Proposed Changes to B2/AS1

Report to Building Industry Authority
November 2003

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1 Overview of Recommended Changes

1.1 Required Timber Treatment

It is recommended that the Authority adopt the requirements outlined below for B2/AS1.

These are in line with the proposed and agreed revisions to NZS3602. (Following the meeting of the Authority on 13 November, Standards New Zealand DZ3602 Committee agreed to amend DZ3602 to match the proposed B2/AS1.)

As a matter of record, differences between the B2/AS1 proposals and the final draft of DZ3602 are noted on the attached comparative table. [Refer Appendix A].

The recommended B2/AS1 requirements have been labelled Option 3 to distinguish this Option from Options 1 and 2 of the Consultation document. Option 1 called for all timber framing to be treated to H1.2 durability level. Option 2 called for H1.2 treated timber in external walls and bottom plates only of internal walls.

The recommended Option 3 requires H1.2 treated timber for some external walls with a higher risk profile, while allowing untreated timber (kiln-dried radiata pine or Douglas fir) for internal walls and for external walls in low risk situations. This represents a position between Option 2 and the current situation in which B2/AS1 untreated kiln-dried radiata pine or Douglas fir is allowed for all framing except that supporting decks and balconies.

The new requirements are as follows:

(Definitions of terms used in this Report are given in Appendix B)

Lowest level of treatment: untreated kiln-dried Radiata, H1.1 treated planer-gauged Radiata and untreated Douglas fir

- All roof framing, trusses, ceiling joists, blocking and non-structural timber within ventilated roof spaces.
- All inter-storey floor joists, blocking and non-structural timber.
- All interior wall framing including bottom plates and non-structural timber.
- All interior beams, posts, rafters, joists and structural supports that are exposed to the interior on not less than two full sides.
- All exterior wall framing of simple, single storey buildings that are fully clad with masonry veneer, and are classified as low risk as described in NZS 3602.
- Exposed timber framing in unlined buildings such as garages, warehouses, where timber cannot remain wet.

H1.2 minimum or equivalent: Pinus species including Radiata Pine

- All subfloor framing.
- All exterior wall framing of buildings (including boundary joists) other than those allowed within the lowest level of treatment above.
- All enclosed framing, beams and structural supports within skillion roofs.

- All framing of *walls* supporting enclosed decks and balconies.
- All framing within or beneath enclosed parapets.

H3.1 minimum

- All framing within enclosed decks and balconies.
- All framing within enclosed balustrades.
- All enclosed framing supporting flat roofs.
- Enclosed *beams and posts* supporting enclosed decks and balconies
- Other specific enclosed exterior elements such as the framing of boxed chimneys, beams and columns.

H3.2 minimum

- Beams and posts exposed to the weather that support decks and balconies.

It should be noted that these requirements make no distinction between untreated kiln dried radiata pine and Douglas fir, and that they allow the use of untreated kiln-dried radiata or Douglas fir framing in external walls for houses with masonry veneer cladding, provided they are low risk category – single storey with eaves and no complex features or junctions as shown in Figure 1.1.

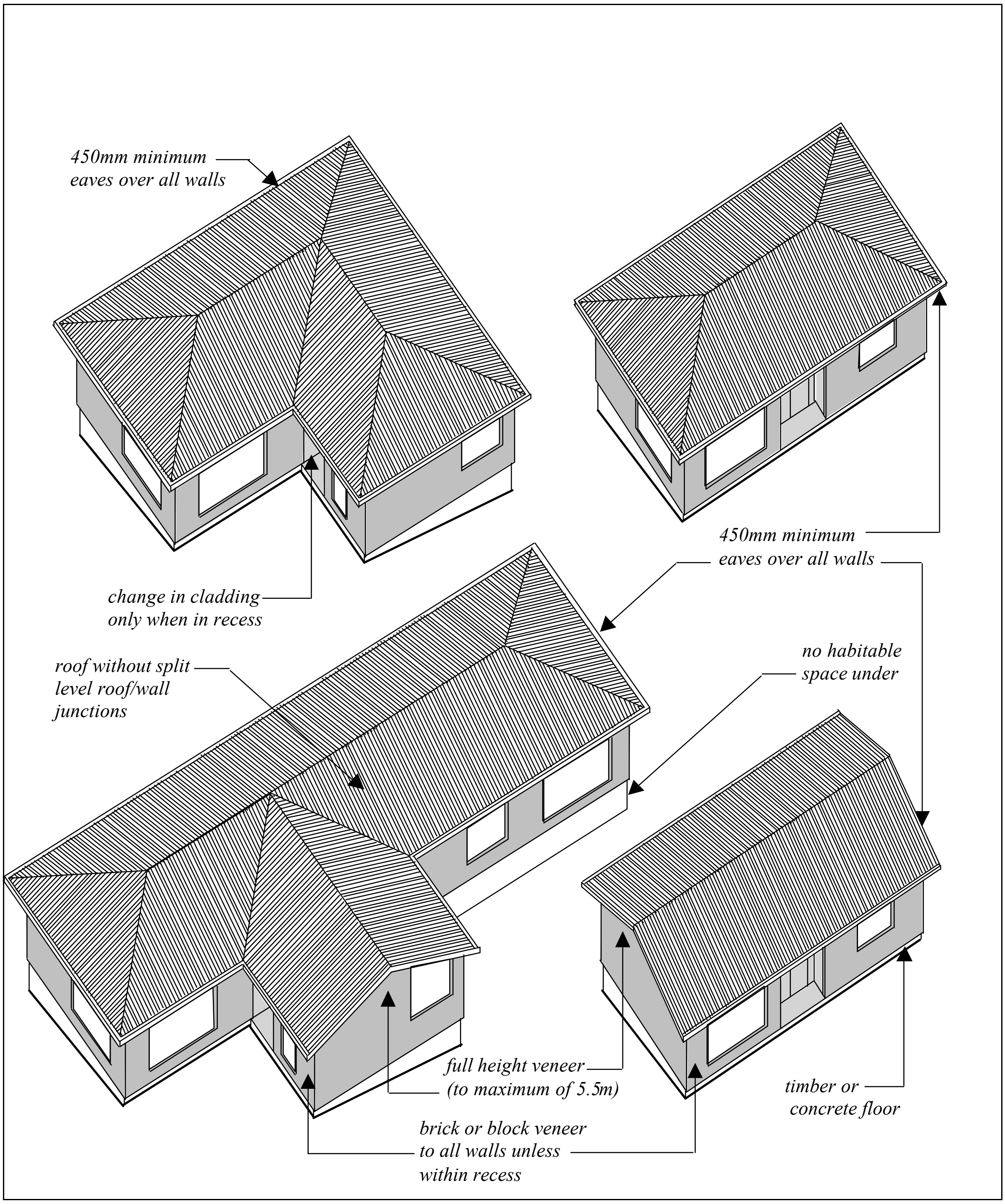

Figure 1.1 Examples of Low Risk Masonry Houses

Figure 1.2 illustrates the primary locations of the varying treatment levels recommended in this report.

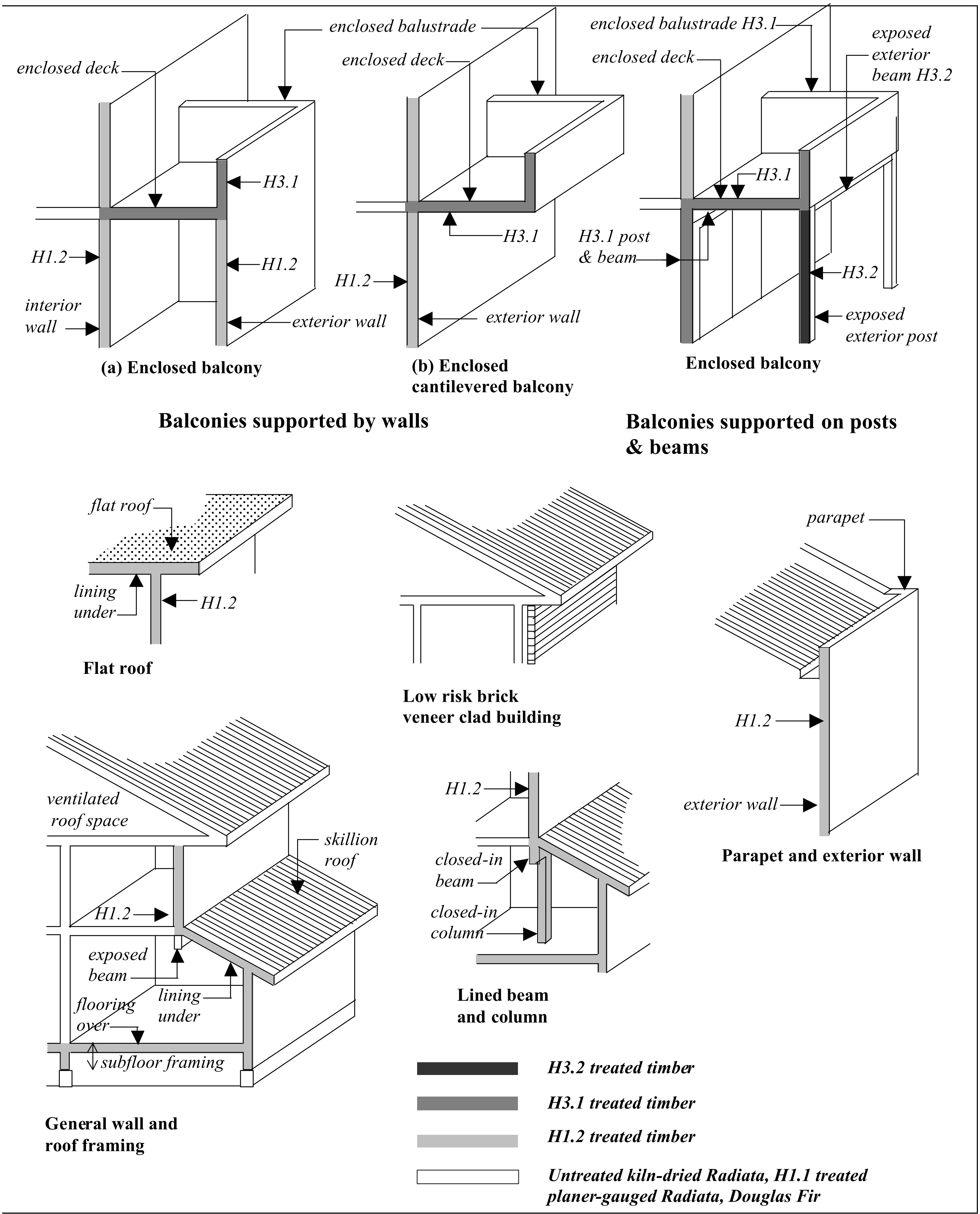

Figure 1.2 (a) – Required Treatment Levels for Timber Framing - by Location

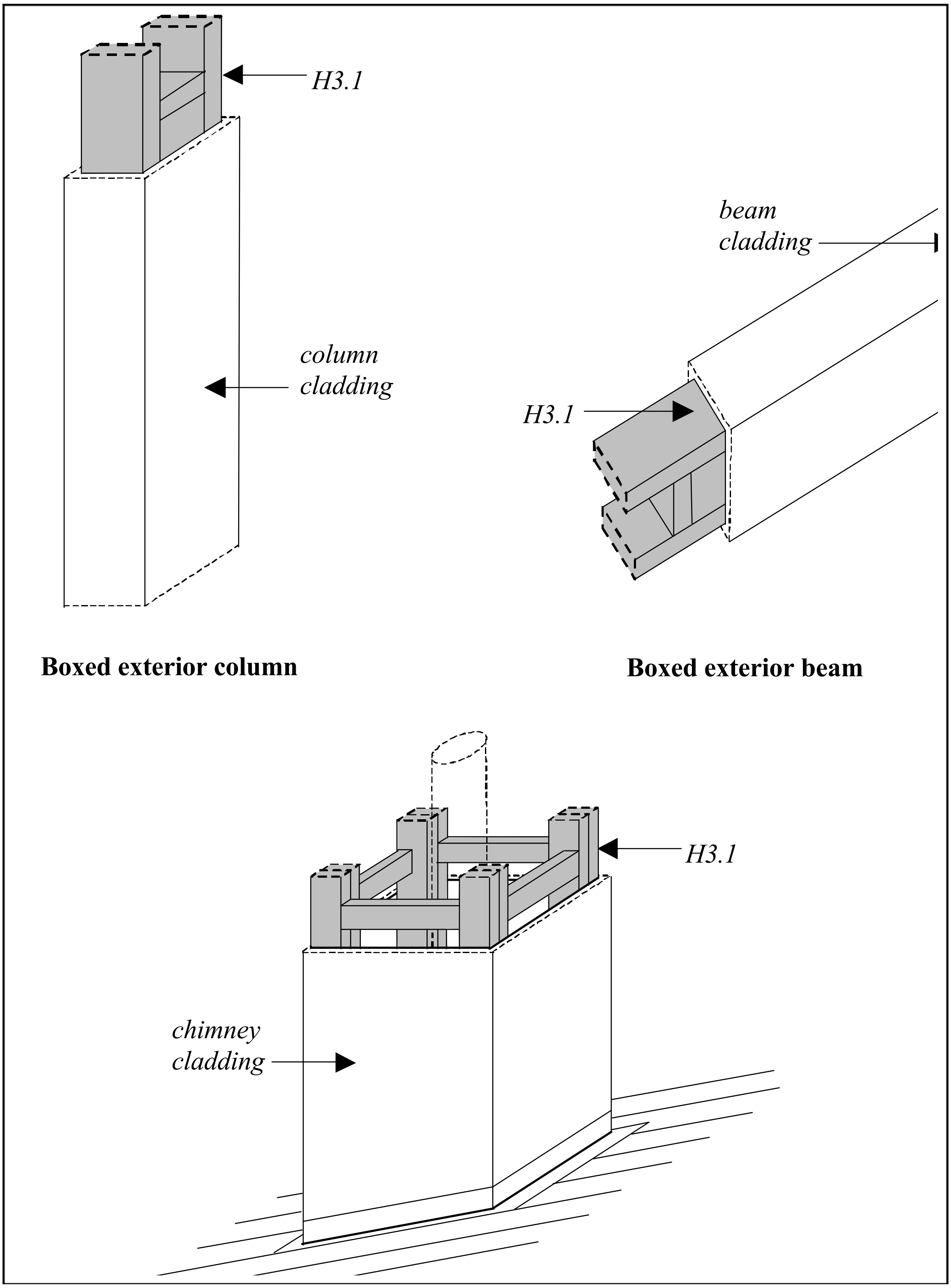

Figure 1.2 (b) - Required Treatment Levels for Timber Framing - by Location

1.2 Durability Table

The Durability Table as issued for comment with B2/AS1 proposals has been modified slightly to take account of detailed comments received and to improve consistency. The introduction of an intermediate durability period of 25 or 30 years has not been included. This will be addressed as part of a review of the Building Code in relation to the proposed new Building Act. Refer Attachment 5.

1.3 Relationship to E2/AS1

No risk matrices will appear in B2/AS1, but a risk matrix approach has been taken in determining the required levels of timber treatment for various situations. The first step in this risk matrix process is an assessment of the E2 Risk Score using the Risk Matrix proposed for E2/AS1. To this extent the detailed provisions of B2/AS1 are dependent on E2/AS1.

The E2 Risk Matrix will undergo further minor development in the process of finalizing E2/AS1 for issue early in 2004, but any changes are not expected to have a significant effect on the basis used in developing the requirements of B2/AS1.

2 Review Process

In issuing the proposed changes for public comment, BIA provided considerable background material including a draft Regulatory Impact Statement and a draft Cost Benefit Analysis [Reference 1]. There was also considerable additional explanatory material.

Two main options were included in the document for comment, a preferred Option 1, requiring treated timber throughout, and Option 2 which allowed untreated (kiln dried) radiata (and Douglas fir) in internal walls and roofs.

Following the close of the eight-week consultation period, submissions were received, recorded and acknowledged. A total of over 300 submissions on both E2 and B2 clauses were received and sent to Working Groups and the Authority members in two forms: scanned originals on CD, and a sortable spreadsheet summary of comments. 225 of these submissions related to the proposed changes to B2/AS1.

The composition of the B2 Working Group is provided in Appendix C. They read all submissions and met for one day to review the issues raised by commentators, and to advise BIA staff on their views. Minutes of this meeting are included in Appendix E.

BIA staff considered the submissions received and the input of the Working Group to analyse the key issues and make recommendations to the Authority.

This analysis included:

- Review of WHRS data [Reference 2] received on 200 out of 2000 registrations
- Development of a risk-informed approach to analyzing the effects of various options for weathertightness and durability
- Updating of the Cost Benefit Analysis

3 Submissions Received

A total of over 300 submissions on both clauses were received totaling more than 3000 pages. Of these, 225 submissions were on the proposed changes to B2 and contained more than 750 comments on the proposed changes.

A report on the submissions received on both clauses is provided as Attachment 1. Part A of that report provides an analysis of comments received on the proposed changes to B2/AS1, and describes the key points made by commentators. It is intended to give an overview of the range of opinion and information provided by commentators.

4 Review of Key Issues

4.1 Timber treatment options, identification and marking

4.1.1 Proposed Hazard Classes and Corresponding Timber Treatments

The proposed hazard classes and corresponding timber treatments have not been changed from the consultation proposal. There were very few comments on the proposed definition and subdivision of Hazard Classes for timber.

The proposed division of H1 into H1.1 (LOSP Permethrin or Boron 0.1%) and H1.2 (LOSP permethrin +Tributyl-tin or IBPC, or Boron 0.4%) is generally accepted by industry.

The proposed division of H3 into H3.1 LOSP (except Copper Napthanate) and H3.2 (copper treatments) is generally accepted by industry.

There were one or two comments advocating the removal of H1.1 as being irrelevant.

No changes to the consultation documents are proposed in this area.

4.1.2 Identification and Marking

- *General*

The attached Table 4.1 shows the proposed allocation of identification and marking to the various treatment types and levels from DZ3640.

The recommended approach remains as proposed - that treatment level should be identified by a unique colour, and treatment type by the addition of a unique end marking based on a system currently used in Australia.

Comments received focused on the need to have a system of identification and marking that provides easy distinction between timbers of different treatment levels, and provides a means for identifying the treatment type.

- *Unique Colour for each Hazard Class*

The proposed colour coding in the documents issued for comment called for untreated radiata, H1.1 and H3.1 called for each to be “Clear”.

Table 4.1 Proposed Allocation of Identification and Marking for Treatments Types and Levels from DZ3640

Colouring

In addition to end branding, framing timber shall be face branded (H3.1 only), or colour coded (H1.2, H3.2) as specified in table 5.2.

Hazard Class	Preservative	Colour (1)
H1.2	TBTO, TBTN or IPBC / permethrin	Blue (2)
	Boron	Pink (3)
H3.1	TBTO or TBTN	No added colour(4) or **green**
H3.2	CCA, alkaline copper quaternary, CuAz, CuN	No added colour (6)

Table 5.2 Colour Coding for Timber to be used as Framing

Notes –

(1) These colours shall not be used for any preservative types/hazard classes other than specified.

(2) The blue colour shall be a red shade blue in order that it does not appear green with the natural yellow of timber (colour Pigment Blue 15.3).

(3) Colour Red 112 (red) or Red 122 (pink).

(4) If not coloured, H3.1 framing shall be branded repetitively along the length, at centres of not more than 1500 mm, of its face or edge.

(5) If coloured green, the colour is to be distinctly different from the green of the H3.2 preservative treatment

(6) No colour is required as the treatment process for copper based preservatives will give the timber a green colour.

The Working Group strongly believed that there should be a unique colour for each level of treatment, regardless of treatment type. Clear should be reserved for untreated timber.

The allocation of “clear” to H1.1 was acceptable because not much timber at this level is produced and the category is likely to disappear altogether in the near future.

The industry is generally happy with blue for H1.2 LOSP and pink for H1.2 Boron.

The colouring of H3.1 represents a considerable challenge. The timber manufacturers exporting to Australia want to colour H3.1 green because that is what is exported to Australia, (they have not yet come to terms with the need to distinguish between LOSP and Copper treatments because of the lower durability achieved by LOSP). The exporters also claim that the artificial green dye or pigment in LOSP is totally different from the natural green colour in copper treatments. Others in the industry point out that there is a strong acceptance that green tints mean copper treatment and are synonymous with CCA treatment, and thus H3.1 LOSP dyed green would be mistaken for CCA treated timber. After considering the above, including the use of alternative colours such as orange or purple, the NZS3640 Committee decided to accept the green colour for H3.1 framing.

It should be noted that the proposals include an instance where colour is used to distinguish treatment type rather than level. H1.2 Boron is proposed to be pink and H1.2 LOSP to be blue, with end marking used to identify chemicals used in treatment.

End marking of treatment type and level

Although in some cases treatment type can be identified by a unique colour, end marking following treatment provides a further means of identification that can always be applied following treatment.

A proposal to emerge from the Working Group discussion was to use an Australian Coding system that enables treatment types and levels to be identified by allocating unique 2-digit to each treatment type. This system is already in use in New Zealand for all timber exported to Australia by Timber Preservation Council (TPC) plants, and the industry sees little difficulty in extending it to cover all treated timber.

BIA would need an undertaking that the code was readily available to Territorial Authorities for inspections.

A drawback of end-marking is that the mark is lost once ends are removed. The most likely time where identification of treatment type will be needed is when the timber is in pallets, such as when it is delivered to site or to a framing factory. Thus, although end-marking identifies both treatment type and level, it is desirable that the treatment level is identified by other means.

Marking to be done at time of treatment

An important issue to emerge in the Working Group discussion was the need for treated timber to be marked at the time of treatment, or immediately thereafter. Marking of treatment type or level prior to treatment should be avoided. Colouring for treatment level and end-marking for treatment type obviate the need for any marking prior to treatment, but is not favoured by all manufacturers.

An alternative to using colour as a means of identification of treatment level is to face mark with both the treatment level and type. However, timber treatment plants do not have a means of face marking the timber (timber comes in packets on the back of a truck, is fork lifted into the pressure vessel for treatment and then trucked away again, in theory after standing for gassing off of the LOSP. Face-marking would require the installation of special marking machines, breaking up of the packets, feeding of the timber through the machine and re-packeting. The additional costs of this are prohibitive.

It has been argued that it would be possible to face mark the timber, prior to treatment, as it is processed in the mill. However, in practice it would require highly developed quality assurance systems in place to ensure that timber marked as say H3.1 prior to treatment, is not mistakenly built in to a job before treatment actually happens.

A further drawback of this approach is that timber has traditionally been end branded after treatment, and the introduction of pre-treatment branding would be a major challenge. (We understand that one large company has quality assurance systems in place to do this and have been doing so, but with no clear indication of whether or not it is working, and if the percentage of slip ups would be worse or better than the mistakes in identity of timber treatment that are occurring now under the present system.)

Overall, separate face-marking does not have the advantages of colour coding imparted as part of the treatment process, and could lead to use of untreated timber in locations requiring treated timber.

As a result of these considerations BIA has recommended to Standards New Zealand:

- That a commentary clause be added to both NZS3640 and NZS3602 to recommend that a simple test for CCA be used and BIA/Standards NZ and Forest Research promote the availability and use of test kits.

- That an amendment to NZS3640:2003 be produced to cover the quality of colours used for identification with a target of completion within twelve months.

- That investigations are made regarding ways in which to assist the industry in quality assurance systems and inline branding to encourage face branding.

4.1.3 Timber Treatment – Health and Safety Issues

CCA Treatment

Health concerns over CCA treatment are an issue in front of the public at the moment. The proposals for B2/AS1 are concerned with durability. Any response to health concerns regarding CCA treated timber would be dealt in clause F2 Hazardous building materials. These concerns are still being evaluated at present, and the recent report commissioned by ERMA did not provide evidence sufficient to prohibit reference to CCA treatment in B2/AS1.

LOSP Treatment

There was some concern expressed by commentators regarding the harmful effects of solvent fumes from LOSP treatments, particularly in relation to the use of LOSP-treated timber in the pre-cut framing industry. Complaints received by BIA of excessive fumes, seemed to be related to the lack of proper airing following treatment. (NZS3640 requires one-week minimum exposure to air following treatment to allow solvent fumes to disperse).

As a sustainable solution for achieving durability, LOSP treatment should be seen as a short-term solution only. The light organic solvent is a petroleum derivative, while the tributyltin additives are not environmentally friendly. The product uses a non-renewable resource which gasses off into the atmosphere and leaves a residue that will become a significant disposal problem in the future as land waste disposal systems become more particular about what goes into them.

LOSP treated timber causes problems for workers in the industry when handling the timber. Workers can suffer from side effects of the LOSP if it is still gassing off, and from the tributyl tin component if they are sensitive to chemicals. The problem is exacerbated in enclosed pre-framing and truss manufacturing factories, although it is easier in these places to put controls in place such as ventilation, and to enforce the use of goggles, masks and gloves for protection, than it is on a building site. OSH control such practices, and BIA have introduced requirements that result in an increased use of LOSP in buildings and BIA should work with OSH to develop a code of practice for handling LOSP. It is especially important that LOSP-treated timber be allowed sufficient standing time before use.

The Working Group considered that although care needed to be taken in dealing with LOSP-treated timber, the risk could be managed acceptably, even taking account of the possibility that more treated timber could result from the B2/AS1 proposals than previously.

A further consideration is that the treatment industry is looking at alternative methods of getting Boron into timber. However, in the short term LOSP will remain a satisfactory treatment. BIA has recently been advised of the development of a LOSP treatment that has markedly reduced solvent emissions. If this product becomes prevalent in the market place, the health concerns from use of LOSP-treated timber will markedly reduce.

4.2 Durability Table

The Durability Table as issued for comment with B2/AS1 proposals has been modified slightly to take account of detailed comments received and to improve consistency. The introduction of an intermediate durability period of 25 or 30 years has not been included. This will be addressed as part of a review of the Building Code in relation to the proposed new Building Act. Refer Attachment 5.

The attached table [Refer Attachment 5] shows the resulting proposals and highlights the changes made from the consultation version.

4.2.1 Consistency

A number of commentators pointed to apparent inconsistencies in the Durability Table. Some of them appear to be the result of misunderstandings about how the durability clause works, but most of these comments relate to different elements that are used in conjunction and yet have varying durability requirements.

The view expressed was that the required durability of a supporting or protecting material should correspond to that of the primary element. For example, underlays and wraps should have the same requirements as those for the cladding, damp-proof membranes should have the same requirements as the structure, and so on. There is also a need to reassess the periods required for some items such as concealed guttering that, while not supporting a primary element, may be extremely difficult to replace.

Such issues have been reviewed in detail, and modifications made to improve consistency.

4.2.2 Intermediate Time Period

A number of commentators expressed the view that there should be a further division of the durability table to incorporate a 25- or 30- year durability category. This is an issue that has been discussed before but recent Weathertightness concerns have highlighted it. In response to the comments received, it is proposed to prepare an outline of how a 25-year category may look. However, any change would not be implemented as part of this revision. Introduction of a 25-year category in Table 1 would require a change in Clause B2.3.1 which currently refers only to 5, 15 and 50 year categories. Such a change would require a new public comment stage. The introduction of a new Building Act will require a review of all building code clauses over the next two years. It is therefore proposed to recommend this change to any future working group that may be assembled to review B2.

4.3 Extent of application of Acceptable Solution

The distinction between commercial and residential construction in NZS 3602 is no longer made. The proposed B2/AS1 accepts the removal of this distinction.

Some commentators expressed concern that the Acceptable Solutions may be limited to smaller scale housing. Territorial Authorities suggested that this would lead to significant work in processing other types of buildings. Commentators urged that the scope of E2/AS1 and B2/AS1 should be expanded to cover all of those buildings that fall within NZS 3604, regardless of their use.

Both the DZ 3602 Standards Committee and the B2 Working Group were strongly against differentiating between durability requirements for housing and for other buildings. It was argued that excluding industrial and commercial buildings would represent unjustifiable concessions for industrial and commercial buildings. The instance was quoted of two identical buildings, one of which had been converted to commercial from residential while the other remained residential. There seemed to be no justification to make a distinction between the two in terms of durability.

The Committee and Working Group considered that where there are strong arguments for using untreated timber, such as internal partitions in portal framed buildings, this is provided for under NZS 3602 Table 1 E, and other situations where special controls are in place may be put forward as alternative solutions.

Such an approach does not have significant implications for the economics and freedom of choice for commercial buildings, for example warehouse buildings with exposed timber rafters. The removal of the distinction will have very little impact because NZS 3602 Table 1 Section E provides for “Members not exposed to weather or ground atmosphere and in dry conditions”. This would apply to most situations where timber is exposed in warehouses. In addition, there is always an Alternative Solution route available for commercial buildings, a route that is taken in many cases at present. Furthermore the proposed B2/AS1 option now favoured allows untreated timber in more situations.

The DZ3602 Committee intends to remove the distinction between housing and commercial/industrial buildings that currently exists. It is recommended that the BIA do the same.

4.4 Extent of need for treated timber framing

4.4.1 General

There was considerable comment on this issue, mostly to the effect that Option 1, in requiring treated timber throughout, was an overreaction to weathertightness problems and that the focus should be on E2 provision's. These comments have been considered carefully by the Working Groups and BIA staff.

Very little by way of additional factual material was submitted that would help with the analysis of the issues. In order to bring the greatest possible degree of analysis to the process, the following steps were identified and examined.

- Exposure of timber to water during construction
- The influence of cladding on protecting the timber framing, including the role of maintenance
- The likelihood of water penetration of the cladding
- The likelihood of water remaining within the building
- The consequences of water remaining in the building.

4.4.2 Development of a Rational Approach to Weathertightness and Durability Issues

In determining the requirements for timber treatment to be prescribed in B2/AS1, a risk-informed approach was taken to analyse the various influencing factors on weathertightness.

The outcome of this process is shown in the attached document Attachment 2 Weathertightness and Durability – Risk Matrix Approach. Examples of the application of the Risk Matrix approach are included.

An outline of the risk matrix approach is as follows:

For E2, External Moisture (Weathertightness) considerations:

- Develop a risk matrix that recognises the principal risk components: wind; number of storeys; eaves width; envelope complexity; decks/balconies.
- Include in the risk matrix levels of severity for each risk component
- Assign points for risk components according to severity – the more risk the higher the number – to arrive at an E2 Risk Score for each face of the building
- Determine allowable cladding types and need for drained ventilated cavities according to the E2 Risk Score. Note that the basis for this determination is to keep the risk to the external framing more or less constant. For example, to allow the external framing to be H1.2 or similar.

For B2, Durability considerations:

- Develop a rating system that provides a measure of the risk of water/moisture entering the building (for external walls this would desirably be the same as that used in E2/AS1, but would need to stand alone within B2/AS1).
- Develop an index which accounts for the drying potential of the wall and/or roof components in a particular application.
- Account for the likely effects of exposure during construction and maintenance issues.
- Combine these considerations to produce an overall B2 Risk Score which is essentially a measure of the risk of moisture entering and remaining in the building.
- The higher the B2 Risk Score, the higher the level of timber treatment required.
- Develop a table relating the known or likely durability performances of various timbers to this B2 Risk Score.
- Allow separately for special features such as decks and balconies, to determine the treatment level required for supporting timber.

The combined approach thus takes account of the effectiveness of the weather skin and the factors that influence the degree of damage/health risk due to rot or fungus growth.

Data from BRANZ [Reference 1] and limited information from the WHRS [Reference 2] gives some indication of the nature and scale of weathertightness and durability problems needing to be addressed. The data is not sufficient to establish clear correlations between cladding types and incidence of leaks, or the relationship between water retention and severity of damage to timber framing. It is thus difficult to make precise analyses of cause and effect. However, by using the data available in conjunction with the principles of weathertightness and timber decay, it is possible to establish a rational approach to determine required levels of timber treatment for a range of situations.

A Report on early results from WHRS is included as Attachment 3. This has been used to inform the risk analysis.

Important Note

It is important to note that the Risk Score determinations described above are intended as background only to the proposed requirements of E2/AS1 and B2/AS1. It is not intended that the detailed numerical scoring would be applied by designers or Building Officials. The purpose of the numerical analyses is to provide a rational and robust background to support the requirements to be included in the two Acceptable Solutions. The figures used in the analysis are based on a limited amount of data, empirical evidence and technical judgment, rather than precise technical analysis.

Furthermore, it should be noted that this process is technically based and does not attempt to introduce other considerations such as public policy, economic impacts, practical constraints, and other effects on sections of the industry. These considerations need to be examined independently as part of the process of producing specific proposals for the Acceptable Solutions.

4.5 Other Considerations

4.5.1 Cladding Construction

The influence of cladding construction on the protection provided to timber framing is a key consideration in determining appropriate durability requirements. These have been examined in developing the Risk Matrix for E2/AS1, as referred to the attached Report.

4.5.2 Effect on Douglas Fir Industry

Strong representations by the Forest Industry Action Group (FIAG) and others pointed to potentially serious effects on the Douglas fir industry of requiring treated timber for all framing as in Option 1 of the consultation documents.

Their objections were on the basis that the requirement to have treated timber throughout would cause major problems for the Douglas fir producers either in loss of market or in requiring treatment processes to be developed and implemented.

Option 3 involves substantially less impact on the Douglas fir industry because Douglas fir would be allowed for all framing except that in external walls in higher risk situations. This is the same situation as for untreated kiln-dried Radiata. BIA have estimated that the percentage of untreated kiln-dried Radiata and Douglas fir that will be used under Option 3 is 80% of all timber framing for houses (excluding sub-floor timbers). Douglas fir represents about 5% of the total market at present, so that Option 3 provides considerable scope for Douglas fir to maintain its place in the market.

The NZIER analysis has not included the costs of any impact on the Douglas fir industry in the Cost Benefit Analysis Update. In the context of a nationally-focussed CBA, as required under the Building Act, NZIER argue that the overall national impact of the proposed changes is small. Nevertheless, it is recognized that extensive requirements for treated timber would have a significant impact on the Douglas fir industry. It is also recognized that the more situations in B2/AS1 that allow untreated timber, the less the impact on the Douglas fir industry.

4.5.3 Effect on Radiata Export Industry

During the early consultations with the timber industry concerns were raised that the removal of the untreated kiln-dried radiata from B2/AS1 would have a seriously detrimental effect on the export opportunities for this timber.

The matter was not raised in formal submissions, and it is difficult to determine the likely quantitative effect. As NZIER point out, any impact on export industry is likely to be driven by general knowledge and media coverage of concerns rather than by changes to B2/AS1. For this reason, the effect of any change in B2/AS1 on the export of Radiata has not been included in the Cost Benefit Analysis Update.
In addition, the requirements of Option 3 recognise the performance to date of untreated kiln-dried Radiata and represent a significant shift from Option 1 as proposed in the Consultation documents.

4.5.4 Cost-Benefit Issues

The CBA Update is based on completely revised data and is better informed as a result of the comments received, the analysis of the WHRS data to date, and the development of a risk matrix approach to both weathertightness and durability issues.

The results give an indication of the trends and provide an endorsement of the move to reduce the requirements for treated timber from those proposed in Option 1 of the Consultation documents.

5 Cost Benefit Issues

5.1 Approach

The detailed views of commentators have been considered by NZIER, and are the subject of a separate report – Update of Cost Benefit Analysis [Attachment 4]. In this NZIER have addressed the key comments and concerns and have presented results of their re-analysis using revised figures for:

- Cost of additional measures for weathertightness (Draft E2 requirements)
- Cost of providing treated timber for framing (B2 requirements)
- Chance of leak occurring
- Chance of damage if leak occurs
- Cost of remediation

Revised figures used were agreed or supplied by BIA and in particular take account of the WHRS data available on 202 out of over 2000 cases reported to WHRS.

Two main options were analysed: Option 1 as in the Consultation Documents and Option 3, refer section 7.1, being the approach recommended (which is similar to Option 2 of the Consultation Documents, but requires less treated timber). Comparisons with earlier results in the Draft Cost Benefit Analysis [Reference 1] provides some link with the previous analyses.

5.2 Background

There was a wide range of opinion in regard to the Cost Benefit Analysis of the proposed changes to B2. Some commentators considered that the costs of the changes implied by the proposals were over-estimated and the costs of potential repair were under-estimated, while others who opposed the changes expressed the opposite view. Many considered that the figures in the CBA were broadly correct.

The following is a brief summary of the key points made by commentators:

Estimates are Broadly Correct
Some considered that the figures in the Cost Benefit Analysis were quite conservative, but still agreed with the overall conclusions of the report. The interpretation of failure rates and repair costs was seen as being reasonable, and consistent with their experience of costs of repair of decayed timbers.

Costs are Overestimated and Benefits are Underestimated
Some considered that the analysis was too conservative in the estimate of potential costs and benefits of the proposed changes. The costs were expected to be substantially less than that estimated, and the benefits larger, as a period of 50 years should be used in the analysis.

Costs are Underestimated and Benefits are Overestimated
Some commentators had serious doubts about the veracity of the data on which the conclusions of the report are based. The results are highly sensitive to the assumptions made, and some considered these to be seriously flawed.

The criticism was that costs were expected be substantially more than that estimated, with the likely total increase for the changes to both clauses being estimated as more than $25,000 for a

stand-alone house versus $5,000 in the analysis. Benefits were expected be substantially less than that estimated, as failure rates and repair costs were overestimated.
Some commentators also considered that the analysis did not adequately allow for many factors that would impact on costs of the proposed changes, and pointed out what they considered to be other flaws in the analysis.

The B2 working group considered the broad issues raised by the comments, and generally concluded that the likely total increase in costs would tend to be in the order of $4,000 to $10,000, rather than the $25,000 to $50,000 as suggested by some commentators. It was expected that, as requirements became standard practice, costs would decrease.

In terms of benefits, it was considered that the aim is to avoid future repair costs and this is difficult to quantify as variations can be very large, there is limited information, and there is also existing houses will may fail in future.

5.3 Results Summary

The Update of the Cost Benefit Analysis took account of the above factors and included a complete re-analysis of the previous Option 1 and the proposed Option 3. In determining the values of parameters used in the analysis, extensive use was made of the relationships derived for the risk matrix approach. This in turn was informed by the WHRS and other data.

Scenarios chosen for analysis were the "1% scenario" that corresponded approximately with the middle scenario of the Cost Benefit Analysis given in the Consultation document. In the 1% scenario, the total buildings under the current situation, assumed to experience weathertightness problems requiring treatment, is 1% of the total built in any year. Similarly in the 2% scenario, 2% of buildings are assumed to be affected.

Two points are worth noting:

- The degree to which buildings are assumed to be affected has been set to match the profile of the WHRS data.
- The WHRS has registered approximately 1% (2,000 out of 200,000) of buildings constructed in the last decade. Thus, the 1% scenario can be regarded as a lower limit since there are bound to be a significant number of unreported cases. The BIA believes the 2% scenario is close to the real situation.

Key results of the new analysis are shown in the following table:

Table 1 NPV of costs
Millions of dollars, 5% discount rate, Period 25 yrs

Failure Rate	E2 Alone	E2 + B2 Option 1	E2 + B2 Option 3
1% scenario	816	1414	928
2% scenario	816	1414	928

Table 2 NPV of benefits
Millions of dollars, 5% discount rate, Period 25 yrs

Failure Rate	E2 Alone	E2 + B2 Option 1	E2 + B2 Option 3
1% scenario	819	1068	1022
2% scenario	1637	2136	2044

Table 3 NPV of benefits less NPV of costs
Millions of dollars, 5% discount rate, Period 25 yrs

Failure Rate	E2 Alone	E2 + B2 Option 1	E2 + B2 Option 3
1% scenario	3	-346	94
2% scenario	822	721	1116

Table 4 Benefit-cost ratios
5% discount rate, Period 25 yrs

Failure Rate	E2 Alone	E2 + B2 Option 1	E2 + B2 Option 3
1% scenario	1.00	0.76	1.10
2% scenario	2.01	1.51	2.20

Source: NZIER

6 Update of Regulatory Impact Statement

In response to the comments received, and the revised results from the Cost Benefit Analysis, the Regulatory Impact Statement issued for Consultation has been updated. This is attached as Appendix E.

Points to note regarding the changes made are:

- Questions posed as part of the Consultation have been removed as having served their purpose.
- Section 4.0 Feasible Options - These have now been narrowed to the original Option 1 requiring treated timber throughout and Option 3.
- Section 5.0 Statements of Net Benefits has been rewritten to include revised results from the cost-benefit analysis.
- Section 6.0 Consultation Programme has been updated to reflect the activities since the Consultation Document was released.
- Section 7.0 Business Compliance Costs has been updated following update of Cost-Benefit Analysis.

7 Commentary on Key Issues and Determination of Recommendations

7.1 Consultation Options

In the documents that were issued for public comment, there were two principal options, broadly summarised as:

- Option 1 (“preferred”) – treat all timber framing to H1.2 at least
- Option 2 – treat timber in external frames only to H1.2 at least.

In similarly broad terms the preferred option is now:

- Option 3 – (BIA Preferred Option) – As for Option 2 above, but allow untreated kiln dried radiata or cut-of-log Douglas fir behind masonry veneers for simple buildings representing low risk as defined in NZS3602.

The “preferred” Option 1 in the Consultation Document was recognized as providing a high level of peace of mind to building owners, both from the point of view of resistance to water-induced decay and to insect attack. It would require a considerable change to the status quo and thus had the potential to affect the timber production and building industries significantly. Considerably more treatment would be required, with resulting increase in the volume of timber requiring treatment and in the use of preservatives. It was this Option that received the most comment.

Option 2 of the Consultation was less of a departure from the status quo, but recognized the additional risk to framing supporting the external cladding. Intuitively, internal walls would be less at risk and given the relatively low incidence of problems in internal walls, appeared to be a reasonable response to recent concerns about weathertightness.

7.2 Comments and Data

Having reviewed the comments and analysed further available data, particularly the recently released initial data from the WHRS, it is apparent that the blame for the damage to buildings due to water ingress was due in large part to the failure of the external envelope to prevent water penetration, and in relatively small part to the lack of treatment of timber. Many commentators had stated this view quite forcefully, and the initial evidence appears to bear this out.

Commentators had argued strongly that masonry veneer buildings had a good record of performance and did not warrant a change to the status quo that allowed the use of kiln-dried Radiata framing to external walls. Initial data shows a low incidence of masonry veneer buildings in the WHRS data set.

Even though the WHRS data set available represents only 10% of the homes so far registered, these initial trends have been given considerable weight, especially when taken with other issues, such as:

- The need to keep use of chemical treatment of timbers to a reasonable minimum.
- The steps taken in E2/AS1 to provide a much higher standard of weathertightness than is currently being achieved.
- The effects on industry of a significant shift from the status quo. This applies particularly to producers of Douglas fir.

Thus the peace of mind resulting from increased use of treated timber had to be balanced with other considerations, taking account of available evidence.

Overall the view has been taken that while it may be technically desirable to treat all timber framing in buildings, there is evidence and there are other considerations that make it acceptable in current circumstances not to depart too far from the status quo. At the same time, the additional risk to external framing must be recognized.

7.3 Risk Matrix Approach

In reaching this conclusion it has been helpful to analyse the components of risk of damage to buildings due to moisture ingress and retention in susceptible elements. In particular, the following should be noted:

- The Risk Matrix developed for E2 measures the risk of moisture penetration due to various risk components. This approach requires a more conservative approach to cladding details as the Risk Score increases. Broadly, this has the effect of keeping the external wall framing at a uniform risk of becoming and staying wet. This approach on its own, if effectively implemented, is expected to provide a much higher level of protection than currently exists, especially for the claddings that are most prevalent in the WHRS data.

- The development of a B2 Risk Score that measures the risk of conditions arising that are conducive to decay. The higher the B2 Risk Score, the higher the level of treatment required to keep overall risk acceptable.

This is not to imply a level of precision in such analyses that cannot exist. But the analytical process allows the consideration of each risk component separately, thus providing better insights into the important parameters and their likely influence on the overall risk. It also enables a more informative analysis of WHRS and other data to be performed.

7.4 Key Questions and Considerations

In determining an appropriate response to amend B2/AS1, the following considerations and questions were of significance:

7.4.1 Is Untreated Timber suitable for use in external walls?

A large number of commentators protested strongly that to require treated timber throughout the building, as required by the preferred option issued for comment, was too conservative. Their view was that there would be no problems with untreated timber if the cladding was installed properly. Even with the acknowledged deficiencies of cladding systems, the proportion of houses with problems was not sufficient to warrant such 'extreme' action.

It is true that a large number of cases of buildings with weathertightness problems showed defects in construction of cladding to be the cause. But it is difficult to argue that E2/AS1 will result in completely moisture free buildings, especially external wall framing.

Radiata pine has been shown to be very susceptible to decay in the presence of moisture. Douglas fir may be slightly better, but not enough to make a significant difference in allowable application. Given this, and given that construction faults will always be present, and the concern over the weathertightness of buildings, it seems prudent to call for treated timber in external framing, except perhaps for very low risk situations. This brings the situation back to that similar to boric treated timber throughout that existed from 1955 and well before the introduction of kiln dried untreated timber in B2/AS1 in 1998

7.4.2 Is Untreated Timber suitable for use in internal walls?

The key question is the extent to which internal walls are less likely to become wet and stay wet when compared to external walls. There is little data to help answer the question. WHRS data appears to support the view that most problems occur at the external framing. This is where the penetrations are. Internal walls are subject to wetting from roof leaks, plumbing leaks, bathroom leaks and so on, but it appears that this causes less concern overall than leaks of external moisture through the weather envelope. In a few cases, lined internal walls have demonstrated their ability to hold water long enough to cause decay in the framing.

In light of this lack of evidence it is tempting to call for treated timber throughout. However, there are downsides to this as some commentators point out. These include the increase in toxic chemicals present in houses and in the construction process. They also include, at least in the short to medium term, a significant effect on the timber industry. More treatment plants will be needed to cope with the extra demand, and the Douglas fir industry would be faced with considerable investment to provide treatment facilities, assuming that such treatment can be shown to be effective and economic.

Overall, the case for treating internal framing is not as strong as that for treating external framing and it does not seem unreasonable to allow Untreated kiln-dried Radiata and Douglas fir for internal frames, at least until further information becomes available. The performance of the new requirements of E2/AS1, B2/AS1 and quality of construction generally could be monitored. Further research could be done by the timber industry on the durability of timbers and on the WHRS and other data to gain a better appreciation of the factors affecting the durability of timber framing.

7.4.3 Treatment of Douglas Fir

It has been suggested that Douglas fir can be treated to H1.2. A process has been trialled but has not been fully proven, accredited or developed for commercial application. The Forest Industry Action Group (FIAG) have warned against making policy on the basis that a viable process exists for treating Douglas fir. This is taken to mean that B2/AS1 should not call for treatment throughout a building on the basis that treatment of Douglas fir may be readily achieved without significant detriment to, or investment by, the Douglas fir industry. Assuming that development of satisfactory treatment of Douglas fir could be achieved, it would require considerable investment in the industry to produce treated Douglas fir.

The overall conclusions from these considerations are:

- If treated timber is called, for example, H1.2 standard, then Douglas fir could be used provided there existed a suitable treatment process that achieved the durability standard required.

- If it is thought that treated timber should be required in all elements including internal walls, then time should be allowed for the industry to make the necessary changes.

7.4.4 Treated timber for bottom plates

For external walls required to be H1.2 or greater this is not an issue. For any external frame situations that allow untreated timber, there is an argument that bottom plates should be of treated timber. The justification for this is that it is the bottom plate that is subject to high wetting actions during construction. There is little data to substantiate or challenge this argument. Practical considerations dictate that no distinction should be made between bottom plates and the remainder of the frames. The risk is principally, but not wholly, one of risk during construction. If walls become wet it is the bottom plates that are most affected.

For internal walls, the same argument applies, but with less risk post-construction. Again, for practical reasons, it does not seem unreasonable to keep the bottom plates the same treatment level as required for the frame. This may need to be restricted to timber that is exposed for less than say eight weeks during construction. This itself has an element of lack of practicality that needs to be balanced with the difficulty of ensuring that treated bottom plates are incorporated in the correct position.

B2/AS1 as an Acceptable Solution requires that construction periods are limited. On this basis the recommendation is made that bottom plates of wall framing be of the same treatment level as required for other reasons.

7.4.5 Douglas Fir and Radiata Pine

In support of the recommendation not to distinguish between Douglas fir and Untreated kiln-dried Radiata, the following points should be noted:

- Douglas fir produced in New Zealand is a mixture of heart and sapwood, and should be judged from a durability standpoint on the performance of its sapwood.

- The performance of Douglas fir to date should be judged on the basis that it is sapwood.

- FIAG (Douglas fir producers) have pointed out that there is no case to distinguish between heart Douglas fir and sapwood Douglas fir.

- Heart Douglas fir is believed to have superior durability and considerably less moisture take-up than radiata pine. Little definitive research has been done to provide evidence of this.

- Recent tests at FR in Rotorua compared run of the mill Douglas fir with UT Radiata. Results indicated that the Douglas fir samples did not reach an average moisture content above the threshold required to initiate decay.

- However, the samples were open to the air allowing any surface moisture to evaporate quickly.

- Furthermore, the moisture content measured was for the mix of sap and heart. Separate measurements were not taken of each, and it is quite possible that the sap absorbed moisture above the threshold while the heart absorbed markedly less. If this were the case, there would be no reason to distinguish between Douglas fir and Untreated Kiln-dried Radiata.

- In other words the tests were inconclusive. Further tests are being done to clarify the difference between Douglas fir sap and Douglas fir heart in this respect.

- Until such time as further test results are available, there is no reason to make a distinction between Douglas fir and Untreated Kiln-dried Radiata.

- There has been a suggestion that heart Douglas fir could be used behind masonry veneers. This is on the basis that heart Douglas fir has superior properties to Untreated Kiln-dried Radiata. However, until further results are available it is not possible to make that distinction. Even if the test results were to show superior performance, specifying heart Douglas fir will be of little practical benefit, since the Douglas fir trees milled in New Zealand make it uneconomic to cut heartwood out. Such a process results in too much waste of wood available in the log.

- The proposed Option 3 would allow Douglas fir in external walls of low risk masonry veneer buildings and internal walls.

7.4.6 Treated vs Untreated timber for external walls

- The recent problems with weathertightness of buildings has highlighted the vulnerability of external frames when cladding systems fail to keep out moisture and it remains within the building sufficient to raise the moisture content above the threshold for decay to occur.

- The proposed E2/AS1 requirements will, if implemented properly, improve the protection to the external framing. Some commentators have argued that addressing the weathertightness of the external envelope is all that is necessary to deal with weathertightness concerns.

- This argument ignores, or gives insufficient weight to the evidence of inadequate construction practices that result in moisture ingress. While the BIA focus on improvement of builder and Territorial Authority performance, it will take time to have a worthwhile effect. Even then, it would be optimistic to base requirements on those improvements resulting in a perfectly weathertight envelope.

- Thus, regardless of the steps taken in E2/AS1 moisture ingress cannot be ruled out.

- The issue is then one of what happens to the moisture once it enters through the building envelope. This will depend largely on the drainage, ventilation and opportunity for evaporation that exist behind the cladding. Clearly, if there is a drained and ventilated cavity, the external framing will be at considerably less risk than if there was no cavity.

- Some commentators have argued strongly that buildings of masonry veneer have shown few if any problems with the use of Untreated Kiln-dried Radiata or Douglas fir in the external framing. Certainly, not enough to warrant a change from the present position.

- These commentators point out that this form of construction is very common in New Zealand and has a proven record of good performance.

- An analysis of the WHRS data available (202 out of 2000 homes) substantiates this view. Masonry veneers are under-represented in the data compared with the parent population.

- The record of other types of cladding with cavities is largely unproven.

- Given this situation and the problems encountered, largely with external walls, it seems prudent to require H1.2 timber treatment for external wall framing, except possibly for the proven situation of traditional and uncomplicated buildings with masonry veneers.

7.4.7 Untreated timber behind masonry veneers in low risk situations

- Given that it is desirable to have H1.2 timber in external wall framing generally, is there sufficient evidence of lack of problems with untreated timber behind masonry veneers in low risk situations to warrant an exception from the general recommendation to have H1.2 timber in external framing?

- Masonry veneer is commonly used for many smaller simpler houses in many parts of New Zealand. It is therefore reasonable to consider making an exception and allow untreated timber for external walls in these situations.

- Questions this raises are:

  - *Is there sufficient evidence/rationale to support making an exception in this instance?*

    Firstly, masonry veneer is under-represented in the WHRS data and other data, indicating a significantly lower risk. Secondly, there are a large number of houses built with this construction (45% of total currently). Given this percentage and the low risk evident in the WHRS data, it is reasonable to make an exception.

  - *Is there enough evidence/rationale to support a distinction between low and high-risk situations?*

    Initial WHRS data and overall risk analysis support this view. Or put another way, whilst an exception can be justified for simple low risk situations, there is insufficient data to warrant extending this exception beyond low risk situations.

  - *Is there evidence/rationale to support the exclusion of other situations involving other claddings with cavity construction?*

In the case of other claddings, there is generally insufficient data to judge the likely behaviour and performance of other types of cladding with cavities. In the case of monolithic and stucco claddings, evidence suggests that their performance in keeping moisture from the external wall frame is markedly less effective than standard masonry veneer. Masonry veneer typically has a minimum of 40mm cavity while others typically have 20mm or less.

8 Recommendations for Changes to B2/AS1

8.1 Proposed changes to B2/AS1 –

This is the proposed revised wording including that for Table 1: Durability Requirements, as it would be issued. Note that the bulk of the detail is covered by the citation of NZS3602, being the SNZ-approved versions of the current DZ3602. Refer Attachment 5.

9 Related Issues

Many commentators raised issues that were beyond the scope of these changes. These related to such issues as the need for more education and further research, the consultation process, opinions as to the reasons for the current problems, problems associated with other parts of the Code, concerns regarding the time and cost involved in using Alternative Solutions, and various other matters beyond the scope of the Building Code.

The more specific concerns raised related primarily to E2, and are therefore covered in that report. Some issues may be able to be considered as part of the upcoming review of the Building Act, while others are beyond the scope of the Act and the Building Code.

References

[1] Building Industry Authority, *Clause B2 Durability – Public Consultation including Cost Benefit Analysis*, July 2003

[2] Weathertightness Homes Resolution Service (WHRS), *Raw Data from first 202 Homes*, October 2003

[3] Clark S., *Weathertightness Failures: Associated Risk Factors*, November 2003, BRANZ
Clark S, Bassett M, Camilleri M, *Building Weathertightness Failures – Associated Risk Factors*, 2003, BRANZ

Appendix A NZS 3602 Comparative Table 1 – November 2003

Appendix B Definitions

Appendix C B2 Durability Working Group - Members

Appendix D B2 Durability Working Group – Minutes - Final

Appendix E B2 Durability Regulatory Impact Statement – November 2003