Department of
Building and Housing
Te Tari Kaupapa Whare

Proposed changes to

Compliance Document for New Zealand Building Code Clause B1 Structure

Closing date for public comment: 16 March 2007

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Contents

Request for comment

The Department of Building and Housing is seeking comments on its proposal to amend the Compliance Document for New Zealand Building Code Clause B1 Structure by referencing the new joint Australian/New Zealand suite of Standards, AS/NZS 1170 Structural Design Actions.

The Department also proposes removing references to certain older Standards.

The Department is seeking comments on the effective dates and the transitional arrangements for the proposed amendments to the Compliance Document.

How to comment

Please submit comments in writing. Typed comments are preferred, but clear handwriting is acceptable.

You can return comments by letter, fax or email.

Additional copies of this document can be downloaded from the Department's website at www.dbh.govt.nz/consulting-index or can be obtained by calling the Department on 0800 242 243.

The closing date for submitting comments on the proposed changes is **16 March 2007**.

They need to be sent to:

Consultation Feedback – Compliance Document B1 Structure
Department of Building and Housing
Building Controls
PO Box 10-729
Wellington
New Zealand

or emailed to comments@dbh.govt.nz. Please put 'Consultation Feedback – Compliance Document B1 Structure' in the subject line

or faxed to (04) 494 0290.

Important note

Please note that all responses will be public information. Responses may be the subject of requests for information under the Official Information Act 1982 (OIA). The OIA specifies that information is to be made available to requesters unless there are sufficient grounds for withholding it, as set out in the OIA. Submitters may wish to indicate grounds for withholding specific information contained in their submission, such as that the information is commercially sensitive or that they wish personal information to be withheld. Any decision to withhold information requested under the OIA is reviewable by the Ombudsman.

1 Executive summary

The Department of Building and Housing is proposing to amend the Compliance Document for Building Code Clause B1 Structure by referencing the new joint Australian/New Zealand suite of Standards, AS/NZS 1170 Structural Design Actions.

The new suite of Standards would be referenced as a Verification Method in the Compliance Document, with certain modifications to make it suitable for this purpose. The Department proposes removing references to certain other Standards.

The Department considers that the new suite of Standards better matches the current understanding of the New Zealand hazard environment, and that it would allow more cost-effective ways of achieving safe buildings.

Overall, the new suite of Standards would provide levels of safety in line with those of the past, when measured against the knowledge of hazards at the time. Where the new suite calls for greater loads, safety would be increased to an acceptable level, given the development in understanding of the hazard environment. Where loads are now decreased, the new suite would allow reductions in cost.

The proposal would have broad implications, with costs and benefits to the building industry and building owners. The Department commissioned a comprehensive cost-benefit analysis by BRANZ Ltd. Its report estimated that the overall cost impact would be positive, assuming that a major damage causing earthquake occurs in Wellington in the next 45 years.

The Department expects the proposal would add about $35 million to the cost of new buildings constructed each year. This is a cost increase of about 0.4 percent for new buildings.

The new suite of Standards would replace the existing loading Standard NZS 4203: 1992. In the 12 years since NZS 4203 was introduced, knowledge of the hazard environment has developed greatly. For example, there are many areas in New Zealand where the most recent seismic data indicates that higher loads should be used in building design. There is also better understanding of the New Zealand wind environment and the hazards it presents.

The new suite of Standards also further develops the concept of building risk and performance classification by increasing design requirements for buildings of higher importance and those that need to continue functioning after a major event, such as hospitals. This is consistent with development work being done by the Department as part of the Building Code review.

Among other things, the proposal would:

- increase some building design live loads
- provide updated earthquake risk information
- increase traffic barrier impact design requirements within buildings
- simplify wind zones in New Zealand, reducing them from seven to three
- revise specifications for snow and wind loads.

Under the proposal, an engineer registered under the Chartered Professional Engineers of New Zealand Act 2002 would be required to sign off designs based on AS/NZS 1170 (that is, all structural designs except those based on simple, prescriptive Standards). Recognising the skills and knowledge that specialist designers require to contribute to building design is consistent with the philosophy underpinning the licensed building practitioner scheme, as instituted by the Building Act 2004.

2 Background

The main reasons for developing the new suite of Standards were to update the existing loading Standard NZS 4203 and to take advantage of the economies of a single Australasian Standard, while recognising that New Zealand earthquake design needs individual treatment.

The new suite of Standards was developed by joint Australia/New Zealand Standards Technical Committees. After initial joint development work, the Earthquake Actions part was completed by a New Zealand-only committee. This joint trans-Tasman work follows the principles of the Closer Economic Relationships agreement, and represents a further step in aligning the building design and construction industries of the two countries.

The new suite of Standards takes account of technical advances (in particular, the revised New Zealand seismicity profile), aligns technical aspects with international Standards, rationalises previous provisions, corrects errors and omissions, provides clarification and reflects latest societal expectations.

The new suite of Standards also further develops the concept of building risk and performance classification by increasing design requirements for buildings of higher importance and those that need to continue functioning after a major event, such as hospitals. This is consistent with development work being done by the Department as part of the Building Code review.

Since NZS 4203: 1992 was introduced, knowledge of the hazard environment has developed greatly. The 1170 suite of Standards recognises new information on hazards, particularly those presented by wind and earthquakes.

There were concerns that NZS 4203 allowed the use of seismic design requirements that were unacceptably low in some regions. Recent interpretations of seismicity show that significantly higher loads should be used in building design to achieve an acceptably low risk of earthquake damage in some areas of New Zealand.

In addition, a better understanding of the wind environment has developed since the introduction of NZS 4203, and the 1170 suite reflects this.

Citing the new suite of Standards would help designers and building officials verify compliance with the Building Code. The new suite has been in use since 2004, but those using it are aware that it has not been declared as a Verification Method for compliance with the New Zealand Building Code. They recognise that NZS 4203 has been superseded, but until its successor has been cited, there is an obligation to accept designs that conform to the earlier Standard.

Citing the new suite would deal with this issue and would make AS/NZS 1170 the recognised suite of Standards for the structural design of buildings, within its stated limitations.

3 Proposals

3.1 Introduction

The suite of Standards published as AS/NZS 1170 consists of six parts, four of which apply to both New Zealand and Australia, one that applies only to Australia (Part 4), and one that applies only to New Zealand (Part 5). The parts that apply to New Zealand are:

- AS/NZS 1170 Structural Design Actions
  - Part 0: 2002 General principles (including Amendments 1, 2 and 4)
  - Part 1: 2002 Permanent, imposed and other actions (including Amendment 1)
  - Part 2: 2002 Wind actions (including Amendment 1)
  - Part 3: 2003 Snow and ice actions
- NZS 1170 Structural Design Actions, Part 5:2004 Earthquake actions – New Zealand.

Separate Commentaries that are published as supplements to the Standards are not included as part of the proposed citation.

3.2 Note on terminology

For brevity, this document refers to the parts of the suite of Standards that apply to New Zealand (together with their amendments) as 1170.

The International Organization for Standardization (ISO) terminology and notation has been adopted in 1170. Therefore, the term ‘action’ is used where ‘load’ was formerly used.

3.3 Overview of proposals

The Department is proposing to cite 1170 in a revision to Verification Method B1/VM1. This proposal includes a number of modifications to 1170 to make it suitable for use as a Verification Method. The modifications include requirements for the involvement of chartered professional engineers in the building consent process.

The specific proposals are to:

1 amend Verification Method B1/VM1 (Structure) by referencing (including modifications):

  a AS/NZS1170: Structural Design Actions

    i Part 0: 2002 General principles (including amendments 1, 2 and 4)

    ii Part 1: 2002 Permanent imposed and other actions (including amendment 1)

    iii Part 2: 2002 Wind actions (including amendment 1)

    iv Part 3 :2003 Snow and ice actions

  b NZS 1170: Structural Design Actions

i Part 5: 2004 Earthquake actions – New Zealand

ii SNZ HB 8630: 2004 Tracks and outdoor visitor structures.

2 remove references to:

a NZS 1900: Model building bylaw Ch 11: 1985 Special structures, Division 11.2 Farm buildings

b AS/NZS1664: Aluminium structures, Part 2: 1997 Allowable stress design

c NZS 3106: 1986 Code of practice for concrete structures for the storage of liquids

d NZS 4203: 1984 Code of practice for general structural design and design loadings for buildings

e NZS 4203: 1992 Code of practice for general structural design and design loadings for buildings

f NZS 4219: 1983 Specification for seismic resistance of engineering systems in buildings

g NZS4230: Code of practice for the design of masonry structures

i Part 1: 1990 Structures

ii Part 2: 1990 Commentary

3 correct an error and make one change to the provisions of Verification Method B1/VM4 (Foundations).

3.4 Timeline

The Department is proposing to publish the amended Compliance Documents on 15 June 2007. These would become effective on **15 September 2007**.

The 3-month introductory period would give designers time to become familiar with the new provisions.

The Department considers the 3-month transition period to be sufficient because, by the time of the proposed referencing, 1170 would have been published for more than 2 years.

Most structural designers and territorial authorities have been taking account of 1170 since December 2004, while recognising that NZS 4203: 1992 remains part of the Compliance Document.

4 Impact of the proposed changes

4.1 Summary

Overall, the new provisions would result in buildings that better match the hazard environment. Some buildings would need to be stronger to provide equivalent levels of safety against all hazards. The cost of this is more than offset by savings available for buildings that do not need to be as strong.

The overall cost impact would be beneficial and the impacts on manufacturing, compliance, design and construction would be negligible. The effects on safety and health would be positive overall.

4.2 Cost-benefit assessment

The Department commissioned BRANZ Ltd to conduct a cost-benefit study on the proposed changes. A copy of the study is available as Appendix 1 on the Department's website at www.dbh.govt.nz

The study estimated the cost savings to be $115 million for each year of additions to the building stock, assuming a Wellington earthquake. These savings would result from:

- reduced damage and maintenance
- less business disruption after a disaster event
- injuries and lives saved through stronger building design.

The study expected the proposed changes to add about $35 million to the cost of new buildings constructed each year. This is a cost increase of about 0.4 percent of the cost of new buildings.

The net present value (costs less benefits, discounted to present values) depends on when the design loading events occur. Table 1 below indicates that if a Wellington design earthquake occurs within the next 45 years, there would be net benefits. If other design loading events occur in addition to the Wellington earthquake, the net savings would be higher than shown.

Table 1: Summary of costs and benefits

<table>
<tr><th colspan="3">National costs and Wellington design event savings</th></tr>
<tr><td>Building costs</td><td>$ million/year of new buildings</td><td>High estimate</td></tr>
<tr><td>Initial cost increase</td><td>35.0</td><td>82.4</td></tr>
<tr><td>Average % building cost increase (1)</td><td>0.4%</td><td>0.9%</td></tr>
<tr><td colspan="2">Benefits</td><td>$ million/year of new buildings</td></tr>
<tr><td colspan="2">Maintenance reduction</td><td>0.1</td></tr>
<tr><td colspan="2">Damage reduction (Wellington event)</td><td>34.0</td></tr>
<tr><td colspan="2">Business disruption savings (Wellington event)</td><td>67.9</td></tr>
<tr><td colspan="2">Injuries/fatalities reductions (Wellington event)</td><td><u>13.4</u></td></tr>
<tr><td colspan="2">Total</td><td>115.4</td></tr>
<tr><td>Time ahead to the Wellington event</td><td colspan="2">Net present value (NPV) (2)
$ million, positive values are net savings</td></tr>
<tr><td>5 years</td><td colspan="2">302</td></tr>
<tr><td>20 years</td><td colspan="2">450</td></tr>
<tr><td>40 years</td><td colspan="2">88</td></tr>
<tr><td>50 years</td><td colspan="2">– 99</td></tr>
<tr><td>60 years</td><td colspan="2">– 253</td></tr>
<tr><td>80 years</td><td colspan="2">– 464</td></tr>
<tr><td>100 years</td><td colspan="2">– 578</td></tr>
<tr><td colspan="3">(1) Assume $8.7 billion of new buildings per year
(2) Discount rate is 5%</td></tr>
</table>

Individual building characteristics determine which load case governs. Generally, timber framed buildings are governed by wind load, while taller and heavier buildings are governed by earthquake loads. Changes to loads on building components also affect costs. For example, the fixing of panels under earthquake load would need to be stronger, roof imposed live and snow loads would need to be larger in some cases, and the higher wind loads in some locations may require strengthened window design.

Adopting 1170 would result in changes in structural performance. Where the new Standards require increased design coefficients, there would be comparative benefits in reduced damage, casualties and business interruption when a design event occurs. The converse applies where the new Standards require reductions in coefficients. These benefits and costs have been estimated for each region and each building category for selected events and aggregated into regional and national totals, as set out in the full study (Appendix 1 on the Department's website at www.dbh.govt.nz).

Benefits were estimated assuming the occurrence of a single earthquake event matching the design level intensity. In estimating the effects for an earthquake event, those buildings for which earthquake provisions dictate the level of change with the new provisions are distinguished from those for which wind provisions dictate the level of change. However, it should be noted that when an earthquake occurs, benefits would result from buildings with an increased coefficient, regardless of which provision dictated the increase.

For wind loadings, the national additional cost for each year of new buildings constructed is $22 million, which would provide annual benefits from reduced damage of $81 million. Indirect benefits from reduced business disruption and other indirect benefits are estimated to be an additional $160 million.

The costs and benefits throughout New Zealand were also compared. All regions have a positive net present value (costs less benefits, discounted to present values), though the time within which the design event needs to occur varies between regions. The cost-benefit ratios are quite high in some regions. For example, the ratio is more than three in Wellington for a design event within 50 years, and in Bay of Plenty/Waikato within 40 years.

4.3 Examples of benefits

4.3.1 For designers

The design levels of environmental effects would be determined by a clear application of annual exceedance probability that replaces the limit state and risk factors. The basis of these factors in NZS 4203 is not as transparent.

There would be clear guidance on the seismic design of brittle structures to ensure they are appropriately designed.

The design of parts of buildings has been simplified in that it would not be necessary to model a whole building in order to design the fixings of parts such as partitions, heating and ventilating equipment, and storage racks.

Fuller descriptions are given of the different soil classes that affect earthquake loads and a hierarchy of soil classification methods is given.

The section dealing with parts and portions of buildings has a new basis for determining actions that does not rely on having to analyse the whole building.

4.3.2 For building consent authorities

There would be one loading Standard in place of the present two, which would simplify processing building consents.

Near fault factors that account for ground motions within 20 km of an earthquake producing fault would fill what is currently a coverage gap in NZS 4203.

4.3.3 For building owners, users and developers

Critical facilities designated as Importance Level 4 buildings (IL4) would be required to remain operational after a major earthquake.

Deflection limits under serviceability wind actions would be halved to avoid joint problems.

Buildings would in general be more robust with loadings that more closely reflect those in use in other countries. Barriers for both people and vehicles would be required to be stronger, so improving safety levels.

The cost of increased wind loadings on domestic buildings up to three storeys high would be offset by benefits of more robust houses that are less susceptible to wind damage.

The strength of buildings to resist earthquakes would be more closely related to the perceived risk that has been evaluated by improved methodologies.

Buildings would now be required to withstand a serviceability level earthquake without requiring repair. Critical, post disaster facilities would be required to remain fully functional following an earthquake of a severity that is expected once in 500 years.

Because of the improved understanding of environmental hazards (earthquake, wind, snow etc), buildings would have a strength that is better aligned with the expected demand from their environment, resulting in more economic designs. Buildings would be more robust and would suffer less damage, particularly from wind. There would be less likelihood of adjoining buildings affecting one another because of new seismic clearance requirements.

4.4 Examples of costs

4.4.1 For designers

Training to become familiar with the new design Standards would be an added cost, but one that can be expected in the normal continuing professional development of designers.

Buildings with exceptional consequences of failure or whose failure poses catastrophic risk to a large area are not covered by 1170 and must be subject to a special study.

Roof cladding, including glass canopies, would be required to be designed for a concentrated load. The concentrated load on floors would have to be applied over a smaller area than under NZS 4203.

Dynamic analysis of tall buildings for wind and earthquake effects would now be required resulting in greater design effort. Smaller engineering design consultancies may be faced with the cost of computer software upgrades for these dynamic analyses.

Some practising structural engineers may need to register under the Chartered Professional Engineers of New Zealand Act 2002.

4.4.2 For building consent authorities

Training would be necessary to familiarise building regulatory staff with the revised Compliance Document.

4.4.3 For building owners, users and developers

The effect of wind loadings on domestic buildings up to three storeys high would account for about half the additional national cost of adopting 1170.

The reassessment of earthquakes in some areas such as Queenstown and Fiordland has resulted in requirements for greater earthquake loads in these areas, which would raise the cost of building. An increased minimum base earthquake shear requirement would affect buildings of 10 storeys or more in Wellington, Napier and Palmerston North, resulting in a maximum cost increase of about 1 percent.

The new seismic clearances from boundaries may reduce the proportion of a lot that can be used for constructing a tall building.

4.5 Impact on safety and health

The primary focus of the Standards affected by the proposed amendment is the ability of buildings to withstand safely the loadings likely to be imposed on them during their lives, and so not to present an unacceptable risk to the community. Everyone would benefit from the lower probability of injury due to the failure of buildings, or parts of buildings, from collapse.

The Standards have been updated to take advantage of advances in the understanding of the loadings imposed on buildings. In particular, the seismic loading requirements make use of research into the likely severity and distribution of earthquakes. The earthquake loading Standard also provides for higher levels of service and more robustness from buildings, such as hospitals, that have a role in post disaster recovery to help ensure continuity of functioning following a major event.

In the case of wind load, greater account is now taken of topography in the variation of likely wind speeds.

The underlying theme of these Standards is to achieve a uniform risk in all parts of the country by incorporating new understanding of the hazard environment. This applies particularly to earthquake, wind, snow and ice loading. Therefore, the required loading for different parts of the country is varied to make the chances of the chosen load level being exceeded the same in every location. The changes mean that for some areas, loads would be higher, while for other areas, loads would be lower than before.

For earthquake loading on houses, the changes range from +40 to –40 percent, depending on location. For wind loading, the corresponding range is from +20 to –15 percent, again depending on location.

Overall, 1170 would provide levels of safety in line with those of the past, when measured against the knowledge of hazards at the time. Where 1170 calls for greater loads, safety would be increased to acceptable levels, given the change in perceptions of the hazard environment. Where loads are now decreased, 1170 allows reductions in costs while maintaining risks at acceptable levels.

An increase in earthquake load of 40 percent would reduce the risk by about the same amount.

1170 has been drafted with the objective of ensuring greater reliability in predicting the performance of buildings when exposed to wind, snow, ice and earthquake loadings, and when subjected to the loadings from normal use as well as from exceptional, unlikely events.

4.6 Impact on the environment

The significant environmental consequence of adopting the proposed revised Compliance Document would be that buildings could be designed to match their likely structural demands, so optimising the use of materials. This should result in more effective use of resources associated with extracting and producing construction materials. There would also be less environmental degradation due to the consequences of clean-up and waste disposal following structural failure due to natural events, such as storms and earthquakes, as buildings are expected to perform better when built to 1170.

4.7 Impact on manufacture

As noted, previously, a closer match between the demands on a structure and its strength due to using more up-to-date design information would result in more economic use of materials, so optimising manufacturing costs. The cost-benefit study also draws attention to the expected reduction in building maintenance costs due to buildings being more robust.

The 0.4 percent increase in costs of building shows that the impact on manufacturing capacity would be minimal.

4.8 Impact on design

There would be a one-off cost to structural design professionals learning to use the new design documents. Structural design software modifications may be needed initially. Such changes are part of the expected continuing professional development of design professionals. There would be some increases in the complexity of the design process, particularly due to the increased importance of serviceability limit state design for earthquake actions. The cost of this additional design effort is expected to be offset by the improved performance of buildings in a serviceability limit state earthquake as the new Standard now requires a building to continue to be used without repair after such an event.

Some designers who have the necessary qualifications and experience but have not registered under the Chartered Professional Engineers of New Zealand Act 2002 would need to do so to be able to certify their designs.

4.9 Compliance costs

The principal impact on compliance costs would be in building design, as noted previously. In addition to designers, building consent authorities would also need to become conversant with the new requirements. The changes to the Compliance Document, such as the requirement for certification of structural aspects of a design by a chartered professional engineer, would result in an increase in emphasis on the checking that would need to be done by building consent authorities. This results from the recognition that most designers would apply engineering judgement when applying the Standards. This is not an additional demand of adopting the new Compliance Document, but rather a clarification of the need for building consent authorities to be satisfied that aspects of a building that are not specifically covered by a Verification Method would meet the requirements of the Building Code.

4.10 Impact on construction

Little noticeable effect on building construction practice is expected, as most of the impact of the changes would be at the design phase. The changes in strength required would be reflected in small changes in material requirements assessed in the cost-benefit study as adding an expected 0.4 percent to construction costs.

5 Specific changes due to 1170

5.1 AS/NZS 1170 Part 0: General principles

There would be a requirement to avoid damage to non structural systems that would prevent evacuation after a major (design) earthquake.

Some load combination factors for the ultimate limit state have changed.

Critical facilities designated as Importance Level 4 buildings (IL4) would need to remain operational after a major earthquake.

Serviceability limit state risk would be set significantly lower (for example, for IL3, it would now be the one in 25 year event; it is currently one in 10).

Buildings with exceptional consequences of failure (IL5) are not covered by 1170 and would need to be subject to a special study.

Buildings and facilities for assembled people (schools, offices, retail outlets) with numbers above specific limits would need to be designed for more severe conditions than required by NZS 4203.

Deflection limits under serviceability wind actions would be halved to avoid joint problems. Roof cladding indentation would be one-sixth of that permissible under NZS 4203.

Floor deflection permitted under a concentrated load before dynamic analysis is required would be doubled.

5.2 AS/NZS 1170 Part 1: Permanent, imposed and other actions

Provision for partitions would be increased to 0.5 kPa. The NZS 4203 requirement was one-third of the weight of the partition per metre length, for example, 0.2 kPa if the partition is 60 kg/m.

Roof cladding including glass canopies would need to be designed for a concentrated load (1.8 kN for street awnings accessible from adjacent windows or balconies, and 1.1 kN for cladding providing direct support). NZS 4203 (Category 11 – Roofs) required a uniformly distributed load but no concentrated load was required. For roof pedestrian traffic areas (as opposed to accessible awnings), the concentrated load requirement would now be 1.8 kN, compared with 1.4 kN in NZS 4203.

Further, 1170 requires that concentrated loads for floors be spread over a much smaller contact area. The new requirement would be no larger than $0.01m^2$. NZS 4203 requires no larger than $0.09\ m^2$.

Several live loads would be changed. Some would be larger and some smaller. For example:

- general office loading would increase from 2.5 kPa to 3.0 kPa
- fixed seating loading in places of worship would increase from 3.0 kPa to 4.0 kPa
- fixed seating loading in dining rooms would increase from 2.0 kPa to 3.0 kPa
- the loading in areas susceptible to overcrowding would increase from 5.0 kPa and 3.6 kN to 7.5 kPa and 4.5 kN.

The live load increases would be offset to some extent by their load combination factor being reduced from 1.6 to 1.5.

The new Standard contains new live load categories.

- Museums and art galleries – 4 kPa and 4.5 kN
- Areas of physical activity – 5 kPa and 9 kN

The uniformly distributed live load would increase for roof members with small tributary areas, for example, purlins and battens. This would affect section sizes, particularly those associated with heavy roofs.

The concentrated load for ceiling and bottom chord truss would increase from 1.0 kN to 1.4 kN, unless the headroom is less than 1.2 m, where 0.9 kN applies.

Barriers, including glass barriers, would now need to be designed for a concentrated force of 0.6 kN applied to the top of the rail. This would apply to all types of building, including domestic ones. NZS 4203 has a requirement for a line load of 0.36 kN/m (for residential buildings) to 0.75 kN/m (for buildings where people may assemble).

Barriers in areas where people may congregate or where overcrowding may occur, and where protection for vehicle traffic is needed, would be required to be designed for increased loads. The main increase would be for the top rail, which would increase from 0.75 kN/m to 1.5 kN/m and infills, which would increase from 0.5 kN to 1.5 kN.

Traffic barrier loads would be significantly increased from 10 kN to:

- 30 kN for light traffic
- 40 kN for medium traffic
- 240 kN for a ramp barrier.

Horizontal loads on crane rails associated with electric overhead cranes would increase from 10 to 20 percent of the vertical load.

5.3 AS/NZS 1170 Part 2: Wind actions

Wind zones in New Zealand would be simplified by reducing them from seven to three.

Wind loadings are different from those in NZS 4203, particularly for domestic low-rise buildings in exposed locations. The changes would vary between –15 and +20 percent, depending on building type and location. The effect of wind loadings on domestic buildings up to three storeys high would account for about half the additional national cost of adopting 1170. This cost would be offset by benefits of more robust houses that are less susceptible to wind damage.

Regional wind speeds would be determined by annual exceedance probability that would replace the limit state and risk factors.

A combination factor would be introduced, which would account for up to 20 percent reduction in wind loads on a structure.

Tall buildings with a period of vibration greater than 1 second would require dynamic wind effects to be assessed.

5.4 AS/NZS 1170 Part 3: Snow and ice actions

Snow and ice actions would be totally revised with a different design basis and a new format.

The design wind pressure associated with the design ice loading would increase by halving the annual probability of exceedance.

Snow load formulation would be changed, resulting in some increases and some decreases. While this would have a significant effect on roof element design, the overall impact on the building industry would likely be low. These provisions would follow Eurocodes, which in turn follow ISO.

Following the severe snow storm in South Canterbury in June 2006, the Department had concerns that the ground snow loads that are predicted by the Standard may not adequately represent the risks of such extreme events at low altitudes. NIWA (National Institute of Water and Atmospheric Research Ltd) was engaged to review AS/NZS 1170 Part 3 and the historical snow data to make recommendations. This work is ongoing, but the preliminary report is available as Appendix 2 on the Department's website at www.dbh.govt.nz As a result of these concerns, the proposed citing of AS/NZS 1170 Part 3 includes a modifying provision that provides a greater minimum snow load in regions N4 and N5 (Canterbury, Otago and Southland.) Appendix 2 contains a web link to the preliminary NIWA report. The second stage report will be made available when the Department receives it. It is expected in January 2007.

5.5 NZS 1170 Part 5: Earthquake actions – New Zealand

The earthquake provisions of NZS 4203 would be completely revised. 1170 includes revised design information generated from recent seismic studies. The seismic actions for which buildings are designed would be increased in some instances and reduced in others.

The new Standard identifies some structures as brittle structures, unlike NZS 4203. The 50 percent increase in S_p factor for brittle structures, introduced to penalise brittle buildings and to discourage their use, would have an impact on costs. The design action coefficient would be the same for both elastically designed buildings and brittle buildings with $\mu = 1$. However, if the elastically designed building has a strain capability as for $\mu > 2$, then $S_p = 0.7$ could be used.

The collapse or support of important parts of the building and the maintenance of emergency exits after a major earthquake would be new provisions and would have an impact on cost.

Buildings with higher importance levels would need to be designed for higher seismic loads. This would be accounted for by the return period factor that incorporates a risk factor and a limit state factor. Loads for critical facilities (Importance Level 4 buildings) would increase by 38 percent and loads for important buildings (Importance Level 3 buildings) would increase by 18 percent.

Serviceability performance requirements would be expanded to avoid damage needing repair and the maintenance of operational capability of critical post earthquake facilities. Serviceability loads would be a higher proportion of ultimate limit state loads than under NZS 4203. This would result in the serviceability load case becoming the governing criterion for higher ductility structures. In general, the serviceability load requirements would increase from 16 to 25 percent of ultimate limit state loads.

The site hazard spectra are reworked using a revised National Seismic Hazard Model and a rigorous probabilistic approach. The effect of this varies throughout the country, but the impact in some areas would be significant. The highest hazard factor would be 4.6 times the lowest. Currently, with NZS 4203, this ratio is 2.0. Changes in the hazard factor would be reflected in changed demands made on the structure of a building, which would in turn influence the strength and size of structural elements and their connections. The impact of this would be greatest in areas such as the Fiordland Lakes and Queenstown. On the other hand, there would be a significant saving in reducing the hazard factor for Auckland. Details are given in the cost-benefit study (Appendix 2 on the Department's website at www.dbh.govt.nz).

Five subsoil classes would be introduced to replace three in NZS 4203, although in New Zealand the strong rock (Class A) and rock (Class B) sites would be the same. Some structures would need to be designed for higher coefficients because of this. For example, where previously the site hazard spectrum for a stiff soil site was the same as for a rock site, under 1170 this may need to be reclassified as shallow soil (Class C). Similarly, an intermediate soil site according to NZS 4203 may need to be classified as a deep or soft soil site (Class D), and a flexible or deep soil site may need to be reclassified as a very soft soil site (Class E).

Near fault factors would be introduced. However, little cost impact would be likely because only buildings with a fundamental period of more than 2 seconds and within 20 km of a major fault would be affected. These are only high-rise buildings of 20 storeys or more in Wellington, Masterton and Palmerston North. According to the cost-benefit study (Appendix 1), medium high-rise residential and commercial buildings cover 11 percent of the building stock. About 10 percent of these buildings, or 1 percent of the country's building stock, lie within 20 km of a major fault.

The live load combination factor for seismic loads would be lowered from 0.4 to 0.3, resulting in a saving.

The new Standard provides an increased minimum base shear in some areas to ensure robustness during an earthquake. This increased minimum would not apply in areas with a low seismic hazard such as New Plymouth, Hamilton and Tauranga northwards, including Auckland. It would also not apply to the east coast areas of the South Island, south of Christchurch. Although the minimum increases by 33 percent in Wellington, Napier and Palmerston North, and by

12 percent in Nelson, it would only apply to buildings over approximately 10 storeys high. Its effect would be most significant on high ductility buildings and buildings in high importance level classes. For such tall buildings, wind loads often govern and so the total effect on building costs of raising the minimum base shear would be minimal. The greatest effect would be only expected to be about 1 percent increase in cost. The benefit would be a more robust building stock.

Nominally ductile and brittle structures would require concurrent application of orthogonal actions (for example, 100 percent in one direction and 30 percent in the orthogonal direction).

Structures, including individual parts, would need to be designed for a seismic vertical load that is 70 percent of the horizontal load.

The equivalent static method of seismic design would be restricted to buildings up to 10 m high from buildings up to 15 m high. Equivalent static would be restricted to buildings where the largest translational period does not exceed 0.4 seconds. Currently, this is 0.45 seconds. This change would impact on small consultants who do not have dynamic analysis capability. They might need dynamic analysis software.

Calculated building horizontal deflections would need to be less than the distance to the adjacent boundary or to the deflected position of an adjacent building. This provision, to prevent impact under seismic actions, would in some cases have a significant impact on the stiffness of the building and how close it could be to a boundary.

Soil retaining structures are not included in the scope of the new Standard. The provisions of Verification Method B1/VM4 (Foundations) would continue to apply.

The NZS 4203 fire provision for a uniformly distributed load of 0.5 kPa on wall panels would not be in 1170. This provision would be included in the recently published Concrete Design Standard, NZS 3101, to address concerns that it should still apply to concrete wall panels.

6 Options considered

6.1 Overview

1170 is not entirely suitable for use as a Verification Method. This is because its scope does not match the scope of the Building Code and some of its provisions require the involvement of professional engineers in decision-making. Ideally, a Verification Method should be self-contained and should not require professional involvement.

However, 1170 is a broadly scoped Standard and it represents the latest knowledge on both environmental hazards and design methods. Therefore, the Department has decided to incorporate its provisions as the best currently available for building design.

Advantages of 1170 are that it:

- is the most up-to-date Standard on loading available to structural engineers when designing buildings in New Zealand
- incorporates significant updates to earthquake and wind loads
- replaces two loadings Standards currently in B1/VM1.

However, 1170 has limitations in that it:

- is designed to be used with compatible material Standards, none of which are currently cited as a means of compliance with the Building Code
- does not cover the full range of physical conditions or performance requirements specified by Clause B1 Structure of the Building Code
- applies to a limited range of buildings, not to the full range covered in the Building Act
- applies to structures such as free standing masts for utilities or scaffolding that are not buildings as defined in the Building Act
- requires knowledge, experience and specialist skill to interpret and apply
- frequently requires essential engineering judgement that is not fully defined.

When considering citing such a Standard as a Verification Method, a balance must be achieved between providing a resource to help users comply with the Building Code, and the risks that any shortcomings in the Standard, or variations in its interpretation, will result in non-compliance with the Building Code.

6.2 Summary of options

Various options for citing 1170 were considered as the present B1/VM1 contains two loading Standards and material Standards that are compatible with one or the other of these. The options for citation that were considered are summarised in the following table.

Table 2: Options for citation of new loading Standard

Option	Description	Detail	Consider further?	Issues
1	Do nothing	Leave current B1/VM1 in place	No	1170 is the most up-to-date knowledge on loadings for New Zealand buildings. Retaining superseded Standards is not appropriate. The positive cost benefits of adopting 1170 are not achieved.
2	Cite 1170, retain NZS 4203: 1984, NZS 4203: 1992, and existing material Standards	Add 1170 to existing B1/VM1, but retain both superseded loadings Standards, NZS 4203: 1984 and NZS 4203: 1992 and their related material Standards	No	Citing three loading Standards from different eras, and assorted material Standards would cause confusion. 1170 has significant improvements to loading and other requirements.
3	Delete B1/VM1	Withdraw all Verification Methods and endorse the Standards as guidance information only	Yes	Leaves industry to use any available Standards, from New Zealand or elsewhere, to demonstrate compliance. All designs would be alternative solutions. More difficult for designers and building officials with no 'recognised' Verification Method. The positive cost benefits of adopting 1170 are not achieved.
4	Cite 1170, retain NZS 4203: 1992, delete NZS 4203: 1984	Add 1170 to existing B1/VM1, retain NZS 4203: 1992 and related material Standards, but delete NZS 4203: 1984 and its related material Standards	No	Undesirable and confusing to retain NZS 4203: 1992 beyond a transitional period.
5	Cite 1170 as the only Standard in B1/VM1	Cite 1170 and delete NZS 4203: 1984 and NZS 4203: 1992 and all related material Standards. (Cite new material Standards that are compatible with 1170.)	Yes	Leaves industry to decide which material Standards to use, and makes alternative solutions of all designs. Industry would not get signals from the regulator as to which Standards can be used in order to verify compliance.
6	Cite 1170 as the only loading Standard in B1/VM1 and retain some material Standards	Cite 1170 and delete NZS 4203: 1984 and NZS 4203: 1992. Indicate that some retained material Standards in the Verification Method may be used, provided loads are derived according to 1170. Give some guidance on this.	Yes	Retains well-known existing New Zealand material Standards. Leaves possible gaps/unknowns when these are not readily interpreted in relation to 1170.

6.3 Assessment of options

6.3.1 Option 1: Do nothing

For

Consultants and territorial authorities already use 1170 as the basis of alternative solutions to comply with the Building Code.

Against

1170 is the result of major work to update the determination of structural design actions. It has had input from industry and is the most up-to-date Standard of its type available. It is an important new Standard, which incorporates the latest data on loadings, and involves significant changes to earthquake and wind loads for some locations. To retain out-of-date Standards but exclude 1170 would cause confusion. Confusion already exists in that two different loading Standards are included in B1/VM1. Industry needs a formal endorsement of 1170 as an acceptable means of verifying compliance with the Building Code. Benefits would not accrue from enhanced building performance provided by 1170.

6.3.2 Option 2: Add 1170, but retain the superseded loading Standards

For

Continued use of familiar design documents would reduce transition costs.

Against

While it appears to have the benefit of retaining the existing Standards, this option would add to the confusion in the present B1/VM1, which offers a choice of two loading Standards. There is a strong need to signal that 1170 should supersede the previous Standards.

6.3.3 Option 3: Delete B1/VM1

This would result in all buildings that involve specific design being regarded as alternative solutions to the Building Code.

For

In all structural design Standards there is considerable scope for interpretation. Decisions and judgements need to be made on assigning parameters that describe structural behaviour and performance. Therefore, the Standards do not strictly fulfil the required attributes of Verification Methods.

The rationale behind this option is that there is insufficient confidence that the Verification Method can be relied on to consistently demonstrate compliance when applied to a range of buildings by a range of engineering practitioners. This is a consequence of the complexity both of the structures and of the judgements that need to be made during their design.

Against

Verification Methods are intended to be procedures that provide consistent and reliable results when used to verify the compliance of a building (or its design) with the Building Code. This option would leave no Verification Methods in the Building Code for general structural design, which would be a significant change to the status quo. It would result in the compliance of every building (or design) having to be verified by whatever methods were considered appropriate by each building consent authority. It would be up to each building consent authority to decide which Standards to use for verifying compliance, leading to local variations and lack of national uniformity. Benefits would not accrue from enhanced building performance provided by 1170.

6.3.4 Option 4: Add 1170, delete 4203: 1984, retain 4203: 1992

For

Continued use of familiar design documents would reduce transition costs.

Against

Adding 1170, deleting 4203: 1984 and retaining 4203: 1992 is a compromise, but still does not send the signal that 1170 represents the latest data on loading for structural design. Some places in New Zealand would have markedly different earthquake or wind loads using 1170 and these should be taken into account.

6.3.5 Option 5: Cite 1170 only, delete all other Standards

For

This option would clearly signal that 1170 is recognised as the most up-to-date and appropriate Standard for structural design loading. Standards New Zealand has published NZS 3101:2006 for concrete structures and this Standard is awaiting citation. Revisions of the steel and concrete masonry Standards to make them compatible with 1170 are under way.

Against

Citing 1170 only leaves industry, and building consent authorities in particular, to decide on acceptable Standards to use with 1170, at least until the compatible material Standards are added in future citations. The development of other material Standards that are compatible with 1170 to replace those removed would be a matter for industry and Standards New Zealand.

6.3.6 Option 6: Cite 1170, delete 4203: 1992 and 4203: 1984, but retain material Standards

This option retains the familiar material Standards that are in limit state format on the basis that experienced engineers can adjust the loadings required to match 1170.

Therefore, some older material Standards would have their citation removed. These are:

- AS/NZS 1664.2: 1997 Aluminium structures - Allowable stress design
- NZS 3106: 1986 Code of practice for concrete structures for the storage of liquids
- NZS 4219: 1983 Specification for seismic resistance of engineering systems in buildings
- NZS 4230 Parts 1 and 2: 1990 Code of practice for the design of masonry structures.

The masonry design Standard NZS 4230 was updated with a new edition published in 2004 before NZS 1170.5: 2004 was published. An amendment to NZS 4230 is being prepared that would make it compatible with 1170 and available for including in B1/VM1 in future. In the mean time, NZS 4230: 2004 could be used as the basis of alternative solutions.

The citation covering farm buildings would also be removed (NZS 1900.11.2: 1985 Model building bylaw - Special structures Division 11.2 Farm buildings). Farm buildings are now within the scope of 1170.

With this option, NZS 3101: 1995 would remain cited until NZS 3101: 2006 is cited. An assessment has shown that, while NZS 3101: 1995 is not compatible with 1170, it is unlikely to result in an unsafe design.

For

Out-of-date Standards that are based on earlier design philosophies would be removed from the Verification Method. Clear expectations of future design documents would be established. Familiar, current Standards would be retained until replaced by their updated versions. Benefits would accrue from the enhanced building performance provided by 1170.

Against

Some adaptation by users of the existing material design Standards would be required until their replacements are cited.

6.4 Preferred option

The Department considers it desirable to adopt 1170 as part of the Verification Method because of the benefits this would bring. These benefits are summarised in this document and are available in Appendix 1 on the Department's website at www.dbh.govt.nz On this basis, Options 2, 4, 5 and 6 are considered acceptable.

Options 3, 5, and 6 were given further consideration. Option 6 was selected as the best as it provides support for 1170 as the up-to-date Standard, while allowing the continued use of some existing material Standards until updates are available. Option 3, deleting B1/VM1 altogether, does not signal the status of 1170. While Option 5 provides this support, it leaves no material Standards to use until those compatible with 1170 are available.

No current material Standards are fully compatible with 1170. Under Option 6, some existing material Standards would be retained until they are revised, even though there could be some interpretation issues when using them. The Department considers this more acceptable than waiting for all or even some material Standards to be published. A designer could use NZS 4203 with the currently cited material Standards on the basis that the resulting designs were at least equal to those required under 1170, but this must be regarded as an alternative means of verification that would need to be evaluated by the building consent authority. This evaluation would need to take account of the changed load levels in the new loading Standard.

Option 6 is the Department's preferred option.

7 Proposed implementation

The Department will not make any decision about citing 1170 until it has considered the comments received. Should the proposal be adopted, this section explains the proposed implementation schedule.

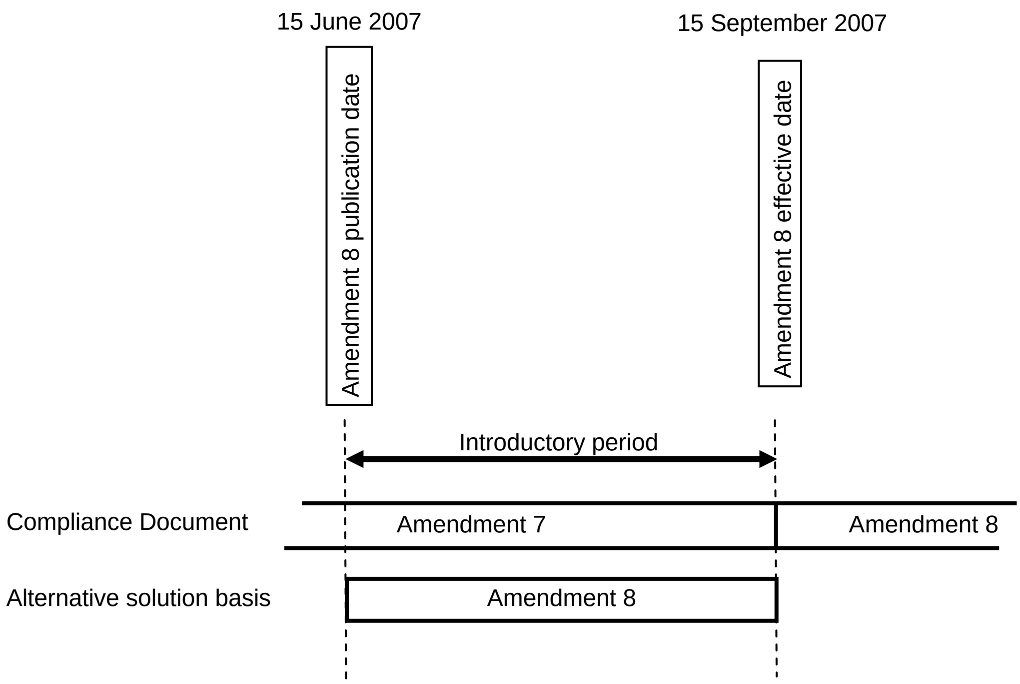
7.1 Transitional arrangements

The current B1 Structure Compliance Document includes the published amendments 1, 2, 3, 4, 5, 6 and 7 and is referred to as B1 Structure Compliance Document (Amendment 7).

The proposed B1 Structure Compliance Document includes amendments 1, 2, 3, 4, 5, 6, 7 and the proposed changes included in this document and is referred to here as B1 Structure Compliance Document (Amendment 8). B1 Structure Compliance Document (Amendment 8) would include any changes to this proposal resulting from public consultation.

The introductory period, when both the existing B1 Structure Compliance Document (Amendment 7) and the proposed B1 Structure Compliance Document (Amendment 8) would apply, would be 3 months from the publication date for Amendment 8. During this introductory period, building consent applicants would be able to choose to use the current or the amended version of the Compliance Document. This period would allow those designs that are based on the existing Compliance Document, and that are well advanced or are part way through processing for building consent, to be progressed without the need for amending. This timing is illustrated in Figure 1 below.

Figure 1: Transitional provisions



Existing B1 Structure Compliance Document (Amendment 7) includes the published amendments 1 to 7.

The proposed B1 Structure Compliance Document (Amendment 8) includes amendments 1 to 8.

The effective date for the B1 Structure Compliance Document (Amendment 10) would be 3 months after publication. During the 3-month introductory period, building consent authorities and the industry would be able to familiarise themselves with the new provisions and building consent applicants would be able to choose to use them as alternative solution proposals in building consent applications.

The publishing date of the B1 Structure Compliance Document (Amendment 8) would be 5 June 2007.

The introductory period, between the publishing and effective dates of Amendment 8 would be 3 months.

7.1.1 Effective date

The effective date of the B1 Structure Compliance Document (Amendment 8) would be 15 September 2007.

How these transitional arrangements would relate to building consents and code compliance certificates is explained below.

7.1.2 Building consents issued before 31 March 2005

Where a building consent was issued before 31 March 2005 and a code compliance certificate has not been issued, the building consent authority has to issue the code compliance certificate if it is satisfied on reasonable grounds that the completed building work complies with the Building Code in place at the time the consent was issued.

7.1.3 Building consents issued after 31 March 2005 and before the effective date for Amendment 8

Where a building consent is applied for between 31 March 2005 and the effective date and the applicant uses B1 Compliance Document (Amendment 7) as the Verification Method, the building consent authority has to issue the consent. The applicant must apply for the consent before the effective date for Amendment 8. At the completion of the building work, the building consent authority must issue the code compliance certificate if the building work complies with the building consent.

Where a building consent is applied for between 31 March 2005 and the effective date for Amendment 8 and the applicant uses B1 Structure Compliance Document (Amendment 8) as an alternative solution, or uses another alternative solution, the building consent authority must issue the consent if it is satisfied that the performance criteria of the Building Code will be achieved. If it refuses to issue the consent, the building consent authority must notify the applicant in writing giving reasons. When the building work is complete, the building consent authority must issue the code compliance certificate if the building work complies with the building consent.

7.1.4 Building consent issued after the effective date

Where a building consent is applied for after the effective date for Amendment 8, the applicant may use B1 Structure Compliance Document (Amendment 8) as the Verification Method for the building consent authority to issue the consent. B1 Structure Compliance Document (Amendment 7) may not be used as the Verification Method for a building consent after the effective date. When the building work is complete, the building consent authority must issue the code compliance certificate if the building work complies with the building consent.

8 Proposed Amendment 8 to the Compliance Document B1 Structure

Document history and document status

These will be updated to include reference to Amendment 8 (this proposed amendment).

Contents

The contents will be updated to reflect changes to Verification Method B1/VM1.

References

The existing list of references will be modified as follows.

Add references to:

AS/NZS 1170: Structural design actions –
Part 0: 2002 General principles (including amendments 1, 2 and 4)
Part 1: 2002 Permanent imposed and other actions (including amendment 1)
Part 2: 2002 Wind actions (including amendment 1)
Part 3: 2003 Snow and ice actions

NZS 1170: Structural design actions –
Part 5: 2004 Earthquake actions – New Zealand

SNZ HB 8630: 2004 Tracks and outdoor visitor structures

Delete references to:

NZS 1900: Model building bylaw Ch 11: 1985 Special structures. Division 11.2 Farm buildings

AS/NZS 1664:- Aluminium structures –
Part 2: 1997 Allowable stress design

NZS 3106: 1986 Code of practice for concrete structures for the storage of liquids

NZS 4203: 1984 Code of practice for general structural design and design loadings for buildings

NZS 4203: 1992 Code of practice for general structural design and design loadings for buildings

NZS 4219: 1983 Specification for seismic resistance of engineering systems in buildings

NZS 4230: Code of practice for the design of masonry structures –
Part 1: 1990 Structures
Part 2: 1990 Commentary.

Definitions

The abbreviated list of definitions for words or terms particularly relevant to this Compliance Document will be updated to reflect the Building Act 2004.

Amendment to Verification Method B1/VM1 General

(The ‘Explanation’ notes in the table below will not form part of the Verification Method.)

Current text	Proposed changes
1.0 Explanatory Note **1.0.1** This part of the Approved Document lists under category headings other Approved Documents and Standards suitable as methods of verification. **1.0.2** Elsewhere in this Approved Document a verification method is given for foundations. It is referred to in Paragraph 9.0. **1.0.3** Modifications to the Standards, necessary for compliance with the New Zealand Building Code, are given against the relevant clause number of each Standard.	**1.0 Explanatory Note** **1.0.1** This part of the Compliance Document lists under category headings other Compliance Documents and Standards suitable as methods of verification. **1.0.2** A Verification Method is given for foundations elsewhere in this Compliance Document. It is referred to in Paragraph 9.0. **1.0.3** Modifications to the Standards, necessary for compliance with the New Zealand *Building Code*, are given against the relevant clause number of each Standard. **1.0.4** Citation of New Zealand Standards as part of this Verification Method (VM) provides users with one way of verifying that a *building* complies with the performance requirements of the *Building Code* **1.0.5** The Standards cited in this Verification Method relate to the design of structures to meet the requirements of Clause B1 Structure. For any particular *building* or *building* design, the Verification Method may consist of two or more of the cited Standards in combinations sufficient to verify the compliance of its expected structural performance. **1.0.6** Citation of Standards in this Verification Method is subject to the following conditions. a) The citation covers only the scope stated or implicit in each Standard. Aspects outside the scope, when applied to a particular *building*, are not part of the Verification Method. b) Further limitations, modifications and/or constraints apply to each Standard as noted below.

Current text	Proposed changes
	c) Provisions that are in non-specific or unquantified terms do not form part of the Verification Method. Non-specific or unquantified terms include, but are not limited to, special studies, manufacturer's advice and references to methods that are appropriate, adequate, suitable, relevant, satisfactory, acceptable, applicable, or the like. Methods that require the application of engineering judgement and rational analysis are included, provided that the outcome is bounded by defined engineering criteria. d) When used in combination, Standards in this Verification Method must be compatible in their underlying philosophy, general approach, currency of information and methods. e) The citation is made on the basis that a chartered professional engineer certifies that aspects of a *building* design that are within the scope of Clause B1 of the *Building Code* will result in a *building* that complies with Clause B1 if the *building work* were properly completed in accordance with the *plans and specifications*. A chartered professional engineer is one who is registered under the Chartered Professional Engineers of New Zealand Act 2002. f) For structures that are Importance Level 3, 4 and 5, as determined by Table 3.2 of AS/NZS 1170 Part 0, an independent review is to be carried out by a chartered professional engineer who is registered under the Chartered Professional Engineers of New Zealand Act 2002. This review is to confirm that aspects of a *building* design that are within the scope of Clause B1 of the *Building Code* will result in a *building* that complies with Clause B1 if the *building work* were properly completed in accordance with the *plans and specifications*.
	Explanation: Refer to section 6.1 of this discussion document.

Your comments on the proposed changes to Paragraph 1.0:

<table>
<tr><th>Current text</th><th>Proposed changes</th></tr>
<tr><td rowspan="2">1.1 Loadings of NZS 4203 to be used

1.1.1 For compliance with this verification method, compatible loadings and material Standards shall be used.

1.1.2 Loadings from NZS 4203:1992 shall be used where materials Standards or documents listed below are written in limit state format.

1.1.3 NZS 4203:1984 is retained as a reference document for use with those material Standards which are not written in limit state format.</td>
<td>1.1 Structural Design Actions Standard

1.1.1 The requirements of the AS/NZS 1170 suite of Standards are to be complied with. These comprise:

• AS/NZS 1170.0:2002 including Amendments 1, 2 and 4,
• AS/NZS 1170.1:2002 including Amendment 1,
• AS/NZS 1170.2:2002 including Amendment 1,
• AS/NZS 1170.3:2003, and
• NZS 1170.5:2004.

COMMENT
This suite of Standards, together with their amendments, are referred to in this document as “1170”.

1.1.2 The requirements of 1170 are subject to the following modifications:

a) Material Standards
Where 1170 calls for the use of appropriate material Standards, only those material Standards included in this B1/VM1 are included. Use of other Standards with 1170 shall be treated as an alternative means of verification.

b) Notes in 1170
“Notes” that relate to clauses, tables or figures of 1170 are part of the Verification Method.</td></tr>
<tr><td>Explanation: The prefaces to AS/NZS 1170 Parts 0, 1, 2 and 3 state: ’Notes to the text contain information and guidance and are not considered to be an integral part of the Standard.’ Any material in Notes that is required as part of a means of compliance is specifically referenced by this citation.</td></tr>
</table>

Current text	Proposed changes
	c) AS/NZS 1170 Part 0, Clause 4.1 General Add the following to the end of the Clause: "The combination factors for permanent actions (dead loads) are based on the assumption that they have a coefficient of variation of approximately 10%. Where this assumption is not valid, the combination factors for permanent actions shall be determined by special study in accordance with Appendix A. Such special study will constitute an alternative solution to the *Building Code*."
	Explanation: This suggested new wording has been based on C4.2.2 in the Commentary to the Standard. As it refers to a potentially non-conservative situation, it has been made part of the Verification Method.
	d) AS/NZS 1170 Part 0, Clause 5.2 Structural models Delete (a) to (d) in the above Clause and replace with: "(a) Static **and/**or dynamic response. (b) Elastic **and/**or non-elastic (plastic) response. (c) Geometrically linear **and/**or geometrically non-linear response. (d) Time-independent **and/**or time-dependent behaviour.
	Explanation The alternatives of (a), (b), (c) and (d) are worded as mutually exclusive alternatives. However, there are likely to be some instances where both may need to be considered. For instance, the wording appears to allow consideration of only the static response to wind of a slender structure for which a dynamic analysis should also be conducted. 'Or' should be replaced by 'and/or'.

Current text	Proposed changes
	e) AS/NZS 1170 Part 1, Appendix B Replace the last paragraph of this clause with the following: "For the design of walking track structures as defined in SNZ HB 8630: 2004, the imposed actions shall be as given by that publication."
	Explanation: The last paragraph of clause AS/NZS 1170 Part 1, Appendix B currently reads: For the design of walking track structures as defined in AS 2156.1, structures in walking track classifications 3 and 4 shall be designed using the values for isolated structures and in walking track classification 5 using the values for remote structures. As written, the application of this Appendix to walking track structures is applicable to Australia only. New Zealand coverage is to be made explicit in the citation by including the new provisions.
	f) AS/NZS 1170 Part 2, Clause 3.2 and 4.4.3 Add the following at the end of Clauses 3.2 and 4.4.3: "Local wind design information, where it is more onerous than determined by this Standard and is published by any *territorial authority* for its area, shall take precedence over the equivalent information in this Standard for the determination of wind actions on *building*s. Where the local wind design information is less onerous than that of this Standard, the use of such information shall not be part of this Verification Method."

Current text	Proposed changes
	Explanation: The small scale of the maps in Figure 3.1 of the Standard results in uncertainty in determining which side of a region or lee zone boundary a building is when it is close to the boundary. The distance from the lee zone boundary is also required for compliance with Clause 4.4.3. In many cases, there is a step change in requirements when crossing a boundary, so that knowing where the boundary is in relation to a particular site is important. The lee zone is measured from 'the leeward crest of the initiating range' and larger-scale maps will be needed to determine these zones with certainty. Larger-scale maps are needed so this figure is to be cited in a way that allows territorial authorities to publish their own local maps of wind regions that take precedence over this figure. This citation is worded so that it cannot be claimed that a building consent authority is asking for more onerous performance than the Building Code requires.
	g) AS/NZS 1170 Part 2, Clause 4.3.1 General Add the following to the end of the Clause: "Account shall be taken of combinations of isolated tall *building*s placed together that lead to local and overall increases in wind."
	Explanation: This is additional wording based on C5.4.1 of the Commentary to the Standard as it refers to potentially non-conservative situations that are made part of the requirements of the Verification Method.

Current text	Proposed changes
	h) AS/NZS 1170 Part 3, Clause 2.1 Add the following at the end of Clause 2.1: "Local snow and ice design information, where it is more onerous than determined by this Standard and is published by any *territorial authority* for its area, shall take precedence over the equivalent information in this Standard for the determination of snow and ice actions on *building*s. Where the local snow and ice design information is less onerous than that of this Standard, the use of such information shall be outside the scope of this Verification Method."
	Explanation Information on snow load regions that is in the future published by territorial authorities in New Zealand should take precedence over the regions shown in Figure 2.2. This is because it is acknowledged in Clause C2.1 of the Commentary to the Standard that Figure 2.2 is approximate and needs to be supplemented by local knowledge. This citation is so that it cannot be claimed that a building consent authority is asking for more onerous performance than the Building Code requires.
	i) AS/NZS 1170 Part 3, Clause 5.4.3 Add the following to end of Clause 5.4.3: "For Regions N4 and N5 the minimum value of s_g shall be taken as 0.9 kPa."
	Explanation: Investigations of the June 2006 South Canterbury snow storm and the building failures that resulted are ongoing as some accounts indicate that the snow loading provisions of both NZS 4203 and 1170 are not adequate. The proposed addition to the clause is provisional and is likely to be revised following this consultation. A preliminary report by NIWA on the AS/NZS 1170.3 snow loading provisions is included as Appendix 2 on the Department's website at www.dbh.govt.nz **We are seeking specific comment on this proposal.**

Current text	Proposed changes
	j) NZS 1170 Part 5, Clause 3.2 Add the following to the end of the Clause 3.2: "At locations where the seismic hazard is dominated by a fault at a distance of less than 10 km, the vertical spectrum shall be assumed to be equal to the horizontal spectrum for periods of 0.3 s and less."
	Explanation This is material from clause C3.2 of the Commentary to the Standard that flags a potentially non-conservative situation that is made a requirement of the Verification Method.
	k) NZS 1170 Part 5, Sections 5 and 6 **Time history analysis** Time history analysis is not part of this Verification Method. Its use shall be considered as an alternative means of verification.
	Explanation: Clauses C6.1.1 and C6.4.1 of the Commentary to the Standard indicate that the numerical integration time history method requires a good deal of experience in its application and is possibly not a method that should generally be used for design without a requirement for expert peer review. The Department considers that it is not a method sanctioned as being part of the Verification Method without special conditions for its use.
	l) NZS 1170 Part 5, Clause 4.2 Seismic weight and seismic mass After: "0.3 is the earthquake imposed action (live load) combination factor for all other applications" add the following: "except roofs. Ψ_E = 0.0 is the earthquake imposed action (live load) combination factor for roofs."
	Explanation: This provision was present in NZS 4203 and appears to have been omitted from 1170.

Current text	Proposed changes
	m) NZS 1170 Part 5, Clause 6.1.4.1 Requirement for modelling Delete the last sentence of the first paragraph and replace with: "The model shall include representation of the diaphragm's flexibility." Delete the third (last) paragraph.
	Explanation: This requirement for modelling needs to be a mandatory requirement and read 'shall'. It is not clear whether 'elastic diaphragm' means that the diaphragms are deformed by diaphragm action only within their elastic range. (It is acknowledged that other inelastic deformations can occur within diaphragms due, for instance, to beam hinging.) The Standard's wording is not clear, although the Commentary does provide some additional explanation. A clear statement of requirements is needed. 'Inelastic deformations associated with in-plane diaphragm actions resulting from earthquake induced forces' appears to contradict the previous paragraph and should be in the Commentary.
1.1.4 Neither of the NZS 4203 Standards addresses the problem of localised site effects such as enhanced earthquake ground motions due to unfavourable ground conditions or proximity to a fault. Where these are identified they shall be the subject of a special study.	(Paragraph 1.1.4 is deleted.)
	Explanation: NZS 1170 Part 5 provides for a wider range of soil types including very soft soil sites and includes treatment of earthquake ground motions due to near fault effects. The clause is therefore no longer necessary.

Your comments on the proposed changes to Paragraph 1.1:

Current text	Proposed changes
2.0 Loadings **2.1 NZS 4203:1984** **2.2 NZS 4203:1992** Volumes 1 and 2 subject to the following modifications: **Clause 6.6.1** Reword to read: "A load factor of 1.6 shall be applied to lateral loads on earth retaining structures except for cases involving earthquake loading where the load factor shall be 1.0. On earth retaining structures dead loads which promote stability shall be unfactored (i.e. load factor of unity)." Clauses 6.6.3 and 6.6.4 Delete. Clause C6.6 Delete.	(Paragraph 2 is blank.) **Explanation:** References to NZS 4203: 1984 and NZS 4203: 1992 have been replaced by reference to 1170.

Your comments on the proposed changes to Paragraph 2.0:

Current text	Proposed changes
3.0 Concrete **3.1 NZS 3101: Part 1** subject to the following modifications: … b) The use of this Standard as a verification method does not extend to the use of any "other appropriate (or approved) loadings Standard". Further where this Standard has provisions that are in non-specific or unquantified terms (such as where provisions are required to be appropriate, adequate, suitable, relevant, satisfactory, acceptable, applicable or the like), then these also do not form part of the verification method and must be treated as an alternative solution.	**3.0 Concrete** **3.1 NZS 3101: Part 1** subject to the following modifications: … b) Refer to 1.1.2 a) above. … f) Actions shall be determined in accordance with 1170. All other references to NZS 4203 are replaced by equivalent references to 1170.
	Explanation: References to NZS 4203: 1992 are replaced by references to 1170 by this amendment. Other modifications to NZS 3101 in B1/VM1 are the same as those in the 1 December 2000 edition as amended up to 1 April 2006. The Department intends to cite the 2006 edition of NZS 3101, replacing the 1995 edition as a means of compliance with the Building Code once public consultation has been completed. Other modifications to NZS 3101: 1995 Concrete Design Standard in B1/VM1 are the same as those in the 1 December 2000 edition as amended up to 1 April 2006.

Your comments on the proposed changes to Paragraph 3.0:

Current text	Proposed changes
3.2 NZS 3106	(Paragraph 3.2 is deleted.)
	Explanation: Reference to this Standard is to be deleted as it is a working stress Standard that depends on NZS 4203: 1984, which is also no longer to be referenced.

Your comments on the proposed deletion of Paragraph 3.2:

Current text	Proposed changes
4.0 Masonry **4.1 NZS 4230: Parts 1 and 2**	(Paragraph 4 is blank.)
	Explanation: Reference to this Standard is to be deleted as it is a working stress Standard that depends on NZS 4203: 1984, which is also no longer to be referenced. A new edition of NZS 4230 was published in 2004 and is being amended to make it compatible with 1170. It is intended to cite this new edition after its amendment is published.

Your comments on the proposed deletion of Paragraph 4.0:

Current text	Proposed changes
5.0 Steel **5.1 NZS 3404: Part 1**	**5.0 Steel** **5.1 NZS 3404: Part 1** **5.1.1** Actions shall be determined in accordance with 1170. All other references to NZS 4203 are replaced by equivalent references to 1170.
	Explanation: An amendment to NZS 3404 is being prepared to make it compatible with 1170. It is intended to cite NZS 3404 after its amendment is published.
5.2 AS/NZS 4600 subject to the following modifications: a) Where the Standard refers to the "relevant loadings Standard" or the "appropriate limit state loading Standard" or other similar statements this shall be read as a reference to NZS 4203:1992.	**5.2 AS/NZS 4600** subject to the following modifications: **a)** Actions shall be determined in accordance with 1170. All other references to NZS 4203 are replaced by references to 1170. …
	Explanation: References to NZS 4203: 1992 are replaced by references to 1170 by this amendment. Other modifications to AS/NZS 4600:1996 Cold-formed Steel Structures in B1/VM1 are the same as those in the 1 December 2000 edition as amended up to 1 April 2006.

Your comments on the proposed changes to Paragraph 5.0:

Current text	Proposed changes
6.0 Timber **6.1 NZS 3603** subject to the following modifications: **Clause 1.6** Reword to read: "All stages of construction of a structure or part of a structure to which this Standard is applied shall be adequately reviewed by a person who, on the basis of experience or qualifications, is competent to undertake the review."	**6.0 Timber** **6.1 NZS 3603** subject to the following modifications: **6.1.1 Clause 1.6** Reword to read: "All stages of construction of a structure or part of a structure to which this Standard is applied shall be adequately reviewed by a person who, on the basis of experience or qualifications, is competent to undertake the review." **6.1.2** Actions shall be determined in accordance with 1170. All other references to NZS 4203 are replaced by equivalent references to 1170.
	Explanation: References to NZS 4203: 1992 are replaced by references to 1170 by this amendment.

Your comments on the proposed changes to Paragraph 6.0:

Current text	Proposed changes
7.0 Aluminium **7.1 AS/NZS 1664.1** subject to the following modifications: **a)** Design loadings must be in accordance with NZS 4203:1992. …	**7.0 Aluminium** **7.1 AS/NZS 1664.1** subject to the following modifications: **a)** Actions shall be determined in accordance with 1170. All other references to NZS 4203 are replaced by equivalent references to 1170.
	Explanation: References to NZS 4203: 1992 are replaced by references to 1170 by this amendment. Other modifications to AS/NZS 1664.1 Aluminium Structures - Limit State Design in B1/VM1 are the same as those in the 1 December 2000 edition as amended up to 1 April 2006.
7.2 AS/NZS 1664.2 subject to the following modifications:	(Paragraph 7.2 is deleted.)
	Explanation: Reference to this Standard AS/NZS 1664.2 Aluminium Structures - Allowable Stress Design is to be deleted as it is a working stress Standard that depends on NZS 4203: 1984 which is no longer to be referenced.

Your comments on the proposed deletion of Paragraph 7.0:

Current text	Proposed changes
8.0 Earth Buildings **8.1 NZS 4297**	**8.0 Earth Buildings** **8.1 NZS 4297** subject to the following modifications: Actions shall be determined in accordance with 1170. All other references to NZS 4203 are replaced by equivalent references to 1170.
	Explanation: References to NZS 4203: 1992 are replaced by references to 1170 by this amendment. NZS 4297 contains an earthquake zone map that provides for lower seismicity at the northern end of the North Island. These provisions are now superseded by the updated earthquake zone maps in NZS 1170.5.

Your comments on the proposed changes to Paragraph 8.0:

Current text	Proposed changes
12.0 Windows **12.1 NZS 4211** References to air leakage, water leakage and operational effectiveness of opening sashes in NZS 4211, are non-structural considerations and do not apply to this Approved Document. The more substantial of such references are listed in Amendment No 2, July 1992.	**12.0 Windows** **12.1 NZS 4211** **12.1.1** References to air leakage, water leakage and operational effectiveness of opening sashes in NZS 4211, are non-structural considerations and do not apply to this Compliance Document. The more substantial of such references are listed in Amendment No 2, July 1992. **12.1.2** Where wind and other loads used are to be determined in accordance with NZS 4203, they shall be determined in accordance with 1170. All other references to NZS 4203 are replaced by references to equivalent information in 1170.
	Explanation: Other modifications to NZS 4211: 1985 Specification for Performance of Windows in B1/VM1 are the same as those in the 1 December 2000 edition as amended up to 1 April 2006. It is noted that some test pressures are specified to align with the requirements of NZS 3604 and these are not changed.

Your comments on the proposed changes to Paragraph 12.0:

Current text	Proposed changes
13.0 Farm Buildings **13.1 NZS 1900: Division 11.2**	(Paragraph 13 is deleted.)
	Explanation Reference to NZS 1900: Model Building Bylaw Ch 11: 1985 Special Structures, Division 11.2 Farm Buildings is to be deleted as farm buildings are now within the scope of 1170.

Your comments on the proposed deletion of Paragraph 13.0:

Current text	Proposed changes
14.0 Seismic Resistance of Building Services **14.1 NZS 4219**	(Paragraph 14 is deleted.)
	Explanation: Reference to this Standard is to be deleted as it is a Standard that depends on NZS 4203: 1984, which is no longer to be referenced.

Your comments on the proposed deletion of Paragraph 14.0:

Amendment to Verification Method B1/VM4 Foundations

(The 'Explanation' notes in the table below will not form part of the Verification Method.)

Current text	Proposed changes
1.0.5 This document shall not be used to design foundations on loose saturated sands or on cohesive soils having a sensitivity greater than 10.	**1.0.5** This document must not be used to design foundations on loose sands, saturated dense sands or on cohesive soils having a sensitivity greater than 2.
	Explanation: Updating of provisions on the recommendation of Professor Michael Pender.
Figure 2: Page 56 … $A' = r^2\left[\cos^{-1}(\xi) - \xi\sqrt{1-\xi^2}\right]$ …	**Figure 2: Page 56** … $A' = 2\,r^2\left[\cos^{-1}(\xi) - \xi\sqrt{1-\xi^2}\right]$ …
	Explanation: Error correction. (Factor 2 missing at the beginning of the expression.)

Your comments on the proposed changes to B1/VM4:

Appendix 1: Cost-benefit analysis

The BRANZ Limited report E410 'AS/NZS 1170 Loading Standard Cost-benefit Analysis' is available on the Department's website at www.dbh.govt.nz

Appendix 2: Snow loads review

The NIWA report CHC2006-148, 'AS/NZS 1170.3 – Snow Loads Review,' is available on the Department's website at www.dbh.govt.nz

A report of the second stage of this investigation will also be made available on this website. It is expected in January 2007.