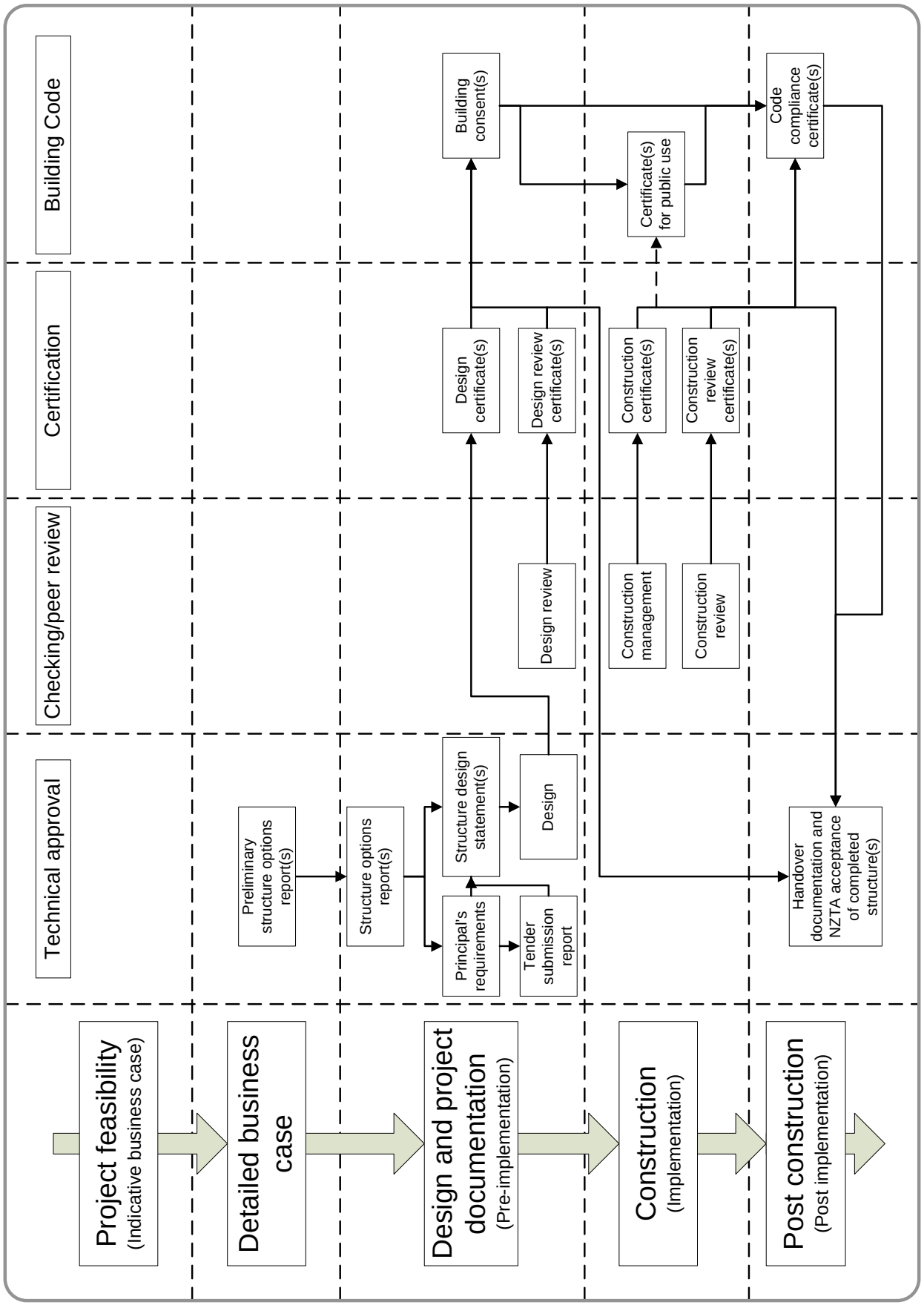
For the purposes of this appendix, structures subject to technical approval shall be placed in one of four categories: 1, 2, 3 or 4, according to the criteria described in A6.2. The category shall be proposed by the design firm and agreed by the Transport Agency, except for design and construct (D&C) contracts where the category shall be detailed in the principal's requirements. The category boundaries are not rigid. In case of doubt each case shall be decided in consultation with the Transport Agency on its merits, having regard to potential consequences of failure, design complexity and whole of life costs.

Structure options reports and structure design statements are required for structures in categories 1, 2 and 3, but not category 4. The level of input to these documents is generally expected to be commensurate with the stage of the project and the complexity, and hence category, of the structure.

Structures that do not require technical approval remain subject to certification requirements and shall be considered as 'uncategorised' structures. They typically are simple structures and do not require building consent.

The technical approval, review and certification requirements for each category of structure are shown in table A1.

Figure A1: Technical approval, review and certification process diagram



A2.3 Structure options reports and structure design statements

The documentation that is required for technical approval shall be developed in stages as the level of knowledge increases through the project phases. Generally the documents shall be produced at three stages: preliminary structure options reports as part of the detailed business case; structure options reports at the commencement of the design phase; and structure design statements prior to detailed design. The general requirements for the documents at each project phase are given in A3 and A4. Model documents are included in annex A1.

Structure options reports shall form an engineering and urban design appreciation of the need for the structures, the factors which influence the designs, the proposed requirements and standards to apply to the design of the structures, the alternative forms the designs can take, the reasons for selection of preferred alternatives as being more suitable than the others and an assessment of the costs.

Structure design statements, once accepted by the Transport Agency, set out the agreed form and nature of the structures to be designed during final design, including the design requirements and standards, and the design methodology. During final design, should the design firm deviate significantly from the form and nature of structure or the design procedure set out in a structure design statement, a revised structure design statement shall be submitted for acceptance by the Transport Agency.

For some methods of procurement of the physical works such as design and construct, the structure options reports, once accepted by the Transport Agency, will generally present the specimen design. Principal's requirements will be prepared to define the fundamental requirements to be satisfied by the design. Subsequently a contractor's tender submission report will set out the proposed options for detailed design.

For an alternative proposal to a fully detailed conforming design, the alternative design shall be compared against the conforming design and the outcomes included in updated structure design statements, which shall accompany the tender submission.

Table A1: Technical approval, review and certification requirements for each category of structure

Category	Preliminary structure options report	Structure options report	Structure design statement	Design certificate	Design review certificate	Construction and construction review certificates	Building code compliance required[1]	Building consent
1	✓	✓	✓	✓	✓	✓	✓	✓[2]
2	✓	✓	✓	✓	✓	✓	✓	✓[2]
3	×	✓[3]	✓[3]	✓	✓	✓	✓	✓[2]
4	×	×	×	✓	✓	✓	✓	✓[2]
U	×	×	×	✓	×	✓	✓	×[4]

Notes:

1. Where applicable (ie not earth slopes).
2. Unless defined as exempt building work in schedule 1 of the Building Act 2004.
3. An abbreviated document is acceptable.
4. Any structure that requires building consent shall not be considered as an uncategorised structure.

A2.4 Site information

The design firm shall ensure that there is sufficient site information to form the basis of the structure options reports or structure design statements. The bridge site information summary given in appendix E is a suitable checklist. However, it is the design firm'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 design firm shall obtain the necessary information before the structure design statements are produced.

A2.5 Structure options reports and structure design statements approval and approval for construction commencement

Structure options reports and structure design statements shall be approved for release, 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 name(s) of the author(s) of the document shall also be included on the cover page.

The consultancy or contractor providing the design service shall obtain the Transport Agency's acceptance of each structure options report or structure design statement. Space for acceptance and comments by the Transport Agency shall be provided as shown in the model documents in annex A1.

The structure design statement shall be accepted by the Transport Agency prior to any construction works associated with the structure proceeding. Such acceptance shall be for the whole structure in its entirety including foundations, any supporting earth embankment structures and associated ground improvement works (eg beneath pad foundations or ground improvement works for liquefaction mitigation purposes).

Changes to the proposed structure and design requirements and standards for an agreed structure design statement (sections 2 and 3 of the model document in annex A1) to account for subsequent variations during design or construction render the structure design statement subject to re-approval and agreement by the Transport Agency. This must be confirmed either in the form of an amended version of the agreed structure design statement or as a separate addendum to the agreed structure design statement.

A2.6 Contractual responsibilities and procedures

Technical approval does not in any way modify and reduce the contractual and statutory responsibilities of any party for the work carried out or the legal responsibilities of professional engineers.

This appendix has been written such that it is applicable in principle to all current and likely future forms of procurement. The procedures, format and terms used in this appendix are intended to be contract-neutral and should be taken as models. The model structure options report and structure design statement provided in annex A1 shall be amended and agreed with the Transport Agency, to suit specific contract requirements. Timings and procedures should be identified in the scheme specific contract requirements.

For some forms of procurement, the technical approval process would typically be completed before tenders for carrying out the construction work required by the design are invited. For other forms of procurement, where the design has not been completed prior to inviting tenders, the technical approval process would typically only be partially completed prior to or during the tender period. Submission of a structure design statement would usually take place following award of contract.

A2.7 Building code requirements

All new building work in New Zealand must comply with the *Building code*[3]. The design and construction or alteration of all highway structures that are buildings under the terms of the Building Act 2004 shall thus comply with the *Building code*[3]. Design firms and constructors are likely to be required to demonstrate compliance with the *Building code*[3] on behalf of the Transport Agency through the building consent process (see *Understanding the building consent process*[4] for general details).

Technical approval should be considered as separate to the requirements of the Building Act 2004. It is however anticipated that the documents required by the technical approval process will assist in demonstrating compliance with the *Building code*[3].

A2.8 Design review requirements

Details of the design review requirements for designs are given in A4.7. Requirements for the peer review of structure options reports and structure design statements shall be detailed in the contract documentation for the scheme.

A2.9 Departures from standards

Design firms may seek to introduce cost savings, innovative techniques, research findings or developments in the state of the art by the adoption of departures from standards.

All applications for departures shall be subject to the approval procedures of the Transport Agency and details of the proposed departures together with reasons and justification, including benefits to the Transport Agency, shall be submitted for consideration.

A2.10 Evaluation and related construction work

In general the evaluation of load carrying capacity of existing structures and related construction work such as demolition, repair, renewal, refurbishment and strengthening work that affects structural integrity should follow the same technical approval process and be categorised on the same basis that the original structure would have warranted.

A3 Requirements for project feasibility and detailed business case

A3.1 Project feasibility

Generally the early feasibility stages of a highway project (the indicative business case) will have no specific requirements for structures technical approval. Scoping of the project at this stage will develop an understanding of the existing environment and transport and functional requirements of the structure.

Where required to support an indicative business case, preliminary structure options reports, as detailed in A3.2, in so far as knowledge of the site constraints permit, shall be provided.

A3.2 Detailed business case

A detailed business case will generally be undertaken to establish the need, requirements and constraints on construction of a highway scheme. The detailed business case may address a length of highway or it may refer only to a particular structure. The detailed business case shall include preliminary structure options reports unless specifically excluded.

The detailed business case 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.

Where preliminary structure options reports are not produced during the detailed business case, any constraints to structure design options that are identified shall be summarised in the business case for implementation for the scheme, for reference during subsequent stages of design development.

A3.3 Preliminary structure options report

Preliminary structure options reports shall consist of the following sections as detailed in the model document included in annex A1:

- Introduction
- Factors influencing design
- Design options (for each option)
- Description of preferred structural option
- Drawings and documents.

The preliminary structure options reports may be based on limited information. The inputs shall be consistent with the scale of the project. Any significant issues requiring further investigations shall be highlighted.

A preliminary structure options report may cover multiple structures for a project.

A4 Requirements for design and project documentation

A4.1 General

During this pre-implementation stage the design of an approved option for a highway scheme will be undertaken. This may either be a complete detailed design or the development of a specimen design that is subsequently followed by a detailed design by a contractor's design firm under a separate contract.

Initially, structure options reports will be developed to identify the recommended options that are either to be continued to detailed design or presented as a specimen design. Once these options have been accepted by the Transport Agency, and prior to the commencement of detailed design, a structure design statement will be developed for each structure providing full details of the proposed structure and how it will be designed and constructed.

The recommended option, once accepted, may sometimes be used for the purpose of obtaining project resource consents before detailed design is completed.

A4.2 Structure options report

Structure options reports, shall build on the information presented in the preliminary structure options reports. They shall consist of the following sections as detailed in the model document included in annex A1:

- Introduction
- Factors influencing design
- Design options
- Description of proposed structure (preliminary details)
- Proposed design requirements and standards
- Geotechnical conditions (preliminary)
- Drawings and documents.

An estimate of cost shall be given for each option showing the total cost and for bridges the cost per m^2 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 Transport Agency's *Economic evaluation manual*[5] shall be met, and shall include consideration of future maintenance costs.

A4.2 continued

An option shall be recommended for final design or specimen 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 direct construction and maintenance costs, as well as the benefits in terms of the Transport Agency's reputation, easing of any consent processes and the quality of the public environment. This is not necessarily the cheapest option. The design firm shall also recommend such further investigation as is considered necessary for completion of the final design.

The recommended option shall be shown on the 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 structure and for bridges shall show 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 urban design performance, shall be identified. A locality plan shall also be included.

For some methods of procurement of the physical works, such as design and construct, a structure options report will present the proposed specimen design solution and recommendations for inclusion in the principal's requirements. In such instances the structure options report need only be an abbreviated document as it will not be a proposed design that is being put forward, rather a set of design requirements.

A structure options report may cover multiple structures for a project.

A4.3 Principal's requirements

Where the method of procurement of the physical works is such that principal's requirements are required, they shall be developed in accordance with the requirements set out in the contract documentation for the scheme. In addition to specifying the technical standards and performance requirements to be met, the principal's requirements shall reflect all factors affecting the design of the specimen design as stated in the structure options report. To the extent conceivable by the design firm, factors affecting the design should also be set out for possible alternatives from the specimen design that tenderers for the contract could be likely to offer.

A4.4 Tender submission report for design and construct contracts

For design and construct contracts each tendering contractor shall include for each structure of category 1, 2 or 3 a structure options report for the contractor's conceptual design as part of the tender submission report.

The structure options report need only be an abbreviated document addressing the following sections as detailed in the model document included in annex A1:

- Description of proposed structure (preliminary details)
- Proposed design requirements and standards
- Geotechnical conditions (preliminary)
- Drawings and documents.

A4.5 Structure design statement

For the option accepted for detailed design, a structure design statement shall be produced before commencement of detailed design that provides sufficient data to permit a full review of the proposal. It shall encompass the complete structure, including all supporting structure and all works on which the structure relies for its integrity. For bridges, this includes the adjacent approach earthworks and natural ground, bridge site ground improvement works to mitigate liquefaction or instability, and scour protection works.

A4.5 continued

Generally a structure design statement shall be submitted for each structure. However, where several similar category 3 structures occur in a project, with the agreement of the Transport Agency, a single structure design statement may be used.

The time taken to complete technical approval will vary according to the size and complexity of the structure and number of departures. To avoid any unnecessary delay, technical approval may be given in stages through the use of an interim structure design statement as details are evolved and agreed. However the use of an interim structure design statement will not be allowed to prejudice the agreement of a structure design statement for the full structure.

The structure design statement shall include the following sections as detailed in the model document included in annex A1:

- Introduction and description of the proposed structure
- Proposed design details (satisfying requirements related to form, function and durability)
- Structural analysis and design
- Design process matters
- Geotechnical conditions
- Drawings and documents.

For structures that are expected to have a significant visual impact on their environment, or are to be integrated within an existing urban environment, perspective drawings, a photomontage or a scale model shall be provided, which describe the structure in situ.

An outline of how the construction is to be checked for compliance, highlighting head design firm monitoring and quality control inspection and checking requirements shall be provided.

Where an alternative to a fully detailed conforming design is proposed by the contractor during tendering, the structure design statement for the conforming design shall be updated to compare the alternative design with the conforming design.

For design and construct, early contractor involvement (ECI) and alliance contracts the structure design statement shall include:

- A summary of the design firm's interpretation of the principal's requirements for the physical deliverables, methodology and standards.
- A description of how the proposed design addresses the principal's requirements.

A4.6 Reference document schedule

Documents relevant to the design, construction, maintenance and operation of the structure shall be listed in a reference document schedule to be included in the structure design statement. In some forms of contract, such as design and construct, these may be contained in the contract requirements. The reference document schedule will normally include the Transport Agency's *Bridge manual*[(2)], this *Highway structures design guide* and other supplementary standards for specific project requirements.

A4.7 Design review requirements

As a minimum, designs and drawings shall be design reviewed as follows:

a. Categories 3 and 4 require a design review to be undertaken by a checker competent in the area being reviewed, who may work in the same company and in the same office, but is not involved in the design. The design review may be part of the internal design verification.

A4.7 continued

b. Category 2 requires a design review to be undertaken by a checker who is professionally independent of the individuals (working either for the design firm or where relevant the contractor) responsible for the design. The review may be undertaken by subsidiary company, or different office of the same company. However the design review certificate must be signed by a different individual to that who signs the design certificate and the checker and his team must have had no involvement in the design or design verification.

c. Category 1 requires a design review to be undertaken by a checker who is independent of (has no professional or financial interest in) the design firm and where relevant the contractor and their associated companies. The review may not be carried out by a subsidiary company or different office of the same company. The checker shall have the expertise and experience appropriate for the complexity of a category 1 structure.

Where for building consent purposes a design review producer statement (PS2) is required to be provided by a different design firm to that providing the design producer statement (PS1), the checker will need to be wholly independent of the design firm.

The design review firm shall carry out a comprehensive examination of all aspects of the design and shall ensure that it complies with the Transport Agency's requirements as set out in an accepted structure design statement. The design review firm shall ensure that the design is translated accurately into design details, drawings and specification clauses.

The design review firm's analytical work shall be independent of that of the design firm and carried out without exchange of calculation sheets or similar information between the design firm and the design review firm.

The method of analysis employed by the respective teams need not be the same but the design firm and the design review firm should consult with each other during the course of their work to ensure that the results they are obtaining are comparable.

All design review firms shall follow the certification requirements of A5, regardless of the category of the structures reviewed.

Consenting authorities may require more independent design reviews to satisfy their requirements for building consent. The Transport Agency will generally accept such requirements in order to prevent any duplication of reviews.

A4.8 Construction review requirements

Unless otherwise indicated in the contract documentation for the scheme, a proposed level of construction contract management and surveillance shall be determined using table A4(i) in appendix 4 of the ACENZ/IPENZ *Guideline on the briefing and engagement for consulting engineering services*[6] and detailed in the structure design statement.

A5 Certification requirements

A5.1 Design certification

On completion of the final design for a structure, and before construction, the design firm and design review firm shall certify to the Transport Agency that the design complies with the Transport Agency's requirements as detailed in the relevant structure design statement (for category 1 to 3 structures) or the Transport Agency's standards or specifications (for category 4 and uncategorised structures) and any subsequent amendments agreed with the Transport Agency.

A5.2 Construction certification

On completion of the construction for a structure, the contractor and construction review firm shall certify to the Transport Agency that the construction complies with the design and any subsequent amendments agreed with the Transport Agency.

A5.3 Model certificates

Certificates shall be signed to certify the satisfactory completion of the work involved and that the organisations concerned have exercised due professional skill and care.

Model certificates are contained in annex A2. They can also be found in the relevant sections of the *State highway construction contract proforma manual*[7]. However, the wording may vary depending on the Transport Agency's particular requirements/type of contract.

Representatives of the design firm, design review firm, contractor and construction review firm shall sign each certificate as appropriate. All signatories to the certificates shall be competent in the field of work undertaken; have relevant experience and appropriate engineering qualifications, which shall be clearly indicated on the certificate along with their name and position in their organisation; and shall be authorised to sign the certificate on behalf of their organisation.

A5.3 continued

Certificates that will typically be required are:

- Design and design review certificate (for use with category 3 and 4 structures only)
- Design certificate
- Design review certificate
- Construction certificate
- Construction review certificate.

Generally certificates shall be submitted for each structure. However, where several similar category 3, 4 or uncategorised structures occur in a project, with the agreement of the Transport Agency, a single certificate may be used.

A5.4 Building consent requirements

Where required the relevant building consents, code compliance certificates, and certificates for public use (if used), shall be obtained by the design firm or contractor, on behalf of the Transport Agency, from the building consent authority.

In order to satisfy the building consent authority that the structure complies with the *Building code*[3] producer statements, in addition to the certificates that are required herein, are likely to be required. Copies of all submissions and the consents received shall be provided to the Transport Agency.

Note that an exemption of the requirement to obtain building consent and code compliance granted by the building consent authority does not constitute an exemption of the need to comply with the *Building code*[3].

A6 Category of structures

A6.1 Category

As described in A2.2 structures subject to technical approval shall be placed in one of four categories. Slopes affecting structures shall be categorised as for the structure. The following criteria shall be considered when determining category:

Category 4:

Simple structures, which conform to the Transport Agency's *Bridge manual*[(2)] or Transport Agency standard specifications and contain no departures, provided they also conform to one of the following:

a. critical small culvert with a total clear opening (waterway area) less than or equal to 3.4m²

b. noise walls less than 2.5m high and without overhangs

c. fence greater than 2.5m in height

d. lighting columns within the scope of NZTA M26[(8)]

e. CCTV masts of less than or equal to 15m height

f. cantilever masts for traffic signals and/or speed cameras:
   - less than 8.5m height
   - with cantilever projection less than 8.5m
   - with any horizontal projected area suspended above the carriageway not exceeding 1.2m² or vertical projected area not exceeding 0.3m²

g. other mast structures that are less than 10m in height and where the horizontal arm projection is less than 3m

h. highway signs
   - small signs (with panel area less than or equal to 4.7m²) on posts that are more than 7m in height but less than 12m in height
   - large signs (with panel area greater than 4.7m²) on posts that are less than 12m in height

i. earth slopes not affecting bridges within the parameters of route importance level 1 in accordance with table 2.3 of the *Bridge manual*[(2)].

Category 3:

Simple structures, other than those in category 4, which conform in all aspects of design and construction to the Transport Agency's *Bridge manual*[(2)] and Transport Agency standard specifications and contain no departures, provided they also conform to one of the following:

a. bridges with a single simply supported span of less than 20m and having less than 25° skew

b. buried concrete box, buried rigid pipes and corrugated metal buried structures with less than 8m clear span

c. earth retaining structures with an effective retained height of 1.5m or greater but less than 5m

d. critical river and coastal protection works that are less than 5m in height

e. noise walls 2.5m or more in height or with overhangs

A6.1 continued

f. lighting columns outside the scope of NZTA M26[8]

g. CCTV masts not within the parameters of category 4

h. cantilever masts for traffic signals and/or speed cameras not within the parameters of category 4

i. portal and cantilever sign and or signal gantries with a span of less than 20m

j. other mast structures that are more than 10m in height but less than 25m in height, or where the horizontal arm projection is more than 3m

k. highway signs on posts that are 12m or more in height

l. earth slopes not affecting bridges within the parameters of route importance level 2 in accordance with table 2.3 of the *Bridge manual*[2].

Category 2:

Intermediate structures, not within the parameters of categories 1, 3 or 4. These include:

a. bridges with any of the following features, unless considered a category 1 structure:
   - a single simply supported span 20m or greater but less than or equal to 50m
   - multiple simply supported or continuous spans, all of which are less than or equal to 50m
   - a skew of 25° or greater but less than or equal to 45°
   - the superstructure is integral with the piers

b. buried concrete box, buried rigid pipes and corrugated metal buried structures with clear span of 8m or greater

c. overhead crossing of a state highway, including footbridge and cycle bridge, unless considered a category 1 structure

d. earth retaining structures with an effective retained height of 5m or greater but less than 14m

e. critical river and coastal protection works that are 5m or more in height

f. portal and cantilever sign or signal gantries with a span of 20m or greater

g. mast structures that are 25m or more in height

h. earth slopes not affecting bridges within the parameters of route importance level 3 in accordance with table 2.3 of the *Bridge manual*[2].

Category 1:

Complex structures, which require out of the ordinary sophisticated analysis or with any one of the following features:

a. high structural redundancy, highly structurally indeterminate

b. unconventional, novel or esoteric design aspects

c. any span exceeding 50m

d. skew exceeding 45°

e. curved bridges where the curvature requires specific analysis

f. bridges where any continuous length of superstructure between movement joints exceeds 200m

g. difficult foundation problems, including where prone to liquefaction

A6.1 continued

h. moveable bridges

i. bridges with suspension systems

j. steel orthotropic decks

k. earth retaining structures with an effective retained height of 14m or greater

l. earth slopes not affecting bridges within the parameters of route importance level 4 in accordance with table 2.3 of the *Bridge manual*(2).

A6.2 Uncategorised structures

As described in A2.2 simple structures that do not require building consent and are not subject to technical approval, but remain subject to certification requirements are considered as 'uncategorised' structures. These include:

a. non-critical small culverts with a total clear opening (waterway area) less than or equal to 3.4m²

b. earth retaining structures with an effective retained height of less than 1.5m

c. non-critical river and coastal protection works

d. fences less than or equal to 2.5m in height

e. small signs (with panel area less than or equal to 4.7m²) on posts that are less than or equal to 7m in height

A7 References

(1) Highways Agency (2012) BD 2/12 *Technical approval of highway structures*. TSO, London, United Kingdom. Use of this information is licensed under the terms of the Open Government Licence <www.nationalarchives.gov.uk/doc/open-government-licence/>.

(2) NZ Transport Agency (2013) SP/M/022 *Bridge manual* (3rd edition). Wellington.

(3) Parliamentary Counsel Office (1992) Building Regulations 1992. Schedule 1 *The building code*. Wellington.

(4) Ministry of Business, Innovation & Employment *Understanding the building consent process*. Last accessed 9 May 2016. <www.building.govt.nz/projects-and-consents/obtaining-a-building-consent/apply-for-building-consent/building-consent-process/>

(5) NZ Transport Agency (2013) *Economic evaluation manual*. Wellington.

(6) ACENZ/IPENZ (2004) *Guideline on the briefing and engagement for consulting engineering services*. Last accessed 9 May 2016. <http://www.acenz.org.nz/uploads/Client/Guideline on the Briefing and Engagement for Consulting Engineering Services-1st Edition 2004.pdf>

(7) NZ Transport Agency (2015) *State highway construction contract proforma manual* (SM031). Wellington.

(8) NZ Transport Agency (2012) NZTA M26 *Specification for lighting columns*. Wellington.

Annex A1 Model technical approval documents

This annex contains the following model documents that shall be developed in accordance with this appendix A, unless otherwise specified in the relevant contract documentation:

- Preliminary structure options report
- Structure options report
- Structure design statement

PRELIMINARY STRUCTURE OPTIONS REPORT	
Name of project	.....
Name of bridge or structure	.....
Location	.....

1. INTRODUCTION
   - 1.1 Reasons for the construction of the structure
   - 1.2 General site description
2. FACTORS INFLUENCING DESIGN[1]
   - 2.1 Service requirements (function)[2]
   - 2.2 Foundation (subsurface) conditions
   - 2.3 Urban design considerations[3]
   - 2.4 Geometrics (vertical and horizontal alignment)
   - 2.5 Hydrology
   - 2.6 Constraints on span arrangement and clearances
   - 2.7 Constraints on construction methods
   - 2.8 Constraints on construction materials
   - 2.9 Interaction of construction with traffic flows
   - 2.10 Site seismic hazard[4]
   - 2.11 Environmental considerations and constraints
3. DESIGN OPTIONS (for each option)
   - 3.1 Structural forms and modes of behaviour
   - 3.2 How the design addresses the factors influencing the design
   - 3.3 Likely methods of construction
   - 3.4 Construction materials and durability
   - 3.5 Cost estimates[5]
4. DESCRIPTION OF PREFERRED STRUCTURAL OPTION (PRELIMINARY)
   - 4.1 Description of structure option[6]
   - 4.2 Structural type[7]
   - 4.3 Span arrangements
   - 4.4 Foundation type
   - 4.5 Proposed arrangements for construction[8]
   - 4.6 Risks and hazards considered[9]
   - 4.7 Estimated costs of proposed structure option
   - 4.8 Recommended design requirements and standards[10]
5. DRAWINGS AND DOCUMENTS
   - 5.1 Drawings and documents accompanying the preliminary structure options report[11]

6. SUBMISSION AND ACCEPTANCE

6.1 Submitted to the NZ Transport Agency for acceptance:

Signed _____

Name _____

Engineering Qualifications _____

Name of organisation _____

Date _____

6.2 Accepted/Rejected on behalf of the NZ Transport Agency subject to the amendments and conditions below:

Signed _____

Name _____

Position held _____

Date _____

Amendments/conditions _____

Notes

1. Significant factors that affect the design shall be discussed, including those listed
2. eg type of highway, permitted traffic speed, traffic volume, pedestrians, cyclists, utilities to be provided for
3. Include the influence of urban design on the structure and its environs (refer section 2.6.3 of the *Bridge manual*)
4. Include subsoil conditions, and the potential for site instability or liquefaction
5. Include consideration of future maintenance costs
6. Describe the proposed structure including details in respect to the urban design of the structure and its environs
7. Proposed details relevant to the structural behaviour, including details related to the provision of seismic resistance, accommodation of thermal and settlement effects, and articulation of the structure
8. The construction methodology and traffic management to be adopted including details of any interface with existing structures
9. A summary of a risk analysis and of special features of the design that are critical to its success and/or that require special attention during construction. List only risks and hazards that would not be apparent to an experienced and competent contractor
10. The recommended design standards and requirements are those that directly impact on cost – for example geometric standards, provision for major services, importance level, liquefaction mitigation etc.
11. Include, without limitation:
    a) General arrangement drawing
    b) Relevant correspondence and documents from consultations

STRUCTURE OPTIONS REPORT	
Name of project	.....
Name of bridge or structure	.....
Location	.....

1. INTRODUCTION
   - 1.1 Reasons for the construction of the structure
   - 1.2 General site description
2. FACTORS INFLUENCING DESIGN[1]
   - 2.1 Service requirements (function)[2]
   - 2.2 Urban design considerations[3]
   - 2.3 Geometrics (vertical and horizontal alignment)
   - 2.4 Hydrology including climate change effects[4]
   - 2.5 Foundation (subsurface) conditions
   - 2.6 Site stability and liquefaction risk
   - 2.7 Constraints on span arrangement and clearances
   - 2.8 Constraints on construction methods
   - 2.9 Constraints on construction materials
   - 2.10 Interaction of construction with traffic flows
   - 2.11 Site seismic hazard[5]
   - 2.12 Environmental considerations and constraints
   - 2.13 Side protection requirements
   - 2.14 Exposure to potential vehicle or train collision[6]
   - 2.15 Access for inspection and maintenance
   - 2.16 Any territorial authority requirements additional to the requirements of the NZ Transport Agency
3. DESIGN OPTIONS (for each option)
   - 3.1 Structural forms and modes of behaviour
   - 3.2 How the design addresses the factors influencing the design
   - 3.3 Likely methods of construction
   - 3.4 Construction materials and durability
   - 3.5 Tolerance of the structure to overloading under critical load conditions
   - 3.6 Tolerance of the structure to seismic effects, including liquefaction[7]
   - 3.7 Maintenance requirements
   - 3.8 Cost estimates[8]
4. DESCRIPTION OF PROPOSED STRUCTURE (preliminary details)[9]
   - 4.1 Description of structure and design working life[10]
   - 4.2 Structural type[11]
   - 4.3 Span arrangements
   - 4.4 Articulation arrangements[12]
   - 4.5 Foundation type

4. DESCRIPTION OF PROPOSED STRUCTURE (preliminary details) continued
   - 4.6 Proposed form of any bridge side protection
   - 4.7 Structure drainage and disposal of stormwater
   - 4.8 Provisions for services[13]
   - 4.9 Proposed form of any collision protection
   - 4.10 Proposed mitigation of any scour or waterway issues
   - 4.11 Provisions for climate change
   - 4.12 Materials and finishes[14, 15]
   - 4.13 Durability and maintenance requirements[16]
   - 4.14 Proposed arrangements for inspection and maintenance, including provisions for access[17]
   - 4.15 Proposed arrangements for construction[18]
   - 4.16 Risks and hazards considered[19]
   - 4.17 Estimated cost of proposed structure
5. PROPOSED DESIGN REQUIREMENTS AND STANDARDS[20]
   - 5.1 Proposed service requirements (functionality) for the structure
   - 5.2 Proposed departures from the NZ Transport Agency's standard design requirements and standards
   - 5.3 Proposed augmentation of the NZ Transport Agency's standard design requirements and standards
   - 5.4 Proposed clarification of the NZ Transport Agency's standard design requirements and standards[21]
   - 5.5 Proposed constraints to be put upon the contractor's design[22]
6. GEOTECHNICAL CONDITIONS (preliminary)
   - 6.1 Extent of geotechnical investigations undertaken and proposed
   - 6.2 Description of the strata in which the structure and its approaches will found
   - 6.3 Indication of the potential range of differential settlement anticipated under static and seismic loading
   - 6.4 Indication of the potential range of anticipated lateral ground movements or vertical settlements due to embankment loading under static and seismic loading etc
   - 6.5 Categorisation of the site subsoil conditions for earthquake loading derivation
   - 6.6 Identification of the risk, consequences, and mitigation of earthquake-induced liquefaction and lateral spread[23]
7. DRAWINGS AND DOCUMENTS
   - 7.1 Drawings and documents accompanying the structure options report[24]
8. SUBMISSION AND ACCEPTANCE
   - 8.1 Submitted to the NZ Transport Agency for acceptance:

Signed _____

Name _____

Engineering qualifications _____

Name of organisation _____

Date _____

8.2 Accepted/Rejected on behalf of the NZ Transport Agency subject to the amendments and conditions below:

Signed _____

Name _____

Position held _____

Date _____

Amendments/conditions _____

Notes

1. All significant factors that affect the design shall be discussed, including those listed
2. eg type of highway, permitted traffic speed, traffic volume, pedestrians, cyclists, utilities to be provided for
3. Include the influence of urban design on the structure and its environs (refer section 2.6.3 of the *Bridge manual*)
4. 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
5. Include subsoil conditions, and the potential for site instability or liquefaction
6. For a bridge over a road or railway, the exposure to potential vehicle or train collision with the bridge supports or superstructure
7. Consider options for liquefaction effect mitigation and address the cost effectiveness and structural performance of the options
8. Include consideration of future maintenance costs
9. For carrying forward to detailed design or specimen design as may be appropriate
10. Describe the proposed structure including details in respect to the urban design of the structure and its environs
11. Proposed details relevant to the structural behaviour, including details related to the provision of seismic resistance, accommodation of thermal and settlement effects, and articulation of the structure
12. The form proposed for such items as bearings, deck joints, load limiting devices (eg knock-off elements), energy dissipation devices and shock load transfer devices
13. Include provisions to be made for any services, structures, signs, or poles to be attached to the bridge
14. Materials design parameters (density, strength, modulus of elasticity, coefficients of shrinkage, creep and thermal expansion etc as relevant) for the materials proposed to be adopted
15. Surface finishes to be adopted or applied to the structure, including concrete surface finishes, steel corrosion protection systems, aesthetic textured finishes or coloured coatings, and anti-graffiti coatings
16. eg corrosion protection systems, use or elimination of deck joints and bearings, and time to first maintenance of details and elements expected to require maintenance
17. Procedures to be adopted for the maintenance and/or replacement of elements expected to require maintenance or replacement within the design working life of the structure, in particular in respect to deck joints and bearings
18. The construction methodology and traffic management to be adopted including details of any interface with existing structures
19. A summary of a risk analysis and of special features of the design that are critical to its success and/or that require special attention during construction. List only risks and hazards that would not be apparent to an experienced and competent contractor
20. For detailed design or for incorporation into principal's requirements
21. Should include those areas where the NZ Transport Agency's design documents require 'consideration' of a factor influencing design
22. For the case of design by others
23. Include predictions of behaviour under earthquake events which are both less and more severe than the design event (refer section 5.1.2 of the *Bridge manual*)
24. Include, without limitation:
    a) General arrangement drawing
    b) Departures from standards
    c) Methods of dealing with aspects not covered by standards
    d) Relevant correspondence and documents from consultations

STRUCTURE DESIGN STATEMENT	
Name of project	.....
Name of bridge or structure	.....
Location	.....

1. INTRODUCTION AND DESCRIPTION OF PROPOSED STRUCTURE
   - 1.1 Reasons for the construction of the structure and service requirements (function)
   - 1.2 General site description, including subsurface conditions
   - 1.3 Description of structure, including vertical and horizontal alignment
   - 1.4 Structural type or form, including load paths[1]
   - 1.5 Span arrangements
   - 1.6 Articulation arrangements[2]
   - 1.7 Pier type
   - 1.8 Abutment type (including settlement slab provisions)
   - 1.9 Foundation type
   - 1.10 Approach type
   - 1.11 Ground stabilisation
2. PROPOSED DESIGN DETAILS (satisfying requirements related to form, function and durability)
   - 2.1 Urban design assessment and features
   - 2.2 Cross section
   - 2.3 Form of any bridge side protection[3]
   - 2.4 Surfacing
   - 2.5 Structure drainage and disposal of stormwater
   - 2.6 Provisions for services[4]
   - 2.7 Lighting
   - 2.8 Signage
   - 2.9 Heavy, high or overwidth load route requirements
   - 2.10 Vertical and horizontal clearances to bridged obstacle
   - 2.11 Form of any substructure and superstructure collision protection
   - 2.12 Tolerance of the structure to overloading under critical load conditions
   - 2.13 Tolerance of the structure to seismic effects, including liquefaction
   - 2.14 Mitigation of any scour or waterway issues
   - 2.15 Provisions for climate change
   - 2.16 Design working life
   - 2.17 Materials and finishes[5, 6]
   - 2.18 Durability and maintenance requirements[7]
   - 2.19 Road joints and bearings, including provision for replacement
   - 2.20 Proposed arrangements for inspection and maintenance, including provisions for access[8]
   - 2.21 Anti-vandal and security provisions, graffiti protection
   - 2.22 Proposed arrangements and methodology for construction[9]

3. STRUCTURAL ANALYSIS AND DESIGN
   - 3.1 List of standards and other design documents to be used in the design
   - 3.2 Loading and load combinations
     - 3.2.1 Permanent loading[10]
     - 3.2.2 Snow, wind, thermal and flood loading
     - 3.2.3 ULS earthquake hazard spectra and the design displacement ductility factor
     - 3.2.4 Earth loads
     - 3.2.5 Settlements
     - 3.2.6 Loading relating to normal traffic[11]
     - 3.2.7 Loading relating to overweight traffic[12]
     - 3.2.8 Traffic fatigue loading
     - 3.2.9 Footway or footbridge live loading
     - 3.2.10 Loading relating to exceptional abnormal loads or indivisible loads[13]
     - 3.2.11 Accidental loading
     - 3.2.12 Collision loading
     - 3.2.13 Construction loading[14]
     - 3.2.14 Load combinations
     - 3.2.15 Any special loading not covered above
   - 3.3 Seismic design philosophy and approach[15]
   - 3.4 Serviceability criteria[16]
   - 3.5 Material parameters to be adopted
   - 3.6 Methods of analysis and design for the superstructure, substructure and foundations[17]
   - 3.7 The form of analysis models[18]
   - 3.8 Assumptions for calculation of structural stiffness
   - 3.9 Soil parameters and earth pressure coefficients adopted for the modelling of soil-structure interaction and for design of soil retaining structures
4. DESIGN PROCESS MATTERS
   - 4.1 Differences from previously accepted structural form and details, if any, and why
   - 4.2 Risks and hazards considered[19]
   - 4.3 Requirements and standards compliance (including departures)[20]
   - 4.4 Special studies
   - 4.5 Design interfaces[21]
   - 4.6 Approvals required – authorities consulted and any special conditions required
   - 4.7 Issues requiring resolution
   - 4.8 Resource consent compliance
   - 4.9 Design review – proposed category (if category 1, name of proposed independent design review firm)
   - 4.10 Proposed level of construction review
   - 4.11 Proposed method of Building code compliance
   - 4.12 Building consent requirements
   - 4.13 Estimated cost of proposed structure (where appropriate)[22]

5. GEOTECHNICAL CONDITIONS
   - 5.1 Extent of geotechnical investigations undertaken and proposed
   - 5.2 Geotechnical interpretive report recommendations
   - 5.3 Description of the strata in which the structure and its approaches will found and proposed allowable or limiting bearing pressures for end bearing and lateral bearing, and skin friction on piles
   - 5.4 Identification of the potential range of differential settlement anticipated under static and seismic loading to be allowed for in design
   - 5.5 Identification of the potential range of anticipated lateral ground movements or vertical settlements due to embankment loading under static and seismic loading etc, to be allowed for in the design
   - 5.6 Results of groundwater tests and any counteracting measures proposed
   - 5.7 Categorisation of the site subsoil conditions for earthquake loading derivation
   - 5.8 Identification of the risk, consequences, and mitigation of earthquake-induced liquefaction and lateral spread[23]
6. DRAWINGS AND DOCUMENTS
   - 6.1 Drawings and documents accompanying the structure design statement[24]
   - 6.2 Reference document schedule
7. SUBMISSION AND ACCEPTANCE
   - 7.1 Submitted to the NZ Transport Agency for acceptance:

     Signed _____

     Name _____

     Engineering qualifications _____

     Name of organisation _____

     Date _____
   - 7.2 Accepted/Rejected on behalf of the NZ Transport Agency subject to the amendments and conditions below:

     Signed _____

     Name _____

     Position held _____

     Date _____

     Amendments/conditions _____

Notes

1. Proposed details relevant to the structural behaviour, including details related to the provision of seismic resistance, accommodation of thermal and settlement effects, and articulation of the structure
2. The form proposed for such items as bearings, deck joints, load limiting devices (eg knock-off elements), energy dissipation devices and shock load transfer devices
3. Include details of vehicle barriers, pedestrian barriers, cycle barriers, noise barriers and anti-throw screens
4. Include provisions to be made for any services, structures, signs, or poles to be attached to the bridge
5. Materials design parameters (density, strength, modulus of elasticity, coefficients of shrinkage, creep and thermal expansion etc as relevant) for the materials proposed to be adopted
6. Surface finishes to be adopted or applied to the structure, including concrete surface finishes, steel corrosion protection systems, aesthetic textured finishes or coloured coatings, and anti-graffiti coatings
7. eg corrosion protection systems, use or elimination of deck joints and bearings, and time to first maintenance of details and elements expected to require maintenance
8. Procedures to be adopted for the maintenance and/or replacement of elements expected to require maintenance or replacement within the design working life of the structure, in particular in respect to deck joints and bearings
9. The construction methodology and traffic management to be adopted including details of any interface with existing structures
10. eg dead loads, post tensioning, creep and shrinkage
11. eg HN loading. Detail lane widths and numbers
12. eg HO loading. Detail loading combinations with normal traffic as appropriate
13. Include the following as applicable:
    a) Gross weight of the vehicle in tonnes
    b) Axle type, load and spacing (longitudinally and transversely)
    c) Location of vehicle track on deck cross-section
14. Include wind and seismic loads appropriate for the construction period
15. Outline how the seismic response is proposed to be resisted, where inelastic behaviour will be designed to occur, how collapse avoidance will be addressed when dependent on ground stability and how ground induced movements and settlements will be designed for
16. eg stresses, crack widths, displacements, vibrations
17. Include the forms of analysis to be applied for static loads, seismic response, and vibration and methods for dealing with stage construction and time dependent effects
18. Include the manner of application of loads
19. A summary of a risk analysis and of special features of the design that are critical to its success and/or that require special attention during construction. List only risks and hazards that would not be apparent to an experienced and competent contractor
20. Include proposed departures from requirements and standards and proposed methods for dealing with aspects not covered by requirements and standards (refer to separate summary if appended)
21. Interfaces between the structure in question with other components of the project that need to be coordinated as part of the design
22. Include consideration of future maintenance costs
23. Include predictions of behaviour under earthquake events which are both less and more severe than the design event (refer section 5.1.2 of the *Bridge manual*)
24. Include, without limitation:
    a) General arrangement drawing
    b) Relevant extracts from the geotechnical interpretive report
    c) Departures from standards
    d) Methods of dealing with aspects not covered by standards
    e) Relevant correspondence and documents from consultations
    f) Special studies and site specific assessments

Annex A2 Model certificates

This annex contains the following model certificates that shall be used, unless otherwise specified in the relevant contract documentation, to certify the satisfactory completion of the work involved and that the organisations concerned have exercised due professional skill and care:

- For design, design review and construction review where the consultant is employed by the Transport Agency:
  - Design and design review certificate
    (for use with category 3 and 4 structures only)
  - Design certificate
  - Design review certificate
  - Construction review certificate
- For design, design review and construction review where the consultant is employed by the contractor:
  - Design and design review certificate (contractor's design)
    (for use with category 3 and 4 structures only)
  - Design certificate (contractor's design)
  - Design review (contractor's design)
  - Construction review (contractor's design)
- For all construction contracts:
  - Construction certificate

DESIGN AND DESIGN REVIEW CERTIFICATE

(for use with category 3 and 4 structures only)

ISSUED BY: .....
(design firm)

TO: THE NZ TRANSPORT AGENCY

IN RESPECT OF: .....
(description of contract works)

AT: .....
(address)

..... has been engaged by the NZ Transport Agency to provide design services
(design firm)
in accordance with a contract, titled .....
(the contract)

I ..... a suitably qualified design professional and duly authorised agent of
..... confirm that the design and a review of the design have been carried out
(design firm)
with due skill, care and diligence as it relates to:

All of the design / Part only of the design as described below:
(delete that which is not applicable)

.....
.....

and I believe on reasonable grounds that the design has been carried out in accordance with the:
standards or specifications listed below (for category 4 structures only); **or**
structure design statement dated ..... and addenda dated ..... listed below (or attached)
(date) *(date)*

.....

and has been accurately translated in drawings and specifications with the unique numbers listed below (or attached).

.....

.....
(Signature of suitably qualified design professional and authorised agent of the design firm)

..... Date .....
(Professional qualifications)

DESIGN CERTIFICATE

ISSUED BY: .....
(design firm)

TO: THE NZ TRANSPORT AGENCY

IN RESPECT OF: .....
(description of contract works)

AT: .....
(address)

..... has been engaged by the NZ Transport Agency to provide design services
(design firm)
in accordance with a contract, titled .....
(the contract)

I ..... a suitably qualified design professional and duly authorised agent of
..... confirm that the design has been carried out with due skill, care and
(design firm)
diligence as it relates to:

All of the design / Part only of the design as described below:
(delete that which is not applicable)

.....

.....

and I believe on reasonable grounds that the design has been carried out in accordance with the:
standards or specifications listed below (for category 4 and uncategorised structures only); **or**
structure design statement dated ..... and addenda dated ..... listed below (or attached)
(date) *(date)*

.....

and has been accurately translated in drawings and specifications with the unique numbers listed below (or attached).

.....

.....
(Signature of suitably qualified design professional and authorised agent of the design firm)

..... Date .....
(Professional qualifications)

DESIGN REVIEW CERTIFICATE

ISSUED BY: .....
(design review firm)

TO: THE NZ TRANSPORT AGENCY

IN RESPECT OF: .....
(description of contract works)

AT: .....
(address)

..... has been engaged by the NZ Transport Agency to review the design
(design review firm)
undertaken in accordance with a contract, titled .....
(the contract)

I ..... a suitably qualified design professional and duly authorised agent of
..... confirm that a category 1 / 2 / 3 / 4 review of the design has been carried
(design review firm) *(delete those that are not applicable)*
out with due skill, care and diligence as it relates to:

All of the design / Part only of the design as described below:
(delete that which is not applicable)

.....
.....

and I believe on reasonable grounds that the design has been carried out in accordance with the:
standards or specifications listed below (for category 4 structures only); **or**
structure design statement dated ..... and addenda dated ..... listed below (or attached)
(date) *(date)*

.....

and has been accurately translated in drawings and specifications with the unique numbers listed below (or attached).

.....

.....
(Signature of suitably qualified design professional and authorised agent of the design review firm)

..... Date .....
(Professional qualifications)

CONSTRUCTION REVIEW CERTIFICATE

ISSUED BY: .....
(construction review firm)

TO: THE NZ TRANSPORT AGENCY

IN RESPECT OF: .....
(description of contract works)

AT: .....
(address)

..... has been engaged by the NZ Transport Agency to provide
(construction review firm)
CM1 / CM2 / CM3 / CM4 / CM5 observation or other ..... services for certain
(delete those that are not applicable) *(extent of engagement)*
building works undertaken in accordance with a contract, titled .....
(the contract)

I ..... a suitably qualified professional and duly authorised agent of
..... confirm that reviews of the construction have been carried out with due
(construction review firm)
skill, care and diligence as it relates to:

All of the construction / Part only of the construction as described below:
(delete that which is not applicable)

.....
.....

and I believe on reasonable grounds that these works have been carried out and completed in accordance with the design as certified in the design certificate dated ..... and addenda dated .....
(date) *(date)*
listed below (or attached) as authorised by the signatory of the design certificate.

.....

.....
(Signature of suitably qualified professional and authorised agent of the construction review firm)

..... Date .....
(Professional qualifications)

DESIGN AND DESIGN REVIEW CERTIFICATE (CONTRACTOR'S DESIGN)

(for use with category 3 and 4 structures only)

ISSUED BY: .....
(contractor)

TO: THE NZ TRANSPORT AGENCY

IN RESPECT OF: .....
(description of contract works)

AT: .....
(address)

..... has contracted to the NZ Transport Agency to carry out and complete
(contractor)
certain building works in accordance with a contract, titled .....
(the contract).

..... has been employed by the contractor as head design firm for the
(contractor's head design firm)
contractor's design in accordance with the contract.

I ..... a suitably qualified design professional and duly authorised agent of the contractor's head design firm confirm that the contractor's design and a review of the design have been carried out with due skill, care and diligence as it relates to:

All of the contractor's design / Part only of the contractor's design as described below:
(delete that which is not applicable)

.....
.....

and I believe on reasonable grounds that the design has been carried out in accordance with the:
standards or specifications listed below (for category 4 structures only); **or**
structure design statement dated ..... *(date)* and addenda dated ..... *(date)* listed below (or attached)

.....

and has been accurately translated in drawings and specifications with the unique numbers listed below (or attached).

.....

.....
(Signature of suitably qualified design professional and authorised agent of the design firm)

..... Date .....
(Professional qualifications)

I ..... a duly authorised agent of the contractor confirm on behalf of the contractor that

a) The contractor's head design firm named above has contracted with the contractor to act as contractor's head design firm;
b) I have been advised in writing by the head design firm that ..... is competent in the relevant field(s) of design and is duly authorised to sign this statement as agent and on behalf of the head design firm;
c) The subcontracting of any part of the contractor's design or the signing of this statement does not relieve the contractor of any liability or obligation under the contract; and
d) The terms used herein have the same meaning as assigned to them in the contract.

..... Date .....
(Signature of authorised agent of the contractor)

DESIGN CERTIFICATE (CONTRACTOR'S DESIGN)

ISSUED BY: .....
(contractor)

TO: THE NZ TRANSPORT AGENCY

IN RESPECT OF: .....
(description of contract works)

AT: .....
(address)

..... has contracted to the NZ Transport Agency to carry out and complete
(contractor)
certain building works in accordance with a contract, titled .....
(the contract).

..... has been employed by the contractor as head design firm for the
(contractor's head design firm)
contractor's design in accordance with the contract.

I ..... a suitably qualified design professional and duly authorised agent of the contractor's head design firm confirm that the contractor's design has been carried out with due skill, care and diligence as it relates to:

All of the contractor's design / Part only of the contractor's design as described below:
(delete that which is not applicable)

.....
.....

and I believe on reasonable grounds that the design has been carried out in accordance with the:
standards or specifications listed below (for category 4 and uncategorised structures only); **or**
structure design statement dated ..... and addenda dated ..... listed below (or attached)
(date) *(date)*

.....

and has been accurately translated in drawings and specifications with the unique numbers listed below (or attached).

.....

.....
(Signature of suitably qualified design professional and authorised agent of the head design firm)

..... Date .....
(Professional qualifications)

I ..... a duly authorised agent of the contractor confirm on behalf of the contractor that

a) The contractor's head design firm named above has contracted with the contractor to act as contractor's head design firm;
b) I have been advised in writing by the head design firm that ..... is competent in the relevant field(s) of design and is duly authorised to sign this statement as agent and on behalf of the head design firm;
c) The subcontracting of any part of the contractor's design or the signing of this statement does not relieve the contractor of any liability or obligation under the contract; and
d) The terms used herein have the same meaning as assigned to them in the contract.

..... Date .....
(Signature of authorised agent of the contractor)

DESIGN REVIEW CERTIFICATE (CONTRACTOR'S DESIGN)

ISSUED BY: ..... *(contractor)*

TO: THE NZ TRANSPORT AGENCY

IN RESPECT OF: ..... *(description of contract works)*

AT: ..... *(address)*

..... *(contractor)* has contracted to the NZ Transport Agency to carry out and complete certain building works in accordance with a contract, titled ..... *(the contract).*

..... *(contractor's design review firm)* has been employed by the contractor as design review firm for the contractor's design in accordance with the contract.

I ..... a suitably qualified design professional and duly authorised agent of the contractor's design review firm confirm that a category 1 / 2 / 3 / 4 review of the contractor's design has *(delete those that are not applicable)* been carried out with due skill, care and diligence as it relates to:

All of the contractor's design / Part only of the contractor's design as described below:
(delete that which is not applicable)

.....

.....

and I believe on reasonable grounds that the design has been carried out in accordance with the:

standards or specifications listed below (for category 4 structures only); **or**

structure design statement dated ..... *(date)* and addenda dated ..... *(date)* listed below (or attached)

.....

and has been accurately translated in drawings and specifications with the unique numbers listed below (or attached).

.....

.....
(Signature of suitably qualified design professional and authorised agent of the design review firm)

..... Date .....
(Professional qualifications)

I ..... a duly authorised agent of the contractor confirm on behalf of the contractor that

a) The contractor's design review firm named above has been employed by the contractor to act as reviewer of the contractor's design;
b) I have been advised in writing by the design review firm that ..... is competent in the relevant fields of design and is duly authorised to sign this statement as agent and on behalf of the design review firm;
c) The subcontracting of any part of the reviewing of the contractor's design or the signing of this statement does not relieve the contractor of any liability or obligation under the contract; and
d) The terms used herein have the same meaning as assigned to them in the contract.

..... Date .....
(Signature of authorised agent of the contractor)

CONSTRUCTION REVIEW CERTIFICATE (CONTRACTOR'S DESIGN)

ISSUED BY: .....
(contractor)

TO: THE NZ TRANSPORT AGENCY

IN RESPECT OF: .....
(description of contract works)

AT: .....
(address)

..... has contracted to the NZ Transport Agency to carry out and complete
(contractor)
certain building works in accordance with a contract, titled .....
(the contract)

..... has been engaged by the contractor as head design firm for the
(contractor's head design firm)
contractor's design in accordance with the contract.

I ..... a suitably qualified design professional and duly authorised agent of the contractor's head design firm confirm that reviews of the contractor's construction have been carried out with due skill, care and diligence as it relates to:

All of the contractor's design / Part only of the contractor's design as described below:
(delete that which is not applicable)

.....
.....

and I believe on reasonable grounds that these works have been carried out and completed in accordance with the contractor's design as certified in the design certificate dated ..... and addenda
(date)
dated ..... listed below (or attached) as authorised by the signatory of the design certificate.
(date)

.....

.....
(Signature of suitably qualified design professional and authorised agent of the head design firm)

..... Date .....
(Professional qualifications)

I ..... a duly authorised agent of the contractor confirm on behalf of the contractor that

a) The contractor's head design firm named above has been employed by the contractor to act as contractor's head design firm;
b) I have been advised in writing by the head design firm that ..... is duly authorised to sign this statement as agent and on behalf of the head design firm;
c) The subcontracting of any part of the contractor's design or the signing of this statement does not relieve the contractor of any liability or obligation under the contract; and
d) The terms used herein have the same meaning as assigned to them in the contract.

..... Date .....
(Signature of authorised agent of the contractor)

CONSTRUCTION CERTIFICATE

ISSUED BY: ..... *(contractor)*

TO: THE NZ TRANSPORT AGENCY

IN RESPECT OF: ..... *(description of contract works)*

AT: ..... *(address)*

..... *(contractor)* has contracted to the NZ Transport Agency to carry out and complete certain building works in accordance with a contract, titled ..... *(the contract)*

I ..... a duly authorised agent of ..... *(contractor)* believe on reasonable grounds that ..... *(contractor)* has carried out and completed

All of the building works / Part only of the building works as specified below:
(delete that which is not applicable)

.....
.....
.....
.....
.....

in accordance with the design as certified in the design certificate dated ..... *(date)* and addenda dated ..... *(date)* listed below (or attached) as authorised by the signatory of the design certificate.

.....

..... Date .....
(Signature of authorised agent of the contractor)

.....
(Contractor)

.....
(Address)