Volume One of the building Code of Australia deals with Class 2 to Class 9 Buildings. A Structural Engineer is primarily concerned with two sections of Volume One of the Building Code of Australia, namely:

Part B1 Structural Provisions

Part B2 Design of Buildings in Cyclonic Areas

both of which contain "Deemed to Satisfy Provisions". Alternative Solutions if used must comply with Clause A0-10 of the BCA.

A Structural Engineer may also be concerned with Part C1 – Fire Resistance and Stability but this Practice Note does not address Part C1.

ACTIONS AND RELEVANT CODES

Part B1, Clause B1.1 requires that

1. the most critical effect on a building or structure is determined using the general design
2. procedures of AS / NZS 1170.0
3. individual actions are determined in accordance with Clause B1.2
4. resistance of the building or structure is determined in accordance with Clause B1.4

Clause B1.2 nominates the following for the determination of individual actions

1. permanent actions AS / NZS 1170.1
2. imposed actions AS / NZS 1170.1
3. wind AS / NZS 1170.2
4. snow and ice AS / NZS 1170.3
5. earthquake AS 1170.4 (as modified by AS / NZS 1170.0)

For wind, snow and ice and earthquake, the above Standards must be used with an annual probability of exceedance determined by

1. assigning the building or structure on importance level in accordance with Table B1.2a of the BCA
2. determining the corresponding annual probability of exceedance in accordance with Table B1.2b for the BCA.

Any other actions must be determined using

- the nature of the action

- the nature of the building or structure
- the importance level determined using Table B1.2a of the BCA
- AS / NZS 1170.1

The cited Australian Standards are mandatory to use in order to satisfy the Deemed to Satisfy Provisions. This statement is reinforced in Clause B1.3 Loads which specifies that the building or structure must resist loads determined in accordance with

1. Dead and live loads and load combinations: AS 1170.1.
2. Wind loads: AS 1170.2.
3. Snow loads: AS 1170.3.
4. Earthquake loads: AS 1170.4.

Note that AS standards are referred to in this Clause not AS/NZS. Both (AS and AS/NZS) are referenced in Specification A1.3. (The references to AS 1170 are expected to be deleted in the May 2008, revision of BCA)

Table B1.2a Importance Levels of Buildings and Structures

Importance	Level Building Types
1	Buildings or structures presenting a low degree of hazard to life and *other property* in the case of failure.
2	Buildings or structures not included in Importance Levels 1, 3 and 4.
3	Buildings or structures that are designed to contain a large number of people.
4	Buildings or structures that are essential to post-disaster recovery or associated with hazardous facilities.

Table B1.2b Design Events for Safety

Importance Level	Annual probability of exceedance			
	Wind		Snow	Earthquake
	Non-cyclonic	Cyclonic		
1	1:100	1:200	1:100	1:500
2	1:500	1:500	1:150	1:500
3	1:1000	1:1000	1:200	1:500
4	1:2000	1:2000	1:250	1:800

The date of issue of these Standards is stated in Specification A1.3 Table 1: Schedule of Referenced Documents. Only the Standard of the specified date in Table 1 may be used in order to ensure compliance with BCA. A Standard issued by Standards Australia may wait for up to twelve months to be included in Table 1 if it is issued after closing date for publication of the BCA. The current issued of a Standard may not be the one referenced in Table 1 of Specification A1.3, so a structural engineer is advised to check always to ascertain the correct issue of a standard to use, in order to ensure compliance with BCA.

Consequently, the Structural Engineer may find that one edition of the aforementioned Standard may need to be complied with for the BCA, but that another edition may need to be used to ensure that the legal requirement to use the latest available information is complied with. Case law indicates that the Structural Engineer is deemed to be aware of the latest information (even if only a draft code, draft amendment to a code, technical paper or the like) when mounting a defence to a claim under Professional Indemnity Insurance.

STRUCTURAL RESISTANCE

Part B, Clause B1.4 specified that structural resistance of materials and forms of construction be determined in accordance with the following Standards

Masonry	– AS 3700
Concrete Construction	– AS 3600
Steel Structure	– AS 4100
Cold-formed Steel Structures	– AS / NZS 4600
Residential and Low Rise Steel Framing	– NASH Standard (not a Standard produced by Standards Australia)
Composite Steel and Concrete	– AS 2327.1
Aluminium Construction	– Either AS / NZS 1664.1 or AS / NZS1664.2
Timber Structures	– AS 1720.1 AS 1684 Part 2, Part 3 or Part 4
Piling	–AS 2159

Glazed Assemblies	– Either AS 2047(external wall) or AS 1288 (other)
Termite Risk Management	– AS 3660.1 unless exempt material
Roof Construction	– Plastic Sheeting AS/NZS 1562.3
	AS/NZS 4256 Parts 1,2,3&5
	– Roofing Tiles AS 2049
	AS 2050
	- Cellulose Cement
	- Corrugated Sheets AS/NZS 2908.1
	- Safety Mesh AS/NZS 1562.3
	– Metal Roofing AS 1562.1
	– Asphalt Shingles ASTM D3018-90 Class A
Particle Board Structural Flooring	– AS 1860
Earthwall Construction	– NBTC Bulletin 5 Edition 4
Lift Shafts (no FRL required)	– AS 1735.2 Clause 11.1.2

The date of issue of these Standards is also stated in Specification A1.3 Table 1: Schedule of Referenced Documents. Only the Standard and Amendments of the date specified in this Table, may be used in order to ensure compliance with BCA. A Standard issued by Standards Australia may wait for up to twelve months to be included in Table 1 if it is issued after closing date for publication of the BCA. The current issue of a Standard may not be the one referenced in Table 1 of Specification A1.3, so a structural engineer is advised to check always to ascertain the correct issue of a standard to use in order to ensure compliance with BCA. Since the BCA is reissued annually, the Specification A1.3 Table 1 is not reproduced in this Practice Note.

Again, the Structural Engineer may find that one edition of the above Standard may need to be complied with for the BCA, but that another edition may need to be used to ensure that the legal requirement to use the latest available information is complied with. Case law indicates that the Structural Engineer is deemed to be aware of the latest information (even if only a draft code, draft

amendment to a code, technical paper or the like) when mounting a defence to a claim under Professional Indemnity Insurance.

CERTIFICATION

In providing structural certification of a design, some proforma certificates issued by Principal Certifiers often ask for certification that "design complies with Part B1 of the BCA". Such a certificate could be taken to cover all standards listed above, even if the structural engineer had no involvement in items such as roof construction, glazed assemblies, termite risk management. Such wording should be avoided.

Structural certification of a design should list only those Standards out of the above list which the structural engineer actually used in the design.

Note that all the above Standards will reference a significant number of other Standards which are by implication also nominated by the BCA as Standards to be complied with. Lists of referenced Standards are contained in each of the above Standards and are too numerous to list here, and need not be listed on any certificate.

OMITTED STANDARDS

A number of Standards which a structural engineer may use are not specifically listed in Clause B1.4. Such Standards need not be listed when certifying compliance with the BCA, but the Certificate may also list other standards or publications not referenced in the BCA but which the Structural Engineer has used for the structural design..

ALTERNATIVE SOLUTIONS

All building design must comply with the relevant State Building Regulations, which are set out in the BCA (Building Code of Australia) Volumes 1 and 2. The BCA defines the performance requirements, generally in very broad terms, and the means of compliance through:

- Deemed-to-Satisfy Provisions, which may include:
    - Acceptable Construction Manuals (e.g. nominated Australian Standards)
    - Acceptable Construction Practice (e.g. forms of construction reproduced in the BCA itself)
    - Alternative Solutions (e.g. Designs based on test results and engineering principles).

Each of these paths to compliance has equal status under the BCA.

In all but the rarest of cases, structural engineers will design using the Deemed-to-Satisfy Solution by:

- Determining loads using AS / NZS 1170 (Parts 0, 1, 2, 3) and AS 1170.4; and,
- Determining resistance using AS 4100, AS 3600, AS 3700, AS 1720, AS 1684, AS 2870 etc.

However, structural engineers are often asked to incorporate new products into their designs. The performance of such products is justified by test because they are outside the scope of the various Australian Standards specified by the BCA as Deemed-to-Satisfy. The requirements are set out in BCA Vol 1 Clauses A0.8, A0.9 and A0.10. When dealing with structural components, the following procedure is appropriate.

1. Determine the performance requirements using BCA Vol 1 Part B1

2. Determine the loads using AS/NZS 1170 (Parts 0, 1, 2, 3) and AS 1170.4

3. Determine the relevant properties from test results e.g. stability, strength, deflection etc.

4. Use AS/NZS 1170.0:2002 Appendix B to assess the test data and obtain design values. Although this Appendix is informative, and therefore not formally part of the BCA Deemed-to- Satisfy path, it provides a reliable component of "Expert Judgement".

5. Use the design values so derived in the context of the normal structural design standards. It should be noted that such design values include allowance for reductions normally associated with the capacity reduction factors.

EXISTING CONSTRUCTION

The BCA deals essentially with new construction.

The question arises as to what should be done when

- an existing structure has to be load-rated
- modifications are carried out to an existing structure
- a new structure is connected to an existing structure

Guidance is given in various Australian Standards, although it is important to remember that part of this work may be outside the scope of the BCA, e.g. renovations would be considered to be outside the scope of the BCA, while an extension would be considered to be within the scope of BCA. It will be necessary for the Structural Engineer to reach agreement with the Consent Authority (e.g. PCA) on what approach is acceptable. A good example of this situation is a proposal to extend an existing building, and there is a requirement that the building have some degree of resistance to earthquake loads. [Note that this example will not apply when AS 1170.4 – 1993 is replaced by AS 1170.4 – 2007 in the BCA. In fact, AS 1170.4 – 2007 will contain no guidance.]

BCA 2006 Volume 1 Clause B1.3 states:

> *The building or structure must resist loads determined in accordance with the following:*
>
> *……..*
>
> *(d) Earthquake load: AS 1170.4*
>
> *……..*

BCA 2006 Volume 1 Table 1 lists AS 1170.4-1993 (including Amendment 1) as a referenced document. AS 1170.4-1993 Section 8 states: "*It is permitted to make structural alterations to existing structures provided that the resistance to horizontal earthquake forces is not less than that before such alterations were made, or ……..*"

Based on these clauses, the resistance to horizontal earthquake forces for the existing structure and the proposed completed structure should be determined and compared, to ensure compliance with that section of AS 1170.4-1993 Section 8 listed above. AS 1170.4-1993 Section 8 goes on to state: "……or that part of the structure as altered complies with the requirements of this Standard." It could be argued that because a structure meets the first alternative, i.e. "……resistance to horizontal earthquake forces is not less than that before …….", it is not necessary to meet the second alternative i.e. "…....that part of the structure as altered complies with the requirements……..". **However**, it is considered that it is responsible engineering to simultaneously meet both alternatives where practical.

The example above demonstrates the ambiguity of BCA and Australian Standards, and it is strongly recommended that clear understanding with the consent authority be obtained before proceeding with the structural design or any certification.