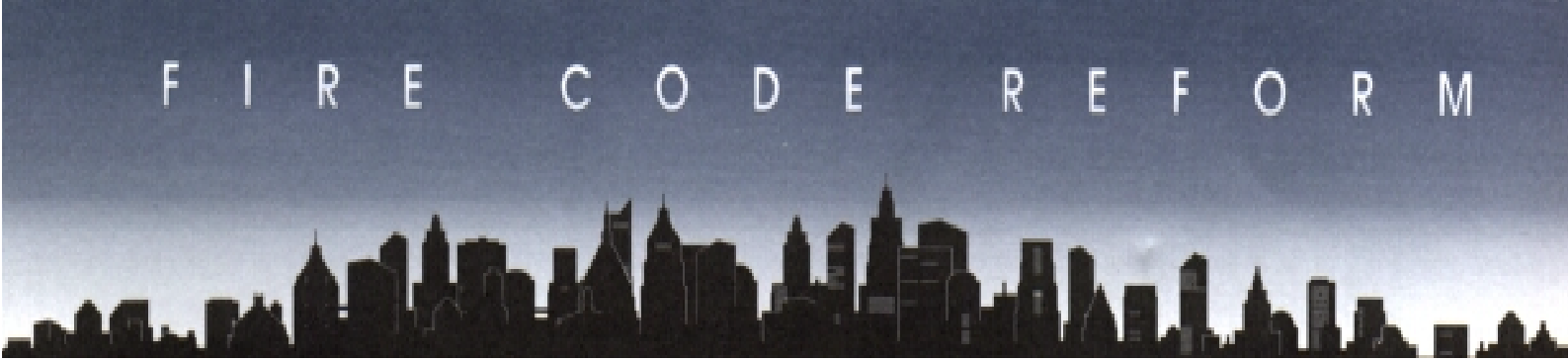

Project Report
FCRC PR 00-01

Fire Resistance And Non-Combustibility

Evaluation of Non-Combustibility Requirements.

FCRC Project 3 Part 4
Fire Resistance and Non-Combustibility

Fire Code Research Reform Program
February 2000

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Comments

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Fire Code Reform Centre

PROJECT 3 Part 4

FIRE RESISTANCE AND NON-COMBUSTIBILITY

EVALUATION OF NON-COMBUSTIBILITY REQUIREMENTS

February 2000

Fire Code Reform Research Program

Project 3

REQUIREMENTS FOR FIRE RESISTANCE AND NON-COMBUSTIBILITY

PART 4

EVALUATION OF NON-COMBUSTIBILITY REQUIREMENTS

FEBRUARY 2000

EXECUTIVE SUMMARY

As part of brief for Fire Code Reform Centre Project 3, Fire Resistance and Non-Combustibility, the project team was required to address the following aspects of non-combustibility

- examine the basis of existing requirements for non-combustibility in the BCA
- establish the role of non-combustibility in delivering fire-safety objectives.

While the BCA defines non-combustibility as "not deemed combustible under AS 1530.1 – Combustibility Test for Materials", the traditional purpose of non-combustibility was simply to prevent the involvement of the building fabric in a fire. The requirement has subsequently been adopted as the fundamental level of control of fire spread. In this study the term "non-combustible" is used to describe materials that fulfil both these aims.

The study has been tackled by three routes. The first was to carry out a historical investigation of how non-combustibility requirements have grown up in the BCA and to establish what the regulators had in mind when introducing such controls. Secondly, a review was carried out of requirements that cover non-combustibility in overseas codes, and in particular the test methods used. Thirdly, the BCA clauses were analysed in terms of the goals established in Part 1 of Project 3 for fire safety requirements, to determine what exactly the non-combustibility requirement was attempting to achieve.

These reviews have suggested that there are a number of possible purposes behind non-combustibility requirements, many of which could be met in other ways. The project team has considered each relevant BCA clause to see whether there is a case for retaining the non-combustibility requirement, or whether the fire-safety objectives identified may be met with greater internal consistency and external simplicity by other means.

The team investigated the feasibility of using analytical approaches to establish the role of non-combustibility and its contribution to fire safety. In a code as complex as the BCA, this was not found to be an appropriate method of tackling the problem. Instead, the role of non-combustibility in each BCA clause was considered individually. The recommendations for change contained in this report are therefore based on the expert opinion of the project team members, both as to the purpose of the requirements and as to how best they might be met.

The outcomes of this report are recommendations for change, which in eight clauses remove the non-combustibility requirement because it is superfluous, and in another thirty clauses replace it with an alternative requirement. In undertaking this process, the project team has sought as far as possible to harmonise with the outcomes of Fire Code Reform Centre Project 2, Fire Performance of Materials, and with Project 3 Part 2 on fire resistance and the provision of smoke barriers. In twelve clauses it is the opinion of the team that there is no alternative that would satisfy the intention of the regulations, and therefore the non-combustibility requirement has been retained in these cases. The report is a research report only and additional work might be needed to incorporate recommendations into the BCA.

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1 INTRODUCTION

1.1 BACKGROUND

Fire Code Reform Project 3 is one of a series of projects designed to introduce flexibility and modern technology into the "deemed to satisfy" prescriptions of the Building Code of Australia (BCA) and to develop a fully engineered risk-assessment approach to building fire safety.

The objectives of Project 3 are:

- To examine the basis of existing requirements for non-combustibility and fire resistance in the BCA[1].
- By considering likely fire severities, to establish the basis on which fire resistance levels should be specified to achieve the regulatory intent and objectives of the BCA.
- To establish the levels of performance required for different methods of construction and occupancy categories.
- To establish the role of non-combustibility in delivering the fire-safety objectives.

Part 1 of this project examined the basis for requirements for fire resistance. This was achieved by reviewing the fire safety objectives of the BCA as part of a coherent whole, and analysing the contribution to these objectives of the various fire safety sub-systems. This approach yielded a rational set of performance levels for fire resistance. The same broad approach is adopted here, in that the contribution of non-combustibility to the same fire safety objectives is assessed and recommendations for change made where appropriate.

1.2 CONTEXT

The BCA has grown up over the years with a number of different requirements that control the use of construction materials. Fire Code Reform Centre (FCRC) Project 3 has as its brief to examine the requirements for fire resistance and non-combustibility within the BCA, and FCRC Project 2 is looking at the use of materials that are controlled by the current AS 1530, Methods for Fire Tests on Building Materials, Components and Structures Part 3 – Simultaneous Determination of Ignitability, Flame Propagation, Heat Release and Smoke Release. The BCA appears to see the control of fire resistance, combustibility and the Early Hazard Indices (material flammability) as distinct. However, from the point of view of fire initiation, growth and development in the context of protection of occupants, the assessment of materials performance is possibly not best dealt with in this disjointed way. FCRC Project 2 has recommended that moves be made towards different test methods for materials control, and it is appropriate in that light to re-examine the role of the combustibility test.

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[1] The term "BCA" refers to the Building Code of Australia. At the start of this project, BCA 1990 Amendment No 9 was current. The recommendations have since been updated to refer to BCA 1996 Amendment 6. All reference to the BCA is to the National clauses without state variations

It is the purpose of this report to consider where non-combustibility is used in the BCA, to determine the purpose for which it is being used in each clause that calls it up, and to investigate whether or not greater effectiveness might be achieved if the material performance were to be controlled in a different way.

1.3 REASONS FOR CHANGE

The purpose of the analysis to be carried out in this report is to reduce complexity and introduce a rational and transparent approach to the control of construction materials. The non-combustibility test as called up in the BCA suffers from some fairly obvious problems. The main one is that many materials, which are accepted from experience and common practice to be effectively non-combustible, fail when subjected to the test procedure. Such materials include pre-finished metal sheeting, plasterboard and some bonded laminates. A list therefore has to be included in the BCA that deems to be non-combustible a range of materials which would otherwise not be permitted for use in certain circumstances. This is an unsatisfactory state of affairs, which needs to be addressed.

Non-combustibility is not always an appropriate measure of the performance that it is attempting to control. The objective of each requirement must first be established and then an appropriate test must be selected. Where the BCA appears to be using non-combustibility to ensure that a smoke barrier will maintain its integrity, a less stringent test might be more suitable; where flame spread and fire development are the issue, state-of-the-art tests used to control flame spread and smoke generation might suffice. In this way, the numbers of tests required for materials may be reduced and the purpose of the requirements is clarified.

1.4 APPROACH ADOPTED

Several approaches were considered and investigated. In the first instance it was proposed that typical scenarios in which non-combustibility would be called up should be considered. A modelling exercise was then carried out to determine the effect of deleting or altering the non-combustibility requirement. The effect was judged in terms of potential fire severity and threat to occupants. The difficulties with this approach became apparent fairly rapidly. Fire modelling techniques at their current stage of development are not sensitive to any great extent to the use of different lining and construction materials as regards fire growth and the threat to those attempting to make their escape. The limitations of modelling in this context have been discussed in detail as part of FCRC Project 2. A thorough analysis of each instance of non-combustibility in the BCA would take into account all possible fire scenarios. Such a detailed analysis is not possible, and the effects of altering the requirements cannot be easily assessed.

In the final analysis, the study has been tackled by three routes. The first was to carry out a historical investigation of how non-combustibility requirements have grown up in the BCA and to establish what the regulators had in mind when introducing such controls. Secondly, a review was carried out of requirements that cover non-combustibility in overseas codes, and in particular the test methods used. If a change in test method is to be recommended, it is important that the proposed method is internationally accepted. Thirdly, the BCA clauses were analysed in terms of the

goals established in Part 1 of Project 3 for fire safety requirements, to see what exactly the non-combustibility requirement was trying to achieve. Armed then with these three assessments, the project has considered each relevant clause. The Project 3 working group has therefore assembled a range of information and, in its expert opinion, generated the recommendations contained within this report.

HISTORICAL PERSPECTIVE

2.1 SUMMARY

During the course of this study, an independent review of the history of current requirements for non-combustibility in the BCA was commissioned. The detailed analysis carried out during this review involved a search of documentation relating to the introduction of the regulations and discussions with those familiar with the background to the regulations. The review is presented in Appendix 1.

The review noted that requirements for non-combustibility became part of Australian building regulations for a number of reasons, including:

1 as a supplement to fire resistance to preclude the need for active intervention in "fully protected" construction,
2 as a provision for smoke control,
3 to prevent ignition of external walls and structures, and hence to prevent fire spread from building to building, and
4 as a low fire resistance level.

2.2 OUTCOMES

The review looks in detail at each of the roles of non-combustibility, and suggests areas where further investigation is warranted. In particular, the following individual issues for examination are drawn out in the conclusions to that review:

1. The basic issue - the necessity or otherwise for any requirement for non-combustibility no matter how defined and the significance of any contribution it might make in isolation or in combination with a requirement for a fire-resistance rating.

2. Alternatives to the present *concept* of non-combustibility in terms of definition and assessment.

3. Examination of the fire-tests of the BCA in general against the background of the future objectives of the BCA. For example

   (a) Could the standard fire-resistance test be modified to eliminate the need, at least in some instances, for a requirement for non-combustibility to be combined with a requirement for an FRL?

   (b) Would a criterion after the style of the American finish rating or the Australian incipient-spread-of-fire rating be a sufficient control of fire-rated combustible construction?

   (c) Could a requirement for an FRL (as presently determined or as amended) replace the requirement for non-combustibility in smoke-compartmentation and, if so, what levels should the set?

(d) Could control of the early-fire-hazard properties of materials be usefully extended to liberalise requirements for non-combustibility?

4. Examination of each remaining requirement for non-combustibility in the BCA as to its necessity or even usefulness. For instance, does drencher-protected construction need to be non-combustible?

5. The question arises as to whether every fire-protection (including smoke-protection) provision of the BCA or proposed reformation of the BCA should be examined as to the usefulness of including a non-combustibility requirement, particularly if the approach to this aspect of materials-control is modified in response to the issues raised above. One way of tackling such a task would be to use, say, the Australian Model Uniform Building Code (AMUBC) as an aide memoire; to compare individual requirements of the BCA with individual requirements of the AMUBC as to whether deregulation was justified.

2.3 FUTURE DIRECTIONS

The particular points noted above have guided the thinking and approach to the assessment of the value of non-combustibility within the context of Project 3. It is noted that the ultimate objectives of the BCA with regard to the *performance* of buildings and their components (and the questions of the definition and assessment of performance) will be basic to any examination of present approaches and of whether or not conservation or change would be useful.

Details of clauses that control combustibility, comparing BCA 1990 with its antecedents, are given in Appendix 2.

Changes in fire protection design and fire-fighting practice have resulted in changes of approach to the regulations, but have not always been reflected in comprehensive amendment to the clauses themselves. While the original objectives give a guide to why requirements were introduced, the requirements need to be re-examined in the light of current BCA objectives. This activity is described in Chapter 5.

3 APPROACHES ADOPTED IN OVERSEAS BUILDING CODES

3.1 SUMMARY

The Project 3 team commissioned a study to look at the use of non-combustibility in regulations overseas with a view to

- establishing whether or not the approach overseas differs significantly from that in the BCA and to
- assess whether different test methods are used overseas that might be of use in Australia.

The review is presented in Appendix 3.

The review concludes that Australian building regulations belong to a widely distributed group with a common approach to fire protection. The group puts personal safety as its priority and property protection is subordinated to it. Personal safety is equated with ease (speed) of evacuation and the protection of the evacuees from fire and its products during evacuation. Escape paths must lead from all parts of the building to a place of safety *outside* the building and there is a common implication that evacuation means evacuation from the building.

Materials of construction are controlled according to the dangers they present, first, to people during evacuation and subsequently to successful containment of the fire. The availability of active fire-suppression and fire-fighting measures mitigates the rigour of passive controls.

Throughout the group the combustibility of materials was originally, and generally still is, regulated according to risk through the control of types of construction. The greater the risk of fire and the complexity (which means the duration) of evacuation, the greater the number of components required to be non-combustible. The non-combustibility of the component was to be absolute according to a test pretty well common throughout the group.

Over the last two decades or so there has developed a trend to the scaling of the combustibility of materials according to risk and moves towards the introduction of materials controls that are seen as more appropriate to regulatory objectives than non-combustibility.

It is difficult, however, to escape the impression that *all* the current international discussions about fire-properties and the pros and cons of various methods of demonstration, although important and potentially valuable, are overly influenced by the fact that the established proscription was on “combustibility” which, because of an ambiguity of definition, came to mean a variety of fire-properties in a variety of contexts.

A requirement for non-combustibility now persists in modern building codes at two levels. There is still the traditional purpose of preventing the involvement of the building fabric in the fully developed fire but the requirement has been adopted also as the fundamental level of control of whether fire spreads or not.

3.2 OUTCOMES

Comparisons of the various international uses of non-combustibility immediately raise the question of the relevance to building regulation of non-combustibility as presently measured. The review, apart from assessing how non-combustibility is used in various codes, then went on the look at the value of the concept and how it is and should be applied.

The earliest regulators saw virtue in materials that, in lay terms, don't burn. They observed the behaviour of materials in building fires and they nominated particular materials for particular uses knowing that they provided the levels of safety they sought. Then, in an effort to liberalise the regulations by moving from the specific to the generic, they encapsulated their requirement in the word "non-combustible". Their scientific advisers at the time took them at their word and steered them into calorimetry - measurement of the heat derivable from a material - as the appropriate demonstrator of compliance. The concept of what was to be measured was, by a not unusual inversion of scientific method, determined by the way it was measured.

At least some of the limitations imposed on materials and components were immediately recognised by the regulators and measures taken to ease them. This reaction is currently accelerating to the extent that in some circles there is an opinion that the prescription of non-combustibility should be rescinded altogether. But the first question to be asked in regard to the appropriateness of non-combustibility to the regulation of fire-protection would appear to be not whether non-combustibility might or might not be important but when it might be important.

Non-combustibility, even the prescription of particular non-combustible materials, means no more than that something will remain after the fire has burnt itself out. But what remains might be a heap of rubble. There is no guarantee of the persistence of a barrier or a component capable of loadbearing or of stability in general. In short, non-combustibility cannot be relied on to compensate for shortcomings in FRL. What should not be overlooked is the necessity to control the internal temperature of combustible fire-barriers (and composites generally) and consequently the possibility of perpetuating destructive distillation.

3.3 FUTURE DIRECTIONS

There appear to be building components for which a requirement for non-combustibility is appropriate, readily met and imposes no untoward restriction on industry. Having said that, it also appears that concerns about the possible limitations of test methods - the appropriateness of particular fire-tests, whether they properly estimate the severity of the hazard or properly reproduce the fire-situation - have resulted in the persistence of a requirement for non-combustibility as a safety net and, in some cases, a safety net of dubious reliability.

But the practice of overseas performance codes of placing non-combustibility into hierarchies of reactions to fire is still worthy of careful consideration. Of these the British applications seem the most thoughtful (while adopting the simplest approach to testing). Such a development could well establish the proper place of non-combustibility. At present it is the universally accepted base out of which branch a wide variety of test methods vigorously defended by the industries that have invested in them and all of which appear to have served their countries well.

The practice suggests also that, with the adoption of the performance concept, there is no need to abandon a particular test directed towards a particular fire situation on the grounds that it does not reproduce every fire situation.

International approaches to fire-regulation indicate that the central issue with regard to materials control is the correct identification of the various fire hazards, their proper quantification and the nomination of reliable predictors of successful control. It could well be that field research has discovered particular situations where present methods are wanting. It is towards the development of reliable predictors for these situations that laboratory research needs to be directed.

However, before the possibility of changing the current Australian test method is considered, the purpose of each BCA clause requiring non-combustibility needs to be considered in detail.

4 AIMS OF NON-COMBUSTIBILITY IN THE CONTEXT OF THE CURRENT BCA

4.1 PURPOSE

In this chapter, the task is to see what the aims of non-combustibility requirements should be in the context of the other fire safety requirements of the BCA.

4.2 APPROACH

4.2.1 Global objectives

Part 1 of this Project examined the objectives of fire resistance levels. In order to establish the specific objectives, it was necessary to study the global objectives of fire safety. Based on BCA 1990, the following global objectives were identified as the intentions behind the provisions of the BCA:

- to keep loss of life in building fires to a very low level (it is assumed that there is a relationship between injury and loss of life in fire, such that the reduction in risk to life automatically implies a reduction in risk of injury)
- to limit property damage by introducing measures to control fire size and to prevent fire spread from premises on fire to neighbouring premises
- to provide protection to firefighters in the execution of their duty.

Since that time a performance-based BCA, BCA 96, has been issued. In BCA 96 the relevant objectives are clearly stated, as follows (Clause numbers are those of BCA 96):

CO1 The objective of this Section is to-

(a) safeguard people from illness or injury due to a fire in a building; and

(b) safeguard occupants from illness or injury while evacuating a building during a fire; and

(c) facilitate the activities of emergency services personnel; and

(d) avoid the spread of fire between buildings; and

(e) protect *other property* from physical damage caused by structural failure of a building as a result of fire.

DO1 The objective of this Section is to-

(a) provide, as far as is reasonable, people with safe, equitable and dignified access to-

(i) a building; and

(ii) the services and facilities within a building; and

(b) safeguard occupants from illness or injury while evacuating in an emergency

EO1 The objective of this Part is to-

(a) safeguard occupants from illness or injury while evacuating during a fire; and

(b) provide facilities for occupants and the *fire brigade* to undertake fire-fighting operations; and

(c) prevent the spread of fire between buildings.

The objectives derived in Part 1 of this Project are similar to those in the BCA, but place more importance on fire brigade intervention and limiting property damage.

4.2.2 Context

In Part 1 it was further acknowledged that the role of any component or aspect of a building which contributes to fire safety could not be studied in isolation. Any such review must be sufficiently comprehensive to analyse the objectives in the context of all relevant building and occupant characteristics.

4.2.3 Building systems

Non-combustibility is one aspect of materials control; materials control can be considered to be a building system. On review it was considered that materials control contributed to achievement of the following fire safety aims:

- reduce risk of ignition
- keep fire small
- protect escape routes from fire (but not smoke*)
- limit fire spread

* Smoke in this context is smoke generated by the fire that might enter the escape route from outside. Such smoke would be prevented from entering the escape route by compartmentation, or exhausted by the smoke control system.

4.2.4 Building characteristics

Certain building characteristics that contribute to fire safety are also influenced by the combustibility of materials of construction. In particular, the degree of combustibility

(a) contributes to the fire load of a building, and

(b) is one aspect of the "nature of materials" that effects the way in which a fire develops.

Control of fire load was seen as contributing to achievement of the following fire safety aims:

- reduce risk of ignition
- keep fire small
- protect escape routes from smoke, fire, collapse

- limit fire spread
- protect fire fighters from smoke, fire, collapse
- protect neighbours from fire, collapse.

Control of the nature of materials (in this instance, non-combustibility) could be said to contribute to achievement of the same fire safety aims, although in Part 1 it was not seen as contributing to the protection of escape routes.

A more detailed discussion on the contributions of various systems and building characteristics is given in Chapter 6 of the Report on Part 1 "Objectives and Performance Levels for Fire Resistance" of the project. Tables from Chapter 6 are reproduced i Table 4/1 and 4.2 of this Report.

4.2.5 Occupant characteristics

The risk to life from fire in buildings changes very markedly with parameters which govern the behaviour of occupants. In particular, whether the occupants may be asleep or otherwise slow to respond is of great importance in determining the time which will be taken for evacuation to be completed. This in turn affects the fire resistance requirements of some barriers and structures, or alters the significance of some of the systems which might be installed. These characteristics are included in Table 4.2.

Table 4.1 Fire Safety Aims and the Contribution of Building System

Matrix Showing some possible building systems that can contribute to achieving the fire safety aims.

Fire Safety Aims \ Building Systems		Detection	Alarms	Escape Routes	Management	Control of materials	Occupant fire fighting	Smoke control	Sprinklers	Communications	Internal fire barriers	Brigade fire fighting	Structure	Boundary fire barriers
Reduce risk of ignition					■	■								
Alert people		■	■		■				■	■				
Keep fire small		■				■	■		■					
Provide escape routes				■										
Protect escape routes	from smoke							■	■		■			
	from fire					■			■		■			
	from collapse								■				■	
Limit fire spread						■			■		■	■		
Protect fire fighters	from smoke							■	■					
	from fire								■		■	■		
	from collapse								■			■	■	
Protect neighbours	from fire								■			■		■
	from collapse								■			■	■	

Table 4.2 Fire Safety Aims and the Contribution of Building Characteristics

Matrix showing some building characteristics that could contribute to achieving fire safety aims

Fire Safety Aims \ Building Characteristics		Length of Escape Route	Capacity of Escape Route	Alertness of Occupants	Confinement of Occupants	Building height	Fire Load	Ventilation	Compartment Area	Compartment volume	Nature of materials	Building location	Distance to Brigade
Reduce risk of ignition							■				■		
Alert people				■									
Keep fire small							■				■		
Provide escape routes		■	■	■	■	■							
Protect escape routes	from smoke	■		■	■	■	■	■	■	■			
	from fire				■		■	■	■	■			
	from collapse						■	■	■	■			
Limit fire spread						■	■	■	■	■	■		
Protect fire fighters	from smoke	■				■	■	■	■	■	■		■
	from fire						■	■	■	■	■		■
	from collapse					■	■	■	■	■	■		■
Protect neighbours	from fire						■	■	■	■	■	■	■
	from collapse						■	■	■	■	■	■	■

4.3 SPECIFIC AIMS OF NON-COMBUSTIBILITY

In Table 4.1 the influence of non-combustibility appears in the system entitled control of materials. In other words, this project has identified that control of materials contributes significantly to the following building fire safety aims:

- reduce risk of ignition
- keep fire small
- protect escape routes from fire
- limit fire spread

Though non-combustibility is not the only way material control is exercised in the BCA we will expect to find that the use of non-combustibility requirements is generally satisfying one or more of these aims. However, as noted in the historical review, there do seem to be occasions within the BCA where the use of the non-combustibility requirements is in fact to provide an internal barrier, generally to block the passage of smoke but in some cases to prevent fire spread for a limited time. On these latter occasions the aim is better achieved using a fire resistance requirement, for consistency with other requirements within the BCA.

In the building characteristics sense (see Table 4.2), the nature of materials achieves the same aims as listed above but it also needs to be noted that combustible construction materials increase the fire load. In places where it is identified that the BCA intends to limit fire load by use of a non-combustibility clause then the intent from Table 4.2 could be to:

- protect escape routes
- protect firefighters
- protect neighbours

as alternatives to the aims outlined above.

Section 2 of this report outlined how the non-combustibility requirements in the regulations arose and gives some clue as to what the regulators intended. As the BCA now stands these original intentions may not be reflected in the way the requirements more generally have developed with time. Therefore it is useful to review the non-combustibility clauses with the breadth of the regulations in mind, and the specific aims as listed above as possible functions for each clause. This will be carried out at the end of the following Section.

5 METHODOLOGY

5.1 REVIEWS CARRIED OUT

The historical and international reviews have revealed that building codes use non-combustibility requirements for a number of purposes. These have grown with time and have not necessarily been set in the wider context of other requirements that control the use of construction materials. There certainly appears to be a case for simplification within the BCA, and indeed within the other codes reviewed.

The requirement for non-combustibility cannot be divorced from the test method that is used to determine it. That much is very plain from the international review. Many codes have gone down similar paths in adopting calorimetric test methods, and have then had to compromise on the strict definition of non-combustibility in order to permit a range of practical construction materials believed from long practice to be acceptable. The international review does not therefore provide insight into alternative test methods that are used elsewhere and which give useful results, but rather highlights the fact that the BCA is not alone in having a set of requirements that lack simplicity and consistency.

5.2 THE PROCESS

A number of steps have been taken in order to rationalise the non-combustibility provisions of the BCA:

1 Each clause that calls up non-combustibility has been carefully examined, first to determine its historical intent and then to determine its current purpose. The results are presented in Appendices 2 and 4.

2 The clauses have been grouped according to the function they perform, and consideration has been given to what material properties the non-combustibility test is trying to achieve for each group.

3 Taking into account the material properties, the best available test method for use in each case has been selected.

5.3 THE AIMS OF CLAUSES

In assembling Appendix 4, the aims for fire safety measures discussed in Section 4 of this report have been used to guide the assessment of the role of non-combustibility in the various BCA clauses. In most cases there is relatively little doubt as to what these aims are, though in some instances, the current function of non-combustibility differs in the opinion of the working group members from the historical role identified in Appendix 2.

On examining Appendix 4, it is seen that the outcomes of the non-combustibility clause assessments fall into 4 categories, namely:

- the requirement does not have any identifiable function and should be removed
- the requirement may be interpreted in the same way as other materials control requirements dealt with under FCRC Project 2 (flame spread and smoke generation), and should be dealt with using the same test methods
- the requirement performs the function of ensuring that a barrier would remain in place for a short period of time and would prevent the migration of smoke to areas remote from the fire
- the requirement is there to limit fire load, and therefore cannot be replaced by an alternative to the non-combustibility requirement.

5.4 MATERIALS PROPERTIES

For each group, the non-combustibility test is currently being used to assess distinctly different material properties. The next step is to consider what material properties would best indicate achievement of the required performance.

- There is no problem for those situations where non-combustibility is superfluous.
- For those requirements where the performance is that of controlling flame spread, , the materials properties (and hence the recommended test methods) should be in line with current controls on the early fire hazard properties of materials as amended from time to time.
- For those situations where non-combustible construction is acting as a barrier to smoke, the barrier will need to retain its integrity at the temperatures to which it is likely to be exposed, until either the fire is brought under control or the fire directly attacks the barrier. Materials that do not deform or emit gases, or in other words remain stable, at 300°C will be suitable. This is a conservative value, and corresponds to the normal practice of using plasterboard for smoke barriers.
- For those elements where the non-combustibility requirement is there to control fire load, it is important that the element should not burn, and non-combustibility is the relevant material property.

5.5 TEST METHODS

Having established which material properties are to be measured, suitable tests must now be selected. In FCRC Project 2, the chosen selection criteria were that the tests should provide appropriate control, be international, be repeatable and reproducible and be cost effective. There should only be a change in test method if the proposed method offers advantages over the current test.

- Review of overseas requirements has shown that there is little difference in combustibility tests used in different countries, and for situations where non-combustibility is to remain as a requirement it is recommended that there should be no change to the test method.
- For those clauses that control flame spread and fire growth in the early stages of the fire, the purpose is the same as for materials considered in Fire Code Reform Project 2. Currently, BCA controls rely on AS 1530.3, the Early Fire Hazard Test. FCRC Project 2, which provides a detailed examination of this test on the control of flame spread, recommends use of the ISO Room Test for control of flame

Typical Performance Ratings of some Generic Materials and Products
A reproduction of Table A8 of the Building Regulations 1991

Rating	Material or product
Class 0	1. any non-combustible material or material of limited combustibility.(Composite products listed in Table A7 must meet the test requirements given in paragraph A12(b)).
	2. brickwork, blockwork, concrete and ceramic tiles.
	3. plasterboard (painted or not, or with a PVC facing not more than 0.5mm thick) with or without an air gap or fibrous or cellular insulating material behind.
	4. woodwool cement slabs.
	5. mineral fibre tiles or sheets with cement or resin binding.
Class 3	6. timber or plywood with a density more than 400 kg/m3, painted or unpainted.
	7. wood particle board or hardboard, either treated or painted.
	8. standard glass reinforced polyesters

Table A8 of the regulations is supplemented by the following notes:

"1. Materials and products listed under Class 0 also meet Class 1.

"2. Timber products listed under Class 3 can be brought up to Class 1 with appropriate proprietary treatments.

"3. The following materials and products may achieve the ratings listed below. However, as: he roper ie f t f erent roduats he th4 b de cbi tion s , s s s d b ystentiated s

the product level as determined by means of ASTM E 136, CAN/ULC-S114 or NFPA 259. There are also similar requirements for the adoption of masonry or concrete in particular cases, for example for fire-walls.

Over the last decade or two, US researchers have pushed for the replacement of the various cylindrical-calorimeter (ISO 1182-type) tests with testing by means of a cone calorimeter and have found supporters world wide.

The advocates of the cone-calorimeter test claim that the important fire-property of a building material is its rate of heat-release and that this is best measured in oxygen-consumption calorimeters of which the cone calorimeter is the appropriate bench-scale apparatus. It necessarily provides gradations of rate of heat-release. To provide the bases for controls for the two stages of a building fire - the early (evacuation from the compartment) stage as well as the later (containment of the developed fire) stage - the cone calorimeter has been adapted to provide measures also of ignitibility and of smoke-production and toxicity. Methods to predict flame-spread in various circumstances have been developed or are under development in various parts of the world.

2.04 New Zealand.

New Zealand building regulations appear to be an amalgam of Australian and UK regulations adapted as necessary to peculiarly New Zealand requirements. Non-combustibility is defined as conformity with AS 1530.1 and BS 476.4. The requirement is absolute; BS 476.11 is not invoked.

Non-combustibility is imposed on a range of heating and burning appliances (chimneys, fireplaces, flue-linings, hearths) principally as nominations of acceptable materials and to a less extent as a requirement for conformity with the standards. In the broader area of the overall building fabric, non-combustibility is required of certain surface finishes both external and internal. Unless the fire-compartment is sprinklered, floor coverings are controlled in the escapeways of all occupancies and throughout institutional occupancies providing accommodation of one form or another. To be acceptable, floor coverings are required to be

> "either *non-combustible* or have a low radius of effects of ignition (assessed according to BS 5287) when tested to the BS 4790 *standard test* for flammability of floor coverings .....".

The acceptability of external surface finishes to external walls depends on occupancy, number of storeys and proximity to the boundary. In the tabulation of acceptabilities there is an interesting tiering. As height, proximity and vulnerability of occupancy increase, the requirement steps from an ignitability index of 0 to non-combustibility.

While the correlation of this particular hazard with height and occupancy can be challenged, it can be deduced that the regulation writers recognized that the real danger was ignitability and decided that there should be no likelihood of ignition. But an I_g of zero as determined according to AS 1530.3 means that there is no ignition at only a specific level of radiation which might be less than that emitted by a fire-plume. Hence the move to non-combustibility as the next available choice.

This feature of the NZ regulations has led Sojer and Wade of the Building Research Association of New Zealand to explore the appropriateness of cone-calorimeter

testing as an alternative to both AS 1530.3 and AS 1530.1/BS 476.4, principally because of the greater range of heat flux commonly used with that apparatus [4].

2.05 South Africa.

South Africa has a building code after the style of BCA 1990 with generalized requirements followed by descriptions of deemed-to-satisfy materials and systems. In some respects the classification of buildings is more finely subdivided (from the point of view of risk) and fire-protection intrudes somewhat further into the single detached dwelling. Test methods for the early-fire-hazard properties of finishing materials (generally wall and ceiling surface finishes) and of floor coverings and the test method for combustibility (at 750^{o}C) are specified in SABS 0177 Parts III, IV and V and are similar to those in their British counterparts in the BS 476 series.

Requirements for non-combustibility are spread throughout the code but all such requirements are ameliorated by the exception of the usual list of materials deemed non-combustible, by the exception of (other) particular materials and components in particular cases and by the exception of "combustible materials that have been favourably evaluated by the Council of the South African Bureau of Standards or the CSIR". This is a common formula.

Control of combustible roof coverings is by way of the control of attachment to non-combustible substrates or the control of areas and of proximity to the boundary and to each other. Large roof spaces in unsprinklered buildings are to be subdivided by non-combustible barriers. Suspended ceilings are to be of non-combustible materials and, where advantage is taken of the exceptions noted above, the sizes of fire-compartments below the ceiling are restricted in taller, unsprinklered buildings. Similarly, ceiling spaces that form the plenums of air-control systems are to be subdivided with non-combustible construction.

Suspended floors are to be non-combustible. Raised access floors are subject to controls similar to those imposed on suspended ceilings.

There is an interesting restriction on partition walls and partitions which are apparently subdividers within single-occupancy fire-compartments. In places of detention, hospitals and residential institutions, partitions attract a fire-resistance of 60 minutes and in offices, dormitories and residences including single, detached houses they attract a fire-resistance of 20 minutes. In addition, partitions erected above the third storey in any building must be either

non-combustible; or

represent a fire-load of no more than 5 kg/m^2 of floor area.

In the control of the fire-hazard properties of finishes, first, ceilings are generally required to be non-combustible and the classification systems of SABS 0177 Parts III and IV do not extend to them. For floor coverings and wall finishes, non-combustibility is integrated into the classification systems and, although it is implied that the primary concern is with the spread of fire and the generation of heat, smoke and toxic fumes (what would be regarded in BCA 1990 as early-fire-hazard properties), the commentaries to the SA clauses repeatedly refer to the possibility also of *significant* contribution to the fire-load. Within the systems of classification for floor and wall finishes, the requirement for non-combustibility is confined to car

parks, plant rooms, high-risk industrial buildings, certain areas of high- and moderate-risk storage buildings and the basements of places of detention, hospitals and residential institutions. Wall finishes are not permitted at all in the basements of multi-unit residential buildings including hotels. The overall surface-finish classifications are confined to areas actually used for the purposes to which the building classifications apply.

2.06 Germany.

The organisation of regulatory responsibilities in Germany is similar to that in Australia. Individual codes differ from state to state of the federation while their administrators agree to adopt so far as is practicable a Model Building Code (for domestic buildings) and Model Regulations (for other types of building). The fire regulations of the models are being progressively developed in anticipation of the harmonisation of regulations among members of the European community. In this, Germany is taking a leading part. Its Model Building Code was last rewritten in 1993 to align it with European trends.

It is worth drawing attention to an important influence on the current evolution of materials control in Germany (and in Europe generally). The code-writers recognise that inroads are being made into the effectiveness of fire-fighting services by curtailment of funds and the logistic difficulties presented by traffic in modern cities. Their reaction has been to enhance in-house fire-protection in compensation with a trend towards the adoption of a "self-contained fire-safety concept" [5].

This is noteworthy in the light of Australian developments. The BCA assumes the attendance of the fire-authorities at every building fire whereas the earliest AMUBC-based regulations did not [6].

In regard to combustibility and reaction to fire the German codes are similar in concept to the UK building regulations. Tests and criteria for "non-combustibility" are not isolated from those of other materials controls. None of the reaction-to-fire tests is isolated; they collectively form a hierarchy that ranks materials from the really non-combustible e.g. concrete, to the "easily flammable" e.g. loose wood wool. (The unmodified use of the "easily flammable" isn't permitted anyway). This hierarchy is, in turn, part of the wider, overall fire-protection hierarchy embracing all passive and active systems. German code writers are apparently very conscious also of what they see as the necessity for reaction-to-fire controls to be appropriate to the circumstances in which materials are used - shape, orientation, nature of the surface, lamination and assembly with other materials.

German developments are conveniently discussed in broader European terms.

2.07 European Community.

There is among members of the European community a long-term ambition to move from a product-classification system, which is prescriptive and within which class is defined essentially in terms of its test method, to a truly performance-based system in which tests and test-results would be judged on the basis of their ability to provide the data necessary for a fire-engineering approach to design. This is, however, a very long-term ambition.

Present regulatory activities in the European community are confined to facilitating the flow of building products (materials and components) between member countries in the current regulatory framework. The hierarchy referred to in 3.06 classifies materials in terms of whether the material is to be permitted or not to contribute (as fuel) to the intensity and duration of a fire and it is at these levels that their properties are controlled. Those that must make "no contribution to fire" or at most only a "very limited contribution to fire" are classes A1 and A2 (Germany) or classes A and B (European Union). Those materials that, while recognized as contributing or 'reacting' to fire, are permitted to be used are classes B1 and B2 (Germany) or classes C, D and E (European Union).

What is seen as relevant to the refractory classes is exposure to the fully developed fire with the level of heat flux at more than 60W/m^2. Testing is primarily by calorimeter.

The less refractory classes are seen primarily as participating in the building fire during its outbreak and early development. Testing is very much reaction-to-fire testing as understood in Australia. Exposure is at most 40W/m^2, on a limited area and decreasing over the surface - exposure to a burning waste-paper basket - (class B1/classes C and D) - down to exposure to a flame no more than 20 mm high on a limited area of the product - a match - (class B2/class E). Note that the fire sources are contents. This approach leads to the following hierarchy of test methods [7]. (It is characteristic of the European struggle towards commonality that the agreement to methods of test in this hierarchy is "in principle").

The European Hierarchy of Test Methods

Reaction-to-fire Testing and Classification

Products other than flooring coverings	Floor coverings
Bomb Calorimeter Test (ISO 1716)	
Small Furnace Test (ISO 1182)	
Single Burning Item Test (SBI)	Radiant Panel Test (ISO 9239)
Small Flame Test (ISO 11925-2)	Methanamine Pill Test

The first of the following tables is a selection of minimum requirements from the German Model Building Code for single, detached dwellings, small blocks of flats and bigger blocks. The second has been abridged from the model regulations for German department stores of over 2000 m^2. They illustrate how the hierarchy is implemented. (Apparently, in adopting and adapting the models, the German states exercise some choice between B1 and B2 and A1 and A2).

Minimum Requirements from the German Model Building Code for three Sorts of Domestic Building (December 1993).

Component	Single, detached single-storey houses	Multi-unit housing of up to three storeys and less than 7 m to the level of the upper floor.	Multi-unit housing where the level of the uppermost floor is between 7 m and 22 m above ground level.
Loadbearing walls.	B2	Fire resistant of 30 minutes plus B2.	Fire resistant of 90 minutes plus B2.
Non-loadbearing external walls and facades.	B2	B2	A or a fire resistance of 30 minutes.
their surfaces and insulations.	B2	Normally B1 but B2 may be permitted.	B1 but supports may be B2.
Separating walls between units.	Only one unit - not applicable.	Fire resistant of 30 minutes plus B2.	Fire resistant of 90 minutes. (Highest storey in lofts 30 minutes).
Fire walls. (There are additional requirements for stability).	No fire walls - not applicable.	More than two units: Fire resistant of 90 minutes plus A. Otherwise: Fire resistant of 90 minutes plus B2.	Fire resistant of 90 minutes plus A.
Floors.	B2	Fire resistant of 30 minutes plus B2.	Fire resistant of 90 minutes plus B2.
Stairs: supporting members	B2	More than two units:A or a fire resistant of 30 minutes. Otherwise: B2.	Fire resistant of 90 minutes.
Stairs: walls floor coverings.	B2	More than two units:A. Otherwise: B2.	A

Minimum Requirements from the German Model Regulations for Department Stores over 2000 m^2 (1995).

Component	Single storey sprinklered	Single storey unsprinklered	Multistorey sprinklered	Multistorey unsprinklered
Loadbearing member.	B2	Fire-resistance of 30 minutes.	Fire-resistance of 90 minutes.	Fire-resistance of 90 minutes.

Loadbearing external wall.	B1	Fire-resistance of 30 minutes.	Fire-resistance of 90 minutes.	Fire-resistance of 90 minutes.
Non-loadbearing external wall.	B1	B1	B1	A
Facade of an external wall.	B1	B1	B1	A
Ceiling.	A	Fire-resistance of 30 minutes.	Fire-resistance of 90 minutes.	Fire-resistance of 90 minutes.
Suspended ceiling.	A, B2 if the ceiling space is sprinklered.	A	A, B2 if the ceiling space is sprinklered.	A
Ceiling panels.	A	A	A	A
Roof support.	B2	Fire-resistance of 30 minutes.	A	Fire-resistance of 90 minutes.
Roof deck.	A	A	A	A
Roof (including covering and insulation).	Resistance to burning brands: DIN 4102.7.	Resistance to burning brands: DIN 4102.7.	Resistance to burning brands: DIN 4102.7.	Resistance to burning brands: DIN 4102.7.

Note that, although the classification A (A1 or A2) is purportedly a control on the contribution of the component to a fully developed fire, it enters these tables as both a control on early reaction to fire and as a fire-resistance rating of or somewhat below 30 minutes.

3. CONCLUSIONS

3.01 The appropriateness of the concept.

Comparisons of the various international uses of non-combustibility immediately raise the question of the relevance to building regulation of non-combustibility as presently measured.

The earliest regulators saw virtue in materials that, in lay terms, don't burn. They observed the behaviour of materials in building fires and they nominated particular materials for particular uses knowing that they provided the levels of safety they sought. Then, in an effort to liberalise the regulations by moving from the specific to the generic, they encapsulated their requirement in the word "non-combustible". Their scientific advisers at the time took them at their word and steered them into calorimetry - measurement of the heat derivable from a material - as the appropriate demonstrator of compliance. The concept of what was to be measured was, by a not unusual inversion of scientific method, determined by the way it was measured.

At least some of the limitations imposed on materials and components were immediately recognised by the regulators and measures taken to ease them. This reaction is currently accelerating to the extent that in some circles there is an opinion

that the prescription of non-combustibility should be rescinded altogether. But the first question to be asked in regard to the appropriateness of non-combustibility to the regulation of fire-protection would appear to be not whether non-combustibility might or might not be important but when it might be important. This brings us to a more detailed consideration of the adoption of the concept in the more modern codes.

Building regulations are concerned to control fire-properties in a variety of situations and the requirement for non-combustibility is persisting in all of them. There are, firstly, some uses of non-combustibility which appear to be uncontroversial and difficult of reasonable alternatives; for example, the UK requirement for the non-combustibility of plant-room ladders, the common requirement for the non-combustibility of external fire-escapes, of certain insulation, of the components of fire-places, hearths, chimneys and the walls of flues and refuse chutes. Non-combustibility or limited non-combustibility of stairs, coupled with control of surface finishes inside a fire-rated shaft can preclude the spread of fire into the shaft.

For control of the earliest stages of a fire, absolute non-combustibility appears as the ultimate limit of early-fire-hazard properties. This is demonstrated by its entry into the South African tables of graded requirements for floor and wall coverings and, somewhat more ambivalently into the German regulations. The New Zealand regulators obviously recognise ignitability as the immediate danger arising from the exposure of an external wall to a fire-plume and require non-combustibility in what they see as the most dangerous situations. In fact, their present methods of test pretty well constrain them to require non-combustibility in the most dangerous cases.

Ceilings and suspended ceilings are widely seen as a special problem. Usually, a fire will spread more quickly across a ceiling than across a floor. The additional concern with a suspended ceiling is that a fire can become fully developed in the ceiling space before being detected. In both cases, evacuation can be significantly hampered. It is therefore common to require non-combustibility of ceilings and/or the components of a ceiling within the ceiling space.

Looking at the subject more broadly it can be seen that the entry of non-combustibility into the hierarchies of fire-control must mean that it will take a place in the hierarchies. As an early-fire-hazard index, it must represent the safest level although there might be few situations (escape-shafts devoid of contents?) where its invocation would be justified. But non-combustibility enters the hierarchy also as an adjunct to, or even a level of, fire-resistance. This is controversial.

The question of the non-combustibility of fire-barriers is complicated by issues circumstantial to the specification of fire-resistance levels. On the one hand there is the adoption of curtailed FRLs; for example, the acceptance of, say, a 60-minute barrier to contain a 90-minute load on the grounds of rapidity of evacuation or lower risk of fire. On the other hand there are doubts about the margins of safety implicit in the assignment of statutory fire loads to particular compartments and doubts about the margins of safety implicit in the attribution to everyday construction of an FRL derived from a laboratory artefact. In all these cases, it appears to be assumed that non-combustibility presents a second chance of sorts, that some barrier will remain, that some structure will continue to bear load.

But non-combustibility is not in itself a solution to these problems. Non-combustibility, even the prescription of particular non-combustible materials, means

no more than that something will remain after the fire has burnt itself out. But what remains might be a heap of rubble. There is no guarantee of the persistence of a barrier or a component capable of loadbearing or of stability in general. In short, non-combustibility cannot be relied on to compensate for shortcomings in FRL. What should not be overlooked is the necessity to control the internal temperature of combustible fire-barriers (and composites generally) and consequently the possibility of perpetuating destructive distillation.

There remains the practice in South Africa and Europe (or at least at present in Germany) of imposing non-combustibility as a control on the degree to which the building fabric might increase the fire-load. Two questions arise: whether such an addition is likely to be significant and, if it is, whether it might be compensated for by an increase in the statutory FRL.

3.02 Future directions.

There appear to be building components for which a requirement for non-combustibility is appropriate, readily met and imposes no untoward restriction on industry. Having said that, it also appears that concerns about the possible limitations of test methods - the appropriateness of particular fire-tests, whether they properly estimate the severity of the hazard or properly reproduce the fire-situation - have resulted in the persistence of a requirement for non-combustibility as a safety net and, in some cases, a safety net of dubious reliability.

But the practice of overseas performance codes of placing non-combustibility into hierarchies of reactions to fire is still worthy of careful consideration. Of these the British applications seem the most thoughtful (while adopting the simplest approach to testing). Such a development could well establish the proper place of non-combustibility. At present it is the universally accepted base out of which branch a wide variety of test methods vigorously defended by the industries that have invested in them and all of which appear to have served their countries well. The practice suggests also that, with the adoption of the performance concept, there is no need to abandon a particular test directed towards a particular fire situation on the grounds that it does not reproduce every fire situation.

International approaches to fire-regulation indicate that the central issue with regard to materials control is the correct identification of the various fire hazards, their proper quantification and the nomination of reliable predictors of successful control. It could well be that field research has discovered particular situations where present methods are wanting. It is towards the development of reliable predictors for these situations that laboratory research needs to be directed.

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APPENDIX 4

ASSESSMENT OF CLAUSES IN THE BCA THAT CONTROL COMBUSTIBILITY

ASSESSMENT OF CLAUSES IN THE BCA THAT CONTROL COMBUSTIBILITY

The letters NC mean "non-combustible" or "non-combustibility".

BCA 1996 CLAUSE No	BCA Text	Comments	Recommended action
A1.1	**Combustible** means- *(a)Applied to a material* - combustible *as determined by AS 1530.1.* *(b)Applied to construction or part of a building - constructed wholly or in part of* combustible *materials.* **Non-combustible** means- *(a)Applied to a material - not deemed* combustible *as determined by AS 1530.1 - Combustibility Tests for Materials.* *(b)Applied to construction or part of a building - constructed wholly of materials that are not deemed combustible.*	Definitions	Update as required
C1.7(a) Single-tier spectator stands	(a) An open spectator stand or indoor sports stadium may be of Type C construction and need not comply with the other provisions of this Part if it contains not more than 1 tier of seating, is of non-combustible construction, and has only changing rooms, sanitary facilities or the like below the tiered seating. (b) In (a), one tier of seating means numerous rows of tiered seating incorporating cross-overs but within one viewing level.	Originally introduced to address the need for survival – property protection. Does not affect life safety.	Consider global objectives
C2.5(d)(i)	A class 9a building must comply with the following:	The intent is to	Apply

BCA 1996 CLAUSE No	BCA Text	Comments	Recommended action
Smoke-proof wall in a patient-care area.	(a) patient care areas must be divided into fire compartments not exceeding 2000 m². (b) Ward areas- (i) where the floor area exceeds 1000 m², must be divided into areas not more than 1000 m² by walls with an FRL of not less than 60/60/60; and (ii) where the floor area exceeds 500 m², must be divided into areas not more than 500 m² by smoke proof walls complying with (d); and (iii) where division of ward areas by fire-resisting walls under (a) and (b)(i) is not required, any smoke proof walls required under (b)(ii) must have an FRL of not less than 60/60/60. (c) Treatment areas must be divided into floor areas not more than 1000 m² by smoke proof walls complying with (d). (d) A smoke-proof wall must- (i) be non-combustible and extend to the underside of the floor above, to the underside of a non-combustible roof covering or to the underside of a ceiling having a resistance to the incipient spread of fire to the space above itself of not less than 60 minutes; and (ii) not incorporate any glazed areas unless the glass is safety glass as defined in AS 1288; and (iii) only have doorways which are fitted with smoke doors complying with Specification C3.4; and (iv) have all openings around penetrations and the junctions of the smoke-proof wall and the remainder of the building stopped to prevent the free passage of smoke; and (v) incorporate smoke dampers where air-handling ducts penetrate the wall, unless the duct forms part of a smoke management system required to continue air movement through the duct during a fire.	restrict the passage of smoke to the next compartment for a (limited) time.	requirement for smoke barriers

BCA 1996 CLAUSE No	BCA Text	Comments	Recommended action
C2.5(g) Ancillary areas in patient-care areas. Introduced with Amndt 5.	(g) The following ancillary use areas located within a patient care area must be separated from the patient care area by walls with an FRL of not less than 60/60/60 and extend to a non-combustible roof covering, the floor above or a ceiling with a resistance to the incipient spread of fire, the doorway being protected with fire doors having an FRL of not less than - /60/30 : (i) A kitchen and related food preparation areas having a combined floor area of more than 30 m². (ii) A room containing a hyperbaric facility (pressure chamber). (iii) A room used predominantly for the storage of medical records having a floor area of more than 10 m². (iv) A laundry, where items of equipment are of the type that are potential fire sources (eg gas fire dryers).	Requirement is to control fire spread, but non-combustible roof probably does not help.	Apply requirement for smoke barriers
C2.6(c) Protective spandrel to be NC.	If in a building (other than an open-deck carpark or an open spectator stand) which is required to be of Type A construction and does not have a sprinkler system complying with Specification E1.5, any part of a window or other opening in an external wall, (except openings within the same stairway)- (a) is above another opening in the storey next below; and (b) its vertical projection falls no further than 450 mm outside the lower opening (measured horizontally), the openings must be separated by- (c) a spandrel which- (i) is not less than 900 mm in height; and (ii) extends not less than 600 mm above the upper surface of the intervening floor; and (iii) is of non-combustible material having an FRL not less than 60/60/60; or (d) - (f) ..	FRL gives sufficient protection	Delete non-combustibility requirement.
C2.6(d) - By	If in a building (other than an open-deck carpark or an open spectator stand) which	FRL gives	Delete non-

BCA 1996 CLAUSE No	BCA Text	Comments	Recommended action
invoking (a). Protective panel wall or curtain wall.	is required to be of Type A construction and does not have a sprinkler system complying with Specification E1.5, any part of a window or other opening in an external wall, (except openings within the same stairway)- (a) is above another opening in the storey next below; and (b) its vertical projection falls no further than 450 mm outside the lower opening (measured horizontally), the openings must be separated by- (c) a spandrel which- (i) is not less than 900 mm in height; and (ii) extends not less than 600 mm above the upper surface of the intervening floor; and (iii) is of non-combustible material having an FRL not less than 60/60/60; or (d) part of a curtain wall or panel wall that complies with (c); or (e) - (f) ..	sufficient protection	combustibility requirement
C2.6(e) Constuction complying with (a) with gaps packed with NC stuff.	If in a building (other than an open-deck carpark or an open spectator stand) which is required to be of Type A construction and does not have a sprinkler system complying with Specification E1.5, any part of a window or other opening in an external wall, (except openings within the same stairway)- (a) is above another opening in the storey next below; and (b) its vertical projection falls no further than 450 mm outside the lower opening (measured horizontally), the openings must be separated by- (c) - (d) .. (e) construction that complies with (c) behind a curtain wall or panel wall and has any gaps packed with a non-combustible material that will withstand thermal expansion and structural movement of the walling without loss of seal against fire and smoke; or	The floor/wall system must be continuous.	Change wording of clause to reflect this.

BCA 1996 CLAUSE No	BCA Text	Comments	Recommended action
	(f) ..		
C2.6(f)(iii) Protective slab to be NC.	If in a building (other than an open-deck carpark or an open spectator stand) which is required to be of Type A construction and does not have a sprinkler system complying with Specification E1.5, any part of a window or other opening in an external wall, (except openings within the same stairway)- (a) is above another opening in the storey next below; and (b) its vertical projection falls no further than 450 mm outside the lower opening (measured horizontally), the openings must be separated by- (c) - (e) .. (f) a slab or other horizontal construction that- (i) projects outwards from the external face of the wall not less than 1100 mm; and (ii) extends along the wall not less than 450 mm beyond the openings concerned; and (iii) is non-combustible and has an FRL of not less than 60/60/60	FRL gives sufficient protection.	Delete requirement for non-combustibility
C2.7(c) Battens crossing fire walls. Amndt 7 introduced the concession.	(a) A fire wall must be constructed in accordance with the following: (i) The fire wall has the relevant FRL prescribed by Specification C1.1 for each of the adjoining parts, and if these are different, the greater FRL, except where Tables 3.9, 4.2 and 5.2 of Specification C1.1 permit a lower FRL on the carpark side. (ii) Any openings in a fire wall must comply with the Deemed-to-satisfy provisions of Part C3. (iii) Building elements, other than roof battens with dimensions of 75 mm x 50 mm or less, must not pass through or cross the fire wall unless the required fire resisting performance is maintained. (b) ..	This is an FRL issue – the barrier is to protect neighbours and the system should meet the FRL requirement	Reword accordingly. Note: Recent amendments have deleted the reference to "non-combustible" in this clause (the concession for roof battens

BCA 1996 CLAUSE No	BCA Text	Comments	Recommended action
	(c)A part of a building separated from the remainder of the building by a fire wall is treated as a separate fire compartment if it is constructed in accordance with (a) and the fire wall extends to the underside of (i) a floor having an FRL required for a fire wall; or (ii) the roof covering		used to apply to "timber or other non-combustible material".
C2.7(b)(iii)(C) NC of a lower roof.	(b)A part of a building separated from the remainder of the building by a fire wall may be treated as a separate building for the purposes of Deemed-to-satisfy Provisions of Sections C, D and E if it is constructed in accordance with the following: (i) - (ii) .. (iii) Where the roof of one of the adjoining parts is lower than the roof of the other part, the fire wall extends to the underside of- (A) the covering of the higher roof, or not less than 6 m above the covering of the lower roof; or (B) the lower roof if it has an FRL not less than that of the fire wall and no openings closer than 3 m to any wall above the lower roof; or (C) the lower roof if its covering is non-combustible and the lower part has a sprinkler system complying with Specification E1.5.	Aim is to stop the roof burning above the sprinkler system.	Materials control issue – consider in light of Project 2 output.
C2.10(b)(ii) Separation of lift shafts - NC in type B. (now C2.10(a)(ii)B)	Lifts connecting more than 2 storeys, or more than 3 storeys if the building is sprinklered, (other than lifts which are wholly within an atrium) must be separated from the remainder of the building by enclosure in a shaft in which- (a) .. (b) in a building required to be of Type B construction- the walls are- (i) in accordance with (a) if the shaft is – (A) loadbearing; or (B) located within a patient care area in a Class 9a building	Reference to "loadbearing" is inappropriate. This is a smoke control issue.	Apply requirement for smoke barriers

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	(ii) of non-combustible construction if the shaft is non-loadbearing and is not located within a patient-care area in a Class 9a building; and (c) ..		
C2.14 Public corridors in Class 2 and 3 buildings	In a Class 2 or 3 building, a *public corridor,* if more than 40 m in length, must be divided at intervals of not more than 40 m with smoke-proof walls complying with C2.5(d).	The intent is to restrict the passage of smoke for a (limited) time.	Apply requirement for smoke barriers
C3.1(a)(ii) NC ventilators in subfloor and cavity walls.	(a)The deemed-to-satisfy provisions of this Part do not apply to-… *(ii)*non-combustible *ventilators for sub-floor or cavity ventilation, if each does not exceed 45 000 mm^2 in face area and is spaced not less than 2 m from any other ventilator in the same wall;*	If such holes are allowed in fire walls, then the FRL is over-stringent.	Non-combustibility requirement should remain
C3.13(a) Openings in shafts - sanitary compartments.	In a building of Type A construction, an opening in a wall providing access to a ventilating, pipe, garbage or other service shaft must be protected by- (a) if it is in a sanitary compartment - a door or panel which, together with its frame, is non-combustible or has an FRL of not less than - /30/30; or (b) - (d) ..	This is a fire resistance issue.	Delete non-combustible alternative.
C3.13(d) Ditto Garbage shafts	In a building of Type A construction, an opening in a wall providing access to a ventilating, pipe, garbage or other service shaft must be protected by- (a) - (c) .. (d) if the shaft is a garbage shaft - a door or hopper of non-combustible construction.	This is a fire resistance issue.	Apply requirement for smoke barriers
D1.8 (Introduction) External stairs to be	An external stairway may serve as a required exit instead of a fire-isolated stairway in a building with an effective height of not more than 25 m if the stairway	Non-combustible construction is	Replace with materials control

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NC. (now D1.8(a)(i))	(including any connecting access bridges) is of non-combustible construction throughout, and-	required to prevent flame spread.	from Project 2.
D1.8(a)(i) Enclosure of ditto (now D1.8(d))	(a) if any part of the stairway is exposed to, and less than 6 m from, a window, doorway, except a doorway complying with C3.4 serving the external stairway, or the like in an external wall of the building served by the stairway- (i) the stairway must be enclosed for its full height above the lowest level of the window or doorway by non-combustible construction with an FRL of not less than 60/60/60; and	FRL with materials control from Project 2 gives sufficient protection.	Delete "non-combustible". (already deleted from the BCA)
D2.2(a) Stairways and ramps inside fire-resisting shafts.	A stairway or ramp (including any landings) that is required to be within a fire-resisting shaft must be constructed- (a) of non-combustible materials; and (b) so that if there is local failure, it will not cause structural damage to, or impair the fire-resistance of, the shaft.	Basic ignition and fire-spread control - second line of defence against fire entering the shaft.	Non-combustibility requirement should remain
D2.3 Ditto not in fire-resisting shafts	In a building having a rise in storeys of more than 2 , required stairs and ramps (including landings and any supporting structural members) which are not required to be within a fire-resisting shaft, must be constructed according to D2.2, or only of- (a) reinforced or prestressed concrete; or (b) steel in no part less than 6 mm thick; or (c) timber that- (i) has a finished thickness of not less than 44 mm; and (ii) has an average density of not less than 800 kg/m3 at a moisture content of 12%; and (iii) has not been joined by means of glue unless it has been laminated and glued with resorcinol formaldehyde or resorcinol phenol formaldehyde glue.	Alternative construction to D2.2	Non-combustibility requirement should remain

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D2.4(b) Separation of rising and descending flights.	If a stairway serving as an exit is required to be fire-isolated- (a) there must be no direct connection between- (i) a flight of stairs rising from a storey below the lowest level of access to a road or open space; and (ii) a flight of stairs descending from a storey above that level; and (b) any construction that separates or is common to the rising and descending flights of stairs must be (i) non-combustible; and (ii) smoke proof in accordance with C2.5(d).	Project 2 controls apply	Apply requirement for smoke barriers
D2.7(d) (Conclusion) Enclosure of installations in exits. (recent minor changes to text not shown)	(a) Access to service shafts and services other than to fire-fighting or detection equipment as permitted in Section E, must not be provided from a fire-isolated stairway, passageway or ramp. (b) An opening to any chute or duct conveying hot products of combustion must not be located in any part of a required exit or any corridor, hallway, lobby or the like leading to a required exit. (c) Gas or other fuel services must not be installed in a required exit. Services or equipment comprising- (i) electricity meters, distribution boards or ducts; or (ii) central telecommunications distribution boards or equipment; or (iii) electrical motors or other motors serving equipment in the building, (d) may be installed in (iv) a required exit, except for fire-isolated exits specified in (a); or (v) in any corridor, hallway, lobby or the like leading to a required exit, if the service or equipment is enclosed by non-combustible construction or a fire-protective covering with doorways or openings suitably sealed against smoke spreading from the enclosure.	This is a fire resistance issue.	Apply requirement for smoke barriers

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D2.11(a) (Introduction) Enclosure of fire-isolated passageways.	(a) The enclosing construction of a fire-isolated passageway must be non-combustible and have an FRL when tested for a fire outside the passageway in another part of the building of- (i) if the passageway discharges from a fire-isolated stairway or ramp - not less than that required for the stairway or ramp shaft; or (ii) in any other case - not less than 60/60/60. (b) ..	FRL requirement is sufficient.	Delete "non-combustible".
D2.11(b)(i) Ditto - walls reaching an NC roof covering.	(a) .. (b) Notwithstanding (a)(ii), the top construction of a fire-isolated passageway need not have an FRL if the walls of the fire- isolated passageway extend to the underside of- (i) a non-combustible roof covering; or (ii) a ceiling having a resistance to the incipient spread of fire of not less than 60 minutes separating the roof space or ceiling space in all areas surrounding the passageway within the fire compartment.	This is a fire spread issue.	Apply requirement for smoke barriers
G2.1(c)(ii) Chimneys mustn't leak smoke nor hot gases to nearby combustibles.	G2.1 deleted in BCA 96	.	
G2.3(a)	G2.3 An open fireplace, or solid-fuel burning appliance in which the fuel-burning compartment is not enclosed must have- (a) a hearth constructed of stone, concrete, masonry or similar *non-combustible* material so that-	Non-combustible is superfluous	Delete non-combustible from (a).

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	(i) – (iii)… (iv) *combustible* material situated below the hearth but not below that part *required* to extend beyond the fireplace opening or the limits of the fireplace is not less than 155 mm from the upper surface of the hearth; and		
G2.4 (a)	If an incinerator is installed in a building any hopper giving access to a charging chute must be- (i) *non-combustible*; and	Relates to the presence of fire in the building	Non-combustibility requirement should remain
G3.4(b) (Introduction) Bounding walls in atria - drencher-protected glass as alternative to fire-rated walls.	Bounding walls must- (a) ..; or (b) be constructed of fixed toughened safety glass, or wired safety glass in non-combustible frames, with- (i) any door openings fitted with a self-closing smoke door complying with Specification C3.4; and (ii) the walls and doors protected with wall-wetting systems in accordance with Specification G3.8; and (iii) a fire barrier with an FRL of not less than -/60/30 installed in any ceiling spaces above the wall.	The drenchers should be designed to protect the frames	Delete “non-combustible”
G3.5 NC balustrade around the balcony.	If a bounding wall separating an atrium from the remainder of the building is set back from the perimeter of the atrium well, a balustrade that is imperforate and non-combustible, and not less than 1 m high must be provided.	Barrier to resist the spread of fire.	Apply requirement for smoke barriers

SPECIFICATIONS

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C1.1 2.2(a)(iii) Support to be NC if the supported part is to be NC	(a) Where a part of a building required to have an FRL depends upon direct vertical or lateral support from another part to maintain its FRL, that supporting part, subject to (b), must- (i) have an FRL not less than that required by other provisions of this Specification; and (ii) if located within the same fire compartment as the part it supports have an FRL in respect of structural adequacy the greater of that required - (A) for the supporting part itself; and (B) for the part it supports; and (iii) be non-combustible- (A) if required by other provisions of this Specification; or (B) if the part it supports is required to be non-combustible.	A part that supports another part must share the properties of the supported part.	Clause might need to be rewritten in the light of other changes.
C1.1 2.4(a) (Introduction) Combustibles on facades.	(a) A combustible material may be used as a finish or lining to a wall or roof, or in a sign, sunscreen or blind, awning, or other attachment to a building element which has the required FRL if- (i) the material is exempted under Clause 7 of Specification C1.10 or complies with the Early Fire Hazard Indices prescribed in Clause 2 of Specification C1.10; and (ii) it is not located near or directly above a required exit so as to make the exit unusable in a fire; and (iii) it does not otherwise constitute an undue risk of fire spread via the facade of the building. (b) ..	Flame spread issue.	Control by material properties – see Project 2.
C1.1 2.5(b) Timber	a) .. (b) Timber columns - A timber column may be used in a single storey building	Concession on non-combustible	Review in light of other

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columns allowed in single storey buildings	if: (i) in a fire wall or common wall the column has an FRL not less than that listed in the appropriate Table 3, 4 or 5; and (ii) in any other case where the column is required to have an FRL in accordance with Table 3, 4 or 5, it has an FRL of not less than 30/-/-. (c) - (f) ..	construction.	changes.
C1.1 2.5(c) (Introduction) NC structures on roofs (recent minor changes to text not shown)	(a) - (b) .. (c) Structures on roofs - A non-combustible structure situated on a roof need not comply with the other provisions of this Specification if it only contains one or more of the following: (i) Hot water or other water tanks. (ii) Ventilating ductwork, ventilating fans and their motors. (iii) Air-conditioning chillers. (iv) Window cleaning equipment. (v) Lift equipment. (vi) Other service units that are non-combustible and do not contain combustible liquids or gases. (d) - (f) ..	Flame spread issue.	Apply Project 2 controls.
C1.1 2.5(c)(vi) "other service units that are non-combustible." (now 2.5(c)(ii)E	See above	Flame spread issue.	Apply Project 2 controls.
C1.1 2.5(d) Curtain walls and	(a) - (c) .. (d) Curtain walls and panel walls - A requirement for an external wall to have an FRL does not apply to a curtain wall or panel wall which is of non-combustible	Fire resistance issue.	Apply requirement for smoke barriers

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panel walls need not have an FRL if they are non-combustible and drencher-protected.	construction and fully protected by automatic external wall-wetting sprinklers. (e) - (f) ..		
C1.1 2.5(e) Materials deemed non-combustible. (now C1.12)	(a) - (d) .. (e) Non-combustible materials - The following materials, though combustible or containing combustible fibres, may be used wherever a non-combustible material is required: (i) plasterboard; (ii) perforated gypsum lath with a normal paper finish; (iii) fibrous-plaster sheet conforming to AS 2185 Specification for Fibrous Plaster Products; (iv) fibre-reinforced cement sheeting; (v) pre-finished metal sheeting having a combustible surface finish not exceeding 1 mm thickness and where the Spread-of-Flame Index of the product is not greater than 0; (vi) bonded laminated materials where- (A) each laminate is non-combustible; and (B) each adhesive layer does not exceed 1 mm in thickness; and (C) the total thickness of adhesive layers does not exceed 2 mm; and (D) the Spread-of-Flame Index and the Smoke-Developed Index of the laminated material as a whole does not exceed 0 and 3 respectively. (f) ..	Illustrates the inappropriateness of the current non-combustibility test.	Review on completion of project.
C1.1 2.5(f)(ii)(B)	(a) - (e) .. (f) Balconies and verandahs - A balcony, verandah or the like and any	Structural stability of the	Apply Project 2 controls

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Columns supporting balconies on facades in type- A	incorporated supporting part, which is attached to or forms part of a building, need not comply with Tables 3, 4 and 5 if- (i) .. (ii) in Type A construction- (A) it is situated not more than 2 storeys above the lowest storey providing direct egress to a road or open space; and (B) any supporting columns are of non-combustible construction.	balcony is unlikely to be a concern. Control is needed on flame spread up the external face of the building	
C1.1 2.6(b) (Introduction) Small mezzanines need no FRL nor to be NC provided	(a) .. (b) A mezzanine and its supports need not have an FRL or be non-combustible provided- (i) the total floor area of all the mezzanines in the same room does not exceed 1/3 the floor area of the room or 200 m², whichever is the lesser; and (ii) the FRL of each wall and column that supports any other part of the building within 6 m of the mezzanine is increased by the amount listed in Table 2.6.	Concession on non-combustibility	Revisit in light of other changes.
C1.1 2.7(b) Bottom of a shaft needn't have FRL if NC and laid on the ground.	Shafts required to have an FRL must be enclosed at the top and bottom by construction having an FRL not less than that required for the walls of a non-loadbearing shaft in the same building, except that these provisions need not apply to- (a) the top of a shaft extending beyond the roof covering, other than one enclosing a fire-isolated stairway or ramp; or (b) the bottom of a shaft if it is non-combustible and laid directly on the ground.	Flame spread and smoke control issue.	Apply Project 2 controls.
C1.1 3.1(b). NC required of floors of lift pits and floor-framing of lift	In a building required to be of Type A construction- (a) .. (b) external walls, common walls and the flooring and floor framing of lift pits must be non-combustible; and (c) - (f) ..	Combination of fire resistance and flame spread.	Apply Project 2 controls.

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pits			
C1.1 3.1(c)(iii) Fire-rated wall to extend to a fire-rated roof or an NC covering.	In a building required to be of Type A construction- (a) - (b) .. (c) any internal wall required to have an FRL must extend to- (i) the underside of the floor next above; or (ii) the underside of a roof complying with Table 3; or (iii) if under Clause 3.5 the roof is not required to comply with Table 3, the underside of the non-combustible roof covering and, except for roof battens with dimensions of 75 mm x 50 mm or less, must not be crossed by timber or other combustible building elements; or (iv) a ceiling that is immediately below the roof and has a resistance to the incipient spread of fire to the roof space between the ceiling and the roof of not less than 60 minutes; and (d) - (f) ..	As discussed previously.	Wall system must have appropriate FRL..
C1.1 3.1(d) Loadbearing internal walls etc to be concrete or masonry.	In a building required to be of Type A construction- (a) - (c) .. (d) a loadbearing internal wall and a loadbearing fire wall (including those that are part of a loadbearing shaft) must be of concrete or masonry; and (e) - (f) ..	Requirement provides robustness combined with fire resistance.	This is not a requirement for non-combustibility and should not be considered under this project.
C1.1 3.1(e) Non-loadbearing internal walls etc to	In a building required to be of Type A construction- (a) - (d) .. (e) a non-loadbearing- (i) internal wall required to be fire-resisting; and	Requirement is to prevent flame spread. More stringent	For walls, apply materials control from Project 2. For shafts, leave

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be NC.	(ii) lift, ventilating, pipe, garbage, or similar shaft that is not for the discharge of hot products of combustion, must be of non-combustible construction; and (f) ..	requirements are needed for shafts	in non-combustibility
C1.1 3.4(a) NC roof superimposed on a concrete slab.	A roof superimposed on a concrete slab roof need not comply with Clause 3.1 as to fire-resisting construction if- (a) the superimposed roof and any construction between it and the concrete slab roof are non-combustible throughout; and (b) the concrete slab roof complies with Table 3.	Possible flame spread through unoccupied space and contribution to fire growth.	Leave requirement for non-combustibility
C1.1 3.5 (Introduction) Roof need not be FR if its covering is NC and	A roof need not comply with Table 3 if its covering is *non-combustible* and the building- (a) has a sprinkler system complying with Specification E1.5 installed throughout; or (b) has a rise in storeys of 3 or less; or (c) is of Class 2 or 3; or (d) has an effective height of not more than 25 m and the ceiling immediately below the roof has a resistance to the incipient spread of fire to the roof space of not less than 60 minutes.	This is a flame spread issue	Apply materials control from Project 2
C1.1 3.6 Roof lights in a roof whose covering must be NC.	If a roof is required to have an FRL or its covering is required to be non-combustible, rooflights or the like installed in that roof must- (a) have an aggregate area not more than 20% of the roof surface; and (b) be not less than 3 m from-	Consistency of system performance.	review in light of other changes

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C1.1 3.8(a) Open spectator stands - NC roof needn't have an FRL.	In an open spectator stand or indoor sports stadium, the following building elements need not have the FRL specified in Table 3 : (a) The roof if it is non-combustible.	Materials control issue.	Apply Project 2 controls.
C1.1 3.8(b) Ditto certain columns and LB walls	In an open spectator stand or indoor sports stadium, the following building elements need not have the FRL specified in Table 3 :.. (b) Columns and loadbearing walls supporting only the roof if they are non-combustible.	Flame spread issue.	Apply Project 2 controls.
C1.1 3.8(c)(i) & (ii) Ditto NBL parts of certain external walls.	In an open spectator stand or indoor sports stadium, the following building elements need not have the FRL specified in Table 3 :… (c) Any non-loadbearing part of an external wall less than 3 m- (i) from any fire-source feature to which it is exposed if it has an FRL of not less than - /60/60 and is non-combustible; or (ii) from an external wall of another open spectator stand if it is non-combustible.	Flame spread issue.	Apply Project 2 controls.
C1.1 3.10(a) (recent minor changes to text not shown)	(a) A Class 2 building having a rise in storeys of not more than 3 may be constructed using- (i) timber framing throughout; or (ii) non-combustible material throughout; or (iii)a combination of (i) and (ii), provided- (iv) any fire wall or internal wall required to be fire-resisting that extends to the underside of the non-combustible roof covering is, except for roof battens with dimensions of 75 mm x 50 mm or less, not crossed by timber or other combustible	This is a complex system involving the contribution of structure and insulation to fire load and FRL	Leave as is – further investigation required

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	building elements; and (v) any insulation installed in the cavity of a wall required to have an FRL is non-combustible; and (vi) the building is fitted with an automatic smoke alarm system complying with E1.7. (b) - (c) ..		
C1.1 3.10(b) (recent minor changes to text not shown)	(a) .. (b) A Class 2 building having a rise in storeys of not more than 4 may have the top three storeys constructed in accordance with (a) provided the lowest storey is used solely for the purpose of parking motor vehicles or for some other ancillary purpose and the construction of that storey, including the floor between it and the storey above, is of concrete or masonry. (c) ..	As above	As above
C1.1 3.10(c)	(a) - (b) .. (c) In a Class 2 building complying with (a) or (b) and fitted with a sprinkler system, any FRL criterion prescribed in Table 3- (i) for any floor and any loadbearing wall, may be reduced to 60, except any FRL criterion of 90 for an external wall must be maintained when tested from the outside; and (ii) for any non-loadbearing internal wall, need not apply if- (A) it is lined on each side with 13 mm standard grade plasterboard or similar non-combustible material; and (B) it extends- (aa) to the underside of the floor next above; or (bb) to the underside of a ceiling with a resistance to the incipient spread of fire of 60 minutes; or	As above.	As above

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	(cc) to the underside of a non-combustible roof covering; and (C) any insulation installed in the cavity of the wall is non-combustible; and (D) any construction joint, space or the like between the top of the wall and the floor, ceiling or roof is smoke sealed with intumescent putty or other suitable material; and (E) any doorway in the wall is protected by a self-closing, tight fitting, solid core door not less than 35 mm thick.		
C1.1 4.1(b) NC required of floors of lift pits and floor framing of lift pits	In a building required to be of Type B construction- (a) .. (b) the external walls, common walls, and the flooring and floor framing in any lift pit, must be non-combustible ; and (c) - (i) ..	Combination of fire resistance and flame spread.	Apply Project 2 controls.
C1.1 4.1(d)(iii) FR wall to extend to an FR roof or an NC covering. Batten concession introduced with Amndt 7.	In a building required to be of Type B construction- (d) any internal wall which is required to have an FRL, except a wall that bounds a sole-occupancy unit in the topmost (or only) storey and there is only one unit in that storey, must extend to- (i) the underside of the floor next above if that floor has an FRL of at least 30/30/30; or (ii) the underside of a ceiling having a resistance to the incipient spread of fire to the space above itself of not less than 60 minutes; or (iii) the underside of the roof covering if it is non-combustible and, except for roof battens with dimensions of 75 mm x 50 mm or less, must not be crossed by timber or other combustible building elements; or (iv) 450 mm above the roof covering if it is combustible, …	Fire resistance issue.	Wall system must have appropriate FRL
C1.1	In a building required to be of Type B construction-	Robustness and	This is not a

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4.1(e) Loadbearing internal walls and loadbearing fire walls to be of concrete or masonry.	(a) - (d) .. (e) a loadbearing internal wall and a loadbearing fire wall (including those that are part of a loadbearing shaft) must be of concrete or masonry; and (f) - (i) ..	fire resistance.	requirement for non-combustibility and should not be considered under this project.
C1.1 4.1(f) Non-loadbearing internal walls that need an FRL to be NC.	In a building required to be of Type B construction- (a) - (e) .. (f) a non-loadbearing internal wall required to be fire-resisting must be of non-combustible construction; and (g) - (i) ..	Flame spread issue.	Apply Project 2 controls
C1.1 4.1(h) Service shafts in certain classes to be NC. (recent minor changes to text not shown)	In a building required to be of Type B construction- (a) - (g) .. (h) lift, ventilating, pipe, garbage, and similar shafts which are not for the discharge of hot products of combustion and not loadbearing, must be of non-combustible construction in- (i) a Class 2, 3 or 9 building; and (ii) a Class 5, 6, 7 or 8 building if the shaft connects more than 2 storeys; and (i) ..	Flame spread issue with very stringent requirement because of shaft dimensions	Leave non-combustible requirement
C1.1 4.1(i) Fire-protective covering above space for cars or	In a building required to be of Type B construction- (a) - (h) .. (i) in a Class 2 or 3 building, except where within the one sole-occupancy unit, or a Class 9 building, a floor separating storeys or above a space for the accommodation of motor vehicles or used for storage or any other ancillary purpose,	Fire resistance issue.	Apply requirement for smoke barriers

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storage.	must- (i) be constructed so that it is at least of the standard achieved by a floor/ceiling system incorporating a ceiling which has a resistance to the incipient spread of fire to the space above itself of not less than 60 minutes; or (ii) have an FRL of at least 30/30/30. (iii) have a fire-protective covering on the underside of the floor, including beams incorporated in it, if the floor is combustible or of metal.		
C1.1 4.3(a)	(a) A Class 2 building having a rise in storeys of not more than 2 may be constructed using- (i) timber framing throughout; or (ii) non-combustible material throughout; or (iii) a combination of (i) and (ii), provided- (iv) any fire wall or internal wall required to be fire-resisting that extends to the underside of the non-combustible roof covering is, except for roof battens with dimensions of 75 mm x 50 mm or less, not crossed by timber or other combustible building elements; and (v) any insulation installed in the cavity of a wall required to have an FRL is non-combustible ; and (vi) the building is fitted with an automatic smoke alarm system complying with Specification E2.2a. (b) ..	Complex system involving contribution of structure and insulation to fire load and FRL	Leave as is – further investigation required
C1.1 4.3(b) (recent minor changes to text not	(a) .. (b) In a Class 2 building complying with (a) and fitted with a sprinkler system, any FRL criterion prescribed in Table 4- (i) for any loadbearing wall, may be reduced to 60, except any FRL criterion of	Non-combustibility used to increase fire resistance.	Use appropriate FRLs except for cavity insulation (to be addressed

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shown)	90 for an external wall must be maintained when tested from the outside; and (ii) for any non-loadbearing internal wall, need not apply, if- (A) it is lined on both sides with 13 mm standard grade plasterboard or similar non-combustible material; and (B) it extends- (aa) to the underside of the floor next above if that floor has an FRL of at least 30/30/30 or is lined on the underside with a fire-protective covering; or (bb) to the underside of a ceiling with a resistance to the incipient spread of fire of 60 minutes; or (cc) to the underside of a non-combustible roof covering; and (C) any insulation installed in the cavity of the wall is non-combustible ; and (D) any constructon joints, spaces and the like between the top of the wall and the floor, ceiling or roof is smoke sealed with intumescent putty or other suitable material.		in later stages of Project 2) – beyond the scope of this project
C1.1 5.1(d) Vertical extent of partition walls in class 2 & 3 - to NC roof sheeting or above combustible roof sheeting.	In a building required to be of Type C construction- (a) - (c) .. (d) in a Class 2 or 3 building an internal wall which is required by Table 5 to have an FRL must extend- (i) to the underside of the floor next above if that floor has an FRL of at least 30/30/30 or a fire-protective covering on the underside of the floor; or (ii) to the underside of a ceiling having a resistance to the incipient spread of fire to the space above itself of not less than 60 minutes; or (iii) to the underside of the roof covering if it is non-combustible, and except for roof battens with dimensions of 75 mm x 50 mm or less, must not be crossed by timber or other combustible building elements; or (iv) 450 mm above the roof covering if it is combustible; and	System must have appropriate fire resistance.	Wall system must have appropriate FRL

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	(e) ..		
C1.1 5.1(e) Coverings to the undersides of floors above garages and storage areas in classes 2 and 3 and exemptions.	In a building required to be of Type C construction- (a) - (d) .. (e) in a Class 2 or 3 building, except where within the one sole-occupancy unit, or a Class 9 building, a floor separating storeys , or above a space for the accommodation of motor vehicles or used for storage or any other ancillary purpose, and any column supporting the floor, must- (i) have an FRL of at least 30/ 30/ 30; or (ii) have a fire-protective covering on the underside of the floor including beams incorporated in it and around the column, if the floor or column is combustible or of metal.	System must have appropriate fire resistance.	Apply requirement for smoke barriers
C1.10 3(a)(iii) Combustibles to be attached to NC substrates.	In a fire-isolated stairway, fire-isolated passageway, or fire-isolated ramp in a Class 2 to 9 building- (a) a material, other than a sarking-type material used in a ceiling or used as a finish, surface, lining or attachment, must have a- (i) Spread-of-Flame Index of 0; and (ii) Smoke-Developed Index of not more than 2; and (iii) if combustible, be attached directly to a non-combustible substrate and not exceed 1 mm in finished thickness; and (b) ..	Flame spread issue.	Changes recommended by Project 2.
C3.15 3(a) (Introduction) Proximity of metal pipe to combustibles. (recent minor	(a) A metal pipe that is not normally filled with liquid must not penetrate a wall, floor or ceiling within 100 mm of any combustible material, and must be constructed of- (i) copper alloy or stainless steel with a wall thickness of at least 1 mm; or (ii) cast iron or steel (other than stainless steel) with a wall thickness of at least 2 mm.		Non-combustibility requirement to remain.

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changes to text not shown)	(b) An opening for a metal pipe must- (i) be neatly formed, cut or drilled; and (ii) be no closer than 200 mm to any other service penetration; and (iii) accommodate only one pipe. (c) A metal pipe must be wrapped but must not be lagged or enclosed in thermal insulation over the length of its penetration of a wall, floor or ceiling unless the lagging or thermal insulation fulfils the requirements of Clause 7. (d) The gap between a metal pipe and the wall, floor or ceiling it penetrates must be fire-stopped in accordance with Clause 7.		
C3.15 7(a) Properties of fire-stopping material.	(a) Material: The material used for the fire-stopping of service penetrations must be concrete, high-temperature mineral fibre, high-temperature ceramic fibre or other material that does not flow at a temperature below 1120oC when tested in accordance with AS 1038.15, and must have- (i) demonstrated in a system tested in accordance with C3.15(a) of the BCA that it does not impair the fire-resisting performance of the building element in which it is installed; or (ii) demonstrated in a test in accordance with (e) that it does not impair the fire-resisting performance of the test slab. (b) - (e) ..	Although related, there is no mention of non-combustibility	No change.
D1.12 2(e) A floor covering under a fire door.	An escalator, moving walkway or non-required non-fire-isolated stairway or pedestrian ramp- (a) - (d) .. (e) when a fire door is closed the floor or any covering over the floor beneath the fire door must not be combustible. (f) - (o) ..	Flame spread issue.	To be considered by Project 2B
E2.2b	(a) A fire compartment must be divided at ceiling level into smoke reservoirs	Fire resistance	Apply

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4 NC of smoke curtain around a floor opening.	formed by smoke baffles/curtains of non-combustible and non-shatterable construction. (b) The horizontal area of a smoke reservoir must not exceed 2000 m2 and in enclosed walkways and malls of a Class 6 building must not exceed 60 m in length. (c) Smoke reservoirs must be of sufficient depth to contain the smoke layer and must not be less than 500 mm below an imperforate ceiling or roof. (d) (i) Within a multi-storey fire compartment, a non-combustible bulkhead or smoke baffle/curtain must be provided around the underside of each opening into a building void to minimise the spread of smoke to other storeys. (ii) The depth of the bulkhead or smoke baffle must be not less than the depth of the smoke reservoir provided under (c) plus an additional 400 mm	issue.	requirement for smoke barriers
G3.8 2.3(b) NC of collector plates.	The floor of the atrium must be protected by sprinklers with- (a) the use of sidewall pattern sprinkler heads together with overhead sprinklers where dictated by the dimensions of the atrium; and (b) sprinkler heads of the fast response type, installed with suitable non-combustible heat collector plates of 200 mm minimum diameter to ensure activation by a rising fire plume.	If the heads are suitable they are presumably non-combustible.	Delete non-combustible
G3.8 2.4.1 (Introduction) Ditto	Where an atrium is separated from the remainder of the building by walls or doors incorporating glazing, a wall wetting system with suitable non-combustible heat collector plates of 200 mm diameter must be provided to protect the glazing as follows: (a) On the atrium side of the glazing - to all glazed walls which are set back more than 3.5 m from the atrium well. (b) On the atrium side of the glazing - to all glazed walls which are not set back, or are set back 3.5 m or less, from the atrium well, for all levels which are less than- (i) 12 m above the floor of an atrium or the floor of the highest storey where the	If the heads are suitable they are presumably non-combustible.	Delete non-combustible

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	bounding wall is set back more than 3.5 m from the atrium well if a Class 2, 3, 5 or 9 part of the building is open to the atrium; or (ii) 20 m above the floor of an atrium or the floor of the highest storey where the bounding wall is set back more than 3.5 m from the atrium well if a Class 6, 7 or 8 part of the building is open to the atrium. (c) On the side of the glazing away from the atrium well - to all glazing forming part of bounding wall at each storey.		
H1.3 6(a) NC of proscenium curtain.	A curtain required by Clause 5 must be- (a) a fire safety curtain- (i) made of non-combustible material; and (ii) capable of withstanding a pressure differential of 0.5 kPa over its entire surface area; and (iii) so fitted that when fully lowered it inhibits the penetration of smoke around the perimeter of the opening, from the stage; or (b) a curtain- (i) having a Spread-of-Flame Index not greater than 0 and a Smoke-Developed Index not greater than 3; and (ii) protected by a deluge system of open sprinklers installed along the full width of the curtain.	Fire resistance issue.	Apply requirement for smoke barriers
H1.3 4 Timber purlins not to cross proscenium wall.	Timber purlins or other combustible material must not pass through or cross any proscenium wall.	Fire resistance/smoke spread issue.	Apply requirement for smoke barriers