Chapter 18

Structures

Auckland Transport
An Auckland Council Organisation

18 Structures

18.1 General

18.1.1 Introduction and Governing Principles

AT structures consist of road structures (structures associated with roads) and public transport structures (stations and terminals for buses, trains and ferries). Apart from stations, AT does not in general own rail structures (structures associated with railways).

This chapter primarily sets out AT's requirements for major/significant (not minor) road structures and public transport structures, including the structural requirements for such structures. Several other chapters also contain requirements that affect major structures. Many of these requirements are referenced from Chapter 18, but the user should be aware that the referencing may not be complete.

The requirements for most minor structures are stated elsewhere in this code of practice, but some minor structures are included in this chapter because they are not covered elsewhere.

Section 18.1.3 below clarifies which chapter should be consulted for different types of structure.

The requirements of this code of practice apply to structures designed and constructed for AT and structures designed and constructed for others that are intended to pass into AT ownership. It is also intended that they apply to structures within the road reserve owned by others, and structures owned by others that are adjacent to and affect the road reserve.

Sections 18.1.6 and 18.1.7 below on Building Act and Building Code compliance of structures apply to all structures.

For the structures covered by this chapter, requirements (including process and documentation requirements) are stated for:

- Design of new structures
- Design of modifications (extensions/retrofits/strengthening) to existing structures
- Construction
- Evaluation of existing structures

Requirements related to the management, inspection and maintenance of structural assets once constructed (asset management) are not covered by this code of practice. However requirements for vesting of assets and asset data are given in *ATCOP Chapter 25*.

18.1.1 Definitions For Purpose of this Chapter

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 gives form and stability.

Structural Design – Designing for strength and stability, and also for serviceability and durability. By definition, a structure requires structural design.

Structural – As used in structural design. Pertaining to structural behaviour.

Design Requirements for Structures – All of the design requirements that apply to a structure, many of which derive from its function. Include, but are not limited to, the structural design requirements.

Building – As defined in the Building Act (see 18.1.5 below). Most or all AT structures are *buildings*.

Building – As normally understood – a structure intended to be occupied by people.

18.1.2 Structure Types Covered By Chapter 18

The types of structures for which requirements are given in Chapter 18 (typically major or significant structures) include:

- Bridges for road traffic, pedestrians and cyclists (excluding minor bridges and boardwalks)
- Minor Bridges and Boardwalks (definition in 18.3)
- Retaining Walls (excluding minor retaining walls)
- Minor Retaining Walls (definition in 18.4)
- Major Culverts (all culverts or multiple culverts with total waterway area equal to or greater than 3.4 m2)
- Pedestrian and Cyclist Subways and Stock Underpasses
- Supports for Overhead Signs, VMS Signs and Large Roadside Signs (panel area > 4.7m2)
- Noise Barriers
- High Mast Lighting Columns (columns not covered by this chapter)
- Buildings Associated With Public Transport Infrastructure (stations and terminals)
- Rail Station and Ferry Terminal Canopies
- Other AT Structures (structures not included in types listed above or below)

Structure types for which requirements are not stated in Chapter 18, but are stated elsewhere in this code of practice (typically minor structures) include:

- Supports For Small Roadside Signs (panel area < 4.7m2) *(see Chapter 10) (as at the date of this draft, structural requirements for small sign supports yet to be added to Chapter 10*)
- Lighting Supports (see Chapter 19)
- Bus Shelters (see Chapter 20) *(as at the date of this draft, structural requirements not yet stated in Chapter 20)*
- Minor Culverts (see Chapter 17) *(as at the date of this draft, structural requirements not yet stated in Chapter 17)*
- Piped Stormwater System Elements (see Chapter 17) *(as at the date of this draft, structural requirements not yet stated in Chapter 17)*
- Fences, Barriers, Railings (see Chapter 9) (*as at the date of this draft, structural requirements not yet stated in Chapter 9*)
- Masts for Traffic Signals, CCTV Cameras, Speed Cameras (see Chapter 7, section 7.11.5)
- Traffic Barriers (see Chapter 9) (as at the date of this draft, structural requirements in Chapter 9 need updating and clarification)
- Street Furniture (see Chapter 6) (as at the date of this draft, structural requirements not yet stated in Chapter 6)
- Rail Station Furniture and Ferry Terminal Furniture (see Chapters 21 and 22 respectively)

18.1.3 Standard Designs For Structures

For certain types of structure (typically minor structures) Auckland Transport have standard designs and standard specifications. These should be used unless agreed otherwise with Auckland Transport.

Standard designs and specifications are referred to from within the relevant chapter.

18.1.4 Structural Design Standards Used In New Zealand

Structural design standards consist of loading standards and material design standards.

The most commonly used loading (or design actions) standard in New Zealand is the AS/NZS 1170 series (AS/NZS 1170.0, AS/NZS 1170.1, AS/NZS 1170.2, AS/NZS 1170.3 and NZS 1170.5) covering general principles, permanent, imposed and other actions, wind actions, snow and ice actions and NZ earthquake actions respectively.

The most commonly material design standards for major/significant structures are NZS 3101 (concrete), NZS 3404 (steel), NZS 3603 (timber) and NZS 4230 (concrete masonry).

The NZTA Bridge Manual consists of a loadings standard appropriate for the types of structures covered (bridges, retaining walls and major culverts) and modifications and additions to several material design standards to suit them for these structure types.

Some other structural design standards are used for special types of structures not covered by the above.

18.1.5 Building Act and Building Code Compliance of Structures

Most, if not all, Auckland Transport structures are considered to be buildings in terms of the Building Act 2004, and for the purpose of this document it has been assumed that all Auckland Transport structures should be buildings.

(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 it is clear that minor structures such as fences, walls, poles, paths, tanks and culverts are considered to be buildings. The Building Code 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 can be concluded that roading 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. Construct in this context includes to design, build, erect, prefabricate and relocate a building.

Building Code compliance is thus a requirement for the construction or alteration of all Auckland Transport structures that are *buildings*.

Design Requirements documents (see section 18.1.8) should include compliance with the relevant clauses of the Building Code as requirements for the structure.

Building Code clauses B1 – Structure and B2 – Durability apply to all buildings and contain the primary structural requirements of the building code.

Many building code clauses are clearly intended to apply to buildings in the normal sense and will apply to some public transport structures, but are not applicable to road structures. However Clause F4 – Safety From Falling applies to some road structures, and Clause E1 – Surface Water and Clauses C1 to C6 (Fire Protection) may apply in some cases. Clause D1 – Access Routes is considered to be not applicable to road 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 D1 Compliance Document or parts thereof may sometimes be used to define AT's additional requirements for a road structure.

Compliance with Building Code clauses can be achieved via the DBH (Department of Building and Housing, now part of the Ministry of Business, Innovation and Employment) Compliance Documents, or via Alternative Solutions.

The DBH Compliance Documents set out accepted means of compliance with the Building Code clauses. As an example, one accepted means of compliance with B1 – Structure described in the B1 Compliance Document is verification method B1/VM1,consisting of the use of the AS/NZS 1170 series, NZS 3101, NZS 3404, NZS 3603 and NZS 4230 together with some modifications deemed necessary by DBH. A design which complies with the Compliance Documents is deemed to be code compliant.

An Alternative Solution is a means of compliance with the performance requirements of the Building Code that differs from those offered by the Compliance Documents. An Alternative Solution must achieve compliance "to the satisfaction of the building consent authority". The NZTA Bridge Manual is a commonly accepted Alternative Solution for Building Code Clauses B1 and B2 for the structure types covered by the Bridge Manual.

Design Statements (see 18.1.8) should note the proposed means of compliance with the Building Code clauses relevant to the structure.

18.1.6 Building Consent Requirements for Structures

Building work for some, but not all, of the AT structures that are buildings will require building consents (note that compliance with the Building Code is required irrespective of whether a building consent is required). Section 41 and Schedule 1 of the Building Act list building work exempt from requiring a building consent. Guidance on exemptions is given in the Department of Building and Housing document "A guide to building work that does not require a building consent". Second Edition, December 2010.

The table below sets out AT's current (July 2013) understanding of which AT structures require building consents for 'construction or alteration', together with the basis for exemption, where applicable. Letters refer to exemptions under Schedule 1.

Note the understanding in the table, particularly the yellow highlighted items, is currently awaiting confirmation from Auckland Council.

Note that repairs and maintenance are generally exempt under exemption (a) of Schedule 1. However, the exemptions under Schedule 1 do not in general cover demolition or removal of a *building*.

Design Requirements documents and Design Statements must 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 (k), 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 "unlikely to be carried out otherwise than in accordance with the building code" or "if carried out otherwise than in accordance with the building code, is unlikely to endanger people or any building". Exemptions under exemption (k) are said in the DBH document to be "at the council's discretion". The AT project manager and the designer may consider whether the work in question may qualify for exemption (k), and if so, discuss with the consenting authority (Auckland Council).

Structure Type	Current Understanding of Building Consent Requirements
Bridges for road traffic, pedestrians and cyclists	Required - except where it is not possible for a person to fall more than 1.5m even if the bridge collapses (exemption (ga)).
Retaining walls (including seawalls)	Required - except where wall retains not more than 1.5m and does not support any surcharge (exemption (c)), 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 by a chartered professional engineer (exemption (db))
Culverts	Grey area. Culverts that are 'simple structures' (not defined) are exempt under exemption (b). Piped culverts with inlet/outlet structures that do not themselves require consent (see above) will thus be exempt. Large box culverts that are little different to small bridges will require a building consent. Most 'major culverts' (waterway area equal to or greater than 3.4 m2) will require a building consent. Many 'minor culverts' (waterway area less than 3.4 m2) will not require a building consent Can this be further clarified ?
Wharves and jetties	Required - except where it is not possible for a person to fall more than 1.5m even if the wharf or jetty collapses (exemption (ga)).
Pedestrian or stock underpasses and subways	Required
Signs and sign supports	Exempt under exemption (ba) if either (i) the sign surface area does not exceed 6 m2 and the sign does not exceed 3m in height above the supporting ground level or (ii) the sign has

Structure Type	Current Understanding of Building Consent Requirements
	been designed by a chartered professional engineer. Otherwise required.
Walls, fences and hoardings (including noise barriers)	Exempt (exemption(daa)) if height does not exceed 2.5m above the supporting ground. Otherwise required (unless exemption (b) applies?)
Lighting supports (all heights)	Exempt under exemption (b) – simple structure owned or controlled by a NUO or other similar organisation.
Masts for traffic signals, speed cameras, CCTV etc	Exempt under exemption (b) – simple structure owned or controlled by a NUO or other similar organisation.
Height restriction gantries	Exempt under exemption (bb)
Bus Shelters	Exempt under exemption (i) – detached building less than 10 m2 in floor area
Piped stormwater system elements (pipes, manholes, chambers)	Exempt under exemption (b) – simple structure owned or controlled by a NUO or other similar organisation.
Roadside or median traffic barriers	Exempt under exemption (b) – simple structure owned or controlled by a NUO or other similar organisation.
Station or terminal buildings	Required – except for small detached buildings that qualify for exemption (i)
Detached station or terminal canopy structures	Required
Boardwalks	Exempt under exemption (ga) - except where it is possible for a person to fall more than 1.5m if the boardwalk collapses
Other	As given by Schedule 1 and DBH Guide

18.1.7 Process for Design and Construction of Structures

The following process for the design and construction of a structure (either a new structure, or modifications to an existing structure) for which requirements are stated in Chapter 18 (generally a major or significant structure) is envisaged. Modifications to the process may be agreed with Auckland Transport on a project-specific basis. (Note that the process outlined is that applicable to 'Conventional' Delivery. For 'Design and Construct' delivery appropriate process modifications must be agreed with Auckland Transport, and include the production of robust developed **Design Requirements.**)

The process outlined below for structures does not replace that outlined in *ATCOP section 1.9*; it is intended to take place within that process.

Documentation described in **bold** is further defined in section 18.1.9.

- Identification of need
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- Documentation of initial **Design Requirements** (can be by AT or by consultant)
- Approval by AT of initial **Design Requirements**

- Investigation (site information)
- Examination of Options
- Selection of Preferred Concept
- Preliminary Design of Preferred Concept
- Preparation of **Design Statement**, including:
    - Developed **Design Requirements**
    - Description of proposed structural form and preliminary general arrangement drawings
- Peer review (if considered appropriate) of Design Statement
- Approval by AT of developed **Design Requirements** and proposed structural form
- Detailed design and preparation of draft drawings and specifications and Design Report (updated **Design Statement**)
- Peer Review
- Assembly of completed **Construction Documentation** (Drawings, Specifications and Design Report) and **Design and Design Review Certification**
- Obtaining of Building Consent (if required – see 18.1.7)
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- Construction and Construction Review
- **Construction and Construction Review Certification**
- Obtaining of Code Compliance Certificate (if a Building Consent was obtained)
- Preparation of **Asset Data** (Handover Documentation)
- Final Acceptance by AT Into Asset Inventory

18.1.8 Documentation Requirements for Design and Construction of Structures

Requirements for documentation associated with the process for the design and construction of structures for which requirements are stated in this chapter (typically major or significant structures) are as follows (note this covers requirements for technical documentation, not procurement documentation. These requirements are additional to any stated elsewhere in this COP.):

18.1.8.1 Design Requirements

A Design Requirements document should state AT's requirements for the structure, including:

- Functional Requirements (requirements related to the purpose of the structure)
- Structural Requirements (standards, loads and design criteria)
- Durability Requirements
- Aesthetic or Urban Design Requirements
- Construction Requirements (additional requirements or constraints applying to construction)

The Design Requirements should incorporate the requirements for specific structure types set out in the following sections of this chapter and other applicable requirements of this Code of Practice. Any ambiguities must be referred to Auckland Transport for resolution.

Construction Requirements must incorporate those set out in section 18.1.10.

Where an existing structure is being modified, the Design Requirements should set out requirements for both new and existing portions of the modified structure. Requirements for the new portion will generally be as for a new structure. Requirements for the existing portion and for the complete modified structure will be agreed on a project and structure specific basis

18.1.8.2 Design Statement

The Design Statement must include:

- Site information influencing the design, including ground conditions and topography
- Options considered
- Description and preliminary drawings of proposed structural form and layout
- Developed **Design Requirements** taking into account proposed structural form
- Proposed design loading, criteria and parameters resulting from interpretation of site information and Design Requirements
- Proposed durability solutions
- Proposed access for future inspection and maintenance
- Proposed analysis and design methodology

The Design Requirements must be appended to the Design Statement

18.1.8.3 Construction Drawings

Drawings must use the Auckland Transport Standard CAD Template (see *ATCOP section 1.9*).

Additionally, construction drawings for structures must be prepared in accordance with AS/NZS 1100.501:2002 – Structural Engineering Drawing.

The drawing set for a structure should include a list of all drawings applicable to a structure, and should note the design standards adopted for the design of the structure.

18.1.8.4 Construction Specifications

Construction technical specifications must 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.

Specifications must be up-to-date, and must not refer to obsolete or superseded standards.

Additionally, construction specifications should address any Construction Requirements (see 18.1.10 below) not incorporated in the Construction Drawings.

18.1.8.5 Design and Design Review Certification

Design and Design Review certification must consist of ACENZ/IPENZ/NZIA PS1 and PS2 producer statements confirming compliance with the relevant clauses of the Building Code plus letters from the designer and design reviewer confirming that the design is in accordance with the approved Design Requirements document.

Note that these certification requirements apply whether or not a building consent is required for the structure.

The signatories of the design and design review certification must be CPEng (or similar approved) accredited.

18.1.8.6 Construction and Construction Review Certification

Construction certification should be in the form of the 'Form of Producer Statement – Construction; NZS 3910: 2013 or PS3 Producer Statement as appropriate.

Construction Review certification must be in the form of the ACENZ/IPENZ/NZIA PS4 producer statement.

Note that these certification requirements apply whether or not a building consent was required for the structure.

The signatories of the construction and construction review certification must be CPEng (or similar approved) accredited.

18.1.8.7 Asset Data (Handover Documentation)

Asset Data consists of As-Built Drawings, Asset Owner's Manual, Design Report, Construction Report, Bridge Overload Data etc. as appropriate for the structure type and required for the operation and maintenance of the structure – refer to *ATCOP Chapter 24* for AT's requirements) Construction Requirements For Structures

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 build in accordance with the drawings and specifications. Sometimes construction requirements become design requirements, and so they should be identified in the Design Requirements document.

18.1.8.8 Strength and Stability During Construction

Buildings are required to comply with Clause B1 of the Building Code both during construction or alteration and throughout their lives. Designers must 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 stages must be clearly outlined.

Consideration must be given by the designer to the design events to be considered during construction. As a minimum, the requirements of AS/NZS 1170.0 to design for wind and earthquake loads with an Annual Probability of Exceedance (APOE) of 1/100 must 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 or adjacent to other property, design for lower APOE may be appropriate. Where relevant, the Design Requirements document must note the standards to apply during construction.

18.1.8.9 Temporary Works Requirements

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

These requirements must be agreed with AT prior to tender.

18.1.8.10 Continuity of Service Requirements

Often existing assets (whether roading or other transportation assets or utilities) 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 should be noted in the Design Requirements for the structure and conveyed to the constructor via the construction drawings and specifications.

18.1.8.11 RMA Requirements During Construction

RMA requirements applying during construction may affect the feasibility of certain construction methodologies. Any applicable requirements should be noted in the Design Requirements document and Design Statement, and conveyed in the construction specifications.

18.1.9 RMA Compliance of Completed Structures

When assembling the Design Requirements pertaining to a structure in its finished form, any requirements pertaining to the completed structure arising from RMA processes must be ascertained from the AT project manager and incorporated.

18.1.10 Evaluation of Existing Structures

Evaluation of an existing road bridge or culvert to obtain parameters which define its traffic load carrying capacity should be carried out in accordance with Section 7.0 of the NZ Transport Agency's Bridge Manual SP/M/022, Third Edition.

18.2 Design Requirements for Bridges, Retaining Walls and Major Culverts

18.2.1 General

The design requirements set out below relate specifically to the design of bridges (excluding minor bridges and boardwalks), retaining walls (excluding minor retaining walls) and major culverts. Major culverts are defined as having a cross sectional area greater than 3.4m2 and must be designed as bridges. Minor bridges are defined in section 18.3. Minor retaining walls are defined in section 18.4.

Essentially the requirements set out below require these structure types to be designed in accordance with the New Zealand Transport Agency's Bridge Manual (3rd edition), with some modifications to general requirements to suit AT structures.

The Bridge Manual includes requirements for the design of foundations for the structure types covered by the Bridge Manual and for the design of earthworks affecting the structures. *ATCOP Chapter 15* also addresses the design of foundations and earthworks. This potential ambiguity is addressed in the following by requiring the Bridge Manual requirements to be followed rather than *ATCOP Chapter 15*.

The Bridge Manual seismic loading requirements for structures in the Auckland region differ from those in NZS 1170.5, with lower Z values, but a requirement that Z.Ru be not less than 0.13. *ATCOP Chapter 15* sets out seismic loading requirements for AT transportation infrastructure. For the structure types covered by the Bridge Manual, any potential ambiguity is addressed in the

following by requiring the Bridge Manual requirements to be followed rather than *ATCOP Chapter 15*.

In addition to covering the design of bridges, retaining walls and major culverts, the Bridge Manual also covers the design of slopes, embankments and cuttings, whether or not affecting structures. For clarity, it is confirmed here that:

- The design of slopes, embankments and cuttings affecting bridges, retaining walls and major culverts must be carried out in accordance with the Bridge Manual as modified below.
- The design of slopes, earthworks and cuttings affecting other structures covered in this chapter must be in accordance with *ATCOP Chapter 15* unless noted otherwise in this chapter.
- The design of slopes, earthworks and cuttings not affecting structures covered by this chapter must be in accordance with *ATCOP Chapter 15*.

18.2.2 Design Requirements

Design of bridges, retaining walls and major culverts must comply with the NZ Transport Agency's Bridge Manual SP/M/022, Third Edition and standards referenced therein except as modified, amplified or added to in section 2.3.

The design of bridges, retaining walls and major culverts must also comply with the Building Code.

Compliance with Clauses B1 – Structure and B2 – Durability should be via the Bridge Manual as an Alternative Solution.

Compliance with Clause F4 – Safety From Falling should be via the DBH Compliance Document for Clause F4. (Note that the Bridge Manual contains requirements for barriers for footpaths and cycleways, which refer to the Compliance Document. However the Bridge Manual does not contain requirements for fall prevention barriers on structures where a footpath or cycleway is not present, such as retaining walls and culvert headwalls. Thus the Bridge Manual on its own is not an adequate means of compliance with F4.)

Fall prevention barriers must also comply with the requirements of *ATCOP Chapter 9.*

Structures should be beautiful and reflect the place specific context and sensitivity. Refer to urban design principles for guidance in *ATCOP Section 2.6*.

Where compliance with other Building Code clauses is judged to be necessary, this should be stated in *ATCOP Section 2.6 Urban Design* for guiding principles.

18.2.3 Modifications to Bridge Manual

18.2.3.1 Section 1 – Introduction

The technical approval and certification procedures set out in section 1.4 do not apply to AT structures.

18.2.3.2 Section 2 – Design – General Requirements

This important section of the Bridge Manual addresses fundamental requirements including importance levels, annual probabilities of exceedance for SLS and ULS design, design working life

and durability requirements, provisions for inspection, maintenance and repair, geometric and side protection requirements, waterway design requirements, site investigation requirements, appearance, form and function requirements and special study requirements. These are modified in the following to reflect AT's requirements.

18.2.3.3 Item 2.1.3 Basis of Design:

The importance level and annual probabilities of exceedance for extreme events for AT's bridges (including major culverts) and retaining structures (and for earth slopes affecting bridges and retaining structures) must be in accordance with 2.1.3 and Tables 2.1 and 2.2, with the primary lifeline routes identified in the reports created by the Auckland Engineering Lifelines (www.aelg.org.nz) added to those shown in Figure 2.1 (c)

18.2.3.4 Item 2.1.5 - Design Working Life:

The design working life of a bridge, major culvert or retaining structure must be 100 yrs except for the following situations, where a design working life of 50 years is acceptable:

- Retaining structures of Importance Level 1 and 2, the replacement of which would not affect the use of the road or affect the stability of adjacent property
- Retaining structures of Importance Level 1 on no-exit or loop rural roads not serving a through road function and serving populations <50

18.2.3.5 Item 2.2 – Geometric and Side Protection Requirements

The geometric requirements for bridges and major culverts set out in Appendix A of the Bridge Manual must be modified as described in *ATCOP Chapters 5, 10 and 11* for AT structures.

The side protection requirements set out in 2.2 should apply to AT structures.

18.2.3.6 Item 2.3 Waterway Design

This section should apply to AT bridges and major culverts, except that the words "state highway" in 2.3.2 (d) must be replaced with "road".

18.2.3.7 Item 2.4 Site Investigations

The requirements of *ATCOP Section 15.1* must apply in addition to those set out in BM 2.4.

18.2.3.8 Item 2.6 – Urban Design:

Refer to *ATCOP section 2.6* for the Urban Design requirements.

18.2.3.9 Sections 3 to 5 – Design Loading, Analysis and Design Criteria, Earthquake Resistant Design

These sections set out structural design requirements for the structures covered by the Bridge Manual, and are adopted without modification. Note that the seismic loading requirements set out in section 5 are thus adopted for the design of AT bridges and that these differ to those in *ATCOP Chapter 15 Earthworks*.

18.2.3.10 Section 6 – Site Stability, Foundations, Earthworks and Retaining Walls

This section should be adopted for the design of retaining walls, foundations of bridges, major culverts and retaining walls and earthworks affecting these structures.

The requirements set out in this section are thus adopted and that these differ to those in *ATCOP Chapter 15 Earthworks.*

18.3 Design Requirements for Minor Bridges and Boardwalks

18.3.1 General

This separate structure type is provided to cover bridge-like structures for which the use of the Bridge Manual would be inappropriate, such as timber boardwalks.

A boardwalk will typically be designed in accordance with the B1 and B2 Compliance Documents and thus have a design life of 50 years, and be designed for lower loads and load factors than a pedestrian bridge designed in accordance with the Bridge Manual.

It may also be considered appropriate to design small pedestrian/cycle bridges or small bridges for maintenance vehicles for this lower standard. It is noted that timber structures typically do not have a design life greater than 50 years. The designer must agree with AT whether or not a small bridge is to be designed as a minor bridge.

18.3.2 Design Requirements

The geometry of minor bridges and boardwalks (widths, gradients, clearances etc) must be in accordance with *ATCOP Chapters 12 and 13*.

The urban design requirements of *ATCOP Section 2.6* must apply.

The design of minor bridges and boardwalks must comply with the Building Code. A design life of 50 years and an importance level of 2 and NZS 4121:2001 – 'Design for Access and Mobility – Buildings and Associated Facilities' should typically be adopted.

Compliance with Clauses B1 – Structure and B2 – Durability must be via the DBH Compliance Documents for these two clauses.

A uniformly distributed live load of at least 4.0 kPa must be adopted, together with concentrated actions as appropriate for the envisaged use and access to the structure.

Compliance with Clause F4 – Safety From Falling must be via the DBH Compliance Document for Clause F4. Fall prevention barriers must also comply with the requirements of *ATCOP Chapter 9*.

Where compliance with other Building Code clauses is judged to be necessary, this must be stated in the Design Requirements document and a means of compliance proposed.

18.3.3 Standard Details

Refer to *ATCOP Chapter 12* for further details.

18.4 Design Requirements for Minor Retaining Walls

18.4.1 General

This separate structure type is provided to cover small retaining walls for which the use of the Bridge Manual would be inappropriate.

A minor retaining wall is defined as a wall that retains not more than 1.5m depth of ground and that does not support any surcharge or any load additional to the load of that ground – i.e. the same definition as that used to determine whether a wall requires a building consent (see Schedule 1 of the Building Act).

18.4.2 Design Requirements

The urban design requirements of *ATCOP section 2.6* must apply.

The design of minor retaining walls must comply with the Building Code. A design life of 50 years should be adopted.

Compliance with Clauses B1 – Structure and B2 – Durability must be via the DBH Compliance Documents for these two clauses.

Compliance with Clause F4 – Safety From Falling, where necessary, must be via the DBH Compliance Document for Clause F4. Fall prevention barriers must also comply with the requirements of *ATCOP Chapter 9*.

Where compliance with other Building Code clauses is judged to be necessary, this must be stated in the Design Requirements document and a means of compliance proposed.

The process and documentation requirements of this chapter (see section 18.1. 8) need not apply to minor retaining walls.

18.4.3 Standard Details

Refer to *ATCOP Section 12.*10for further details.

18.5 Design Requirements for Pedestrian and Cycle Subways and Stock Underpasses

18.5.1 Design Requirements

For functional design requirements for pedestrian and cycle subways and stock underpasses refer to the following ATCP chapters:

- Urban Design, Safety and Accessibility – Chapter 2
- Cycling Infrastructure Design – Chapter 13
- Geometric – Chapters 12 and 13
- Drainage – Chapter 17
- Lighting – Chapter 19

The structural design of pedestrian subways and stock underpasses must be as for major culverts, as set out in section 18.2 (i.e. Bridge Manual with modifications).

Subways and underpasses must be detailed to limit the ingress of water to acceptable levels as appropriate for the intended use.

The design of pedestrian subways and stock underpasses must also comply with the Building Code, CPTED and NZS 4121:2001 – 'Design for Access and Mobility – Buildings and Associated Facilities'.

Compliance with Clauses B1 – Structure and B2 – Durability should be via the Bridge Manual as an Alternative Solution.

Compliance with Clause F4 – Safety From Falling must be via the DBH Compliance Document for Clause F4. Fall prevention barriers (at subway and underpass entrances) must also comply with the requirements of Chapter 9 of this COP.

Where compliance with other Building Code clauses is judged to be necessary, this must be stated in the Design Requirements document and a means of compliance proposed.

18.6 Design Requirements for Supports for Overhead Signs, VMS Signs and Large Roadside Signs

Requirements for signs, sign face design and supports for small roadside signs are provided in *ATCOP Chapter 10*.

Sign supports and their foundations must comply with TNZ P/24:2008 Performance Based Specification For Traffic Signs.

Supports for overhead and VMS signs must be designed for a 50 year life with an Importance Level of 2.

Supports for large roadside signs (signs with face area greater than 4.7 m2) must be designed for a 25 year life with an Importance Level of 2.

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

Corrosion protection to sign supports must provide a time to first maintenance of at least 25 years.

The design of supports for VMS signs must take into account the requirement to access the VMS signs for maintenance. Access arrangements must be described in the Design Statement.

The design of sign supports must comply with the Building Code.

Compliance with Clauses B1 – Structure and B2 – Durability must be via the DBH Compliance Documents for these two clauses.

Note that the Building Act does allow buildings to have a life of less than 50 years, as per Section 113 of the Act. Where a building is intended to have a life of less than 50 years (as with large roadside signs and also small roadside signs) the nominated life is termed the Specified Intended Life.

18.7 Design Requirements for Noise Barriers

Noise wall design should follow the recommendations of the NZTA State Highway Noise Barrier Design Guide (Version 1.0 August 2010).

Noise barriers should have a 50 year design life and an Importance Level of 2. Corrosion protection to steel elements must provide a time to first maintenance of at least 25 years. However in the case where a noise barrier is on a property boundary, consideration should be given to the feasibility of access for inspection and maintenance. This may result in an increased life to first

maintenance. Where connections (for example of panels to posts) are not accessible for inspection, the vulnerability of the fixings to interference must be taken into account in the detailing.

The design of noise barriers must comply with the Building Code, CPTED and the urban design principles outlined in *ATCOP Chapter 2*.

Compliance with Clauses B1 – Structure and B2 – Durability must be via the DBH Compliance Documents for these two clauses.

18.8 Design Requirements for High Mast Lighting Columns

Requirements for the design of street lighting are provided in *ATCOP Chapter 19*.

Requirements for standard lighting columns (up to 14m from ground to tip of bracket arm) are given in *ATCOP Chapter 19 Appendix 19C*.

This section gives requirements for the design of non-standard (usually taller) lighting columns.

Columns should have a 50 year design life, and an Importance Level of 2.

Corrosion protection to columns must provide a life to first maintenance of at least 25 years.

Design wind speeds must be as given in *ATCOP Chapter 19 Appendix 19C*.

Dynamic response must be considered as required by AS/NZS 1170.2.

Columns must be designed for fatigue using the wind fatigue spectrum contained in AS/NZS 1170.2 and the fatigue provisions of NZS 3404.

Provision for cable access and switchboard access must be made, generally in accordance with *ATCOP Chapter 19 Appendix 19C*.

Lighting column performance under vehicle impact must be considered, taking into account the speed environment and proximity to the road. Where necessary, either barrier protection or a frangible column should be provided.

The guidance given in NZTA M26:2012 Specification for Lighting Columns must be considered when formulating Design Requirements and a Design Statement for high mast columns.

The design of lighting columns must comply with the Building Code.

Compliance with Clauses B1 – Structure and B2 – Durability must be via the DBH Compliance Documents for these two clauses.

18.9 Design Requirements for Buildings Associated With Public Transport Infrastructure (Stations and Terminals)

18.9.1 Design Requirements

The design of station and terminal buildings must be in accordance with *ATCOP Chapters 20, 21 and 22* for bus stations, rail stations and ferry terminals respectively.

Where for a particular aspect of the building design a requirement is not stated in the above chapters, requirements must be agreed with Auckland Transport on a project specific basis.

Buildings associated with public transport infrastructure must have a 100 year design life except as agreed otherwise with Auckland Transport.

From a durability viewpoint this design life requirement must apply to those building elements that would normally require a 50 year life to satisfy Clause B2 of the Building Code. The life for those elements normally requiring a lesser life (15 or 5 years) should remain unchanged.

Seismic design loading must be derived from NZS 1170.5:2004, except that the hazard factor (Z) must be derived from Figure 5.2 of the Bridge Manual (3rd edition) and for the ultimate limit state the product ZRu must not be taken as less than 0.13.

(Note that the combined effect of increased design life and reduced Z factor on seismic loads is that loads are no less than those that would result from the application of the Building Code minimum requirements).

The design of station and terminal buildings must also comply with the Building Code and NZS 4121:2001 – 'Design for Access and Mobility – Buildings and Associated Facilities'.

Buildings and associated spaces should be beautiful and reflect the place specific context and sensitivity. Refer to urban design principles for guidance in *ATCOP Chapter 2.6* for guidance..

Structural design of buildings must be in accordance with Building Code Compliance Documents B1 and B2.

The proposed means of compliance with other relevant Building Code clauses must be stated in the Design Requirements document.

18.10 Design Requirements for Station and Terminal Canopies

The design of canopies must be in accordance with *ATCOP Chapters 20, 21 and 22* for bus stations, rail stations and ferry terminals respectively.

Canopies should have a 50 year design life and must be considered to have an Importance Level of 2.

The design of canopies must also comply with the Building Code.

Structural design of canopies must be in accordance with Building Code Compliance Documents B1 and B2.

18.11 Design Requirements for Other AT Structures

Design requirements for other AT structures not addressed in this COP must be agreed with Auckland Transport on a project-by-project and structure-by-structure basis.

The design of all structures must comply with the Building Code.

Structures should be beautiful and reflect the place specific context and sensitivity. Refer to urban design principles for guidance in *ATCOP Section 2.6*.

The proposed means of compliance with relevant Building Code clauses must be stated in the Design Requirements document or Design Statement.