



## Determination 2011/094

# Dispute about the Building Code compliance of fire safety design for a proposed warehouse and office building at 7 Peterkin Street, Taita, Lower Hutt

### 1. The matters to be determined

- 1.1 This is a Determination under Part 3 Subpart 1 of the Building Act 2004<sup>1</sup> (“the Act”) made under due authorisation by me, John Gardiner, Manager Determinations, Department of Building and Housing (“the Department”), for and on behalf of the Chief Executive of that Department.
- 1.2 The parties to this determination are:
- the applicant, Hutt City Council, carrying out its duties and functions as a territorial authority or a building consent authority (“the authority”)
  - the owners of the proposed building, S and L Moore (“the owners”), represented by an architect (“the architect”)
  - the fire engineer for the project, M Simpson/MacDonald Barnett (“the fire engineer”), who is a Chartered Professional Engineer<sup>2</sup>.
- 1.3 I have also included the construction firm for the project, Euroclass Limited, (“the construction firm”) as persons with an interest in the determination.
- 1.4 I have provided the New Zealand Fire Service Commission (“the NZFS”) with the determination documentation for comment by way of consultation under section 170 of the Act.
- 1.5 This determination arises from a dispute about the Building Code (Schedule 1, Building Regulations 1992)<sup>3</sup> for a fire safety design for a proposed new warehouse

---

<sup>1</sup> The Building Act, Building Code, Compliance documents, past determinations and guidance documents issued by the Department are all available at [www.dbh.govt.nz](http://www.dbh.govt.nz) or by contacting the Department on 0800 242 243.

<sup>2</sup> Chartered Professional Engineers are treated as if they were licensed in the building work licensing class Design 3 under the Building (Designation of Building Work Licensing Classes) Order 2010.

and attached office block (“the building”). The authority did not grant a building consent for the proposed building, although has subsequently agreed to a staged consenting approach and has granted a consent for at least one stage of the building work.

- 1.6 Therefore, I consider the matter to be determined<sup>4</sup> is whether the fire design of the proposed building complies with the Building Code.
- 1.7 The authority has identified a number of issues of Building Code compliance that require consideration:
- the adequacy of the structural fire endurance rating (“S rating”) and the validity of the methodology that has been used to calculate the rating
  - the adequacy of the fire design with glass reinforced polyester (“GRP”) panels and the applicability of Subparagraphs 4.2.3 and 4.2.4 of C/AS1
  - the adequacy of the fire fighting water supply, ground hydrants (in terms of distance, volume and pressure), and the fire service attendance point.
- 1.8 In making my decision, I have considered the submissions of the parties, the reports of the independent expert commissioned by the Department to advise on this dispute (“the expert”), and the other evidence in this matter.
- 1.9 I have not considered any other aspects of the Act or the Building Code. The key relevant Building Code clauses and content of C/AS1 that is referred to in this determination is included in the Appendix.

## **2. The building work**

- 2.1 The proposed building is a warehouse and office development consisting of
- a single storey warehouse with a floor area of 5137m<sup>2</sup>
  - a two storey office building (at the northwest elevation of the building) with an ground floor area of 543m<sup>2</sup> and an upper floor area of 530m<sup>2</sup>.
  - a canopy with an area of 877m<sup>2</sup>.
- 2.2 The building is proposed to be constructed with a concrete floor slab and foundations, with precast concrete external walls, and a steel framed roof, and lined with pre-coated metal cladding and glass reinforced polyester roof panels (“GRP roof panels”).
- 2.3 The fire design for the proposed building incorporates two firecells; one for the warehouse area and one for the office area. The warehouse firecell is purpose group WH (spaces used for working, business or storage – high fire load and slow/medium/fast fire growth rates). The office firecell is purpose group WL (spaces used for working, business or storage – low fire load).

---

<sup>3</sup> In this determination, unless otherwise stated, references to sections are to sections of the Act, and references to Clauses are to Clauses of the Building Code.

<sup>4</sup> Under section 177(1)(a)

- 2.4 The fire design incorporates the following fire safety precautions (Table 4.1 of C/AS1):
- type 4f automatic fire alarm activated by smoke detectors and manual call points complying with NZS 4512:2010 and F7/AS1
  - type 16 visibility in escape routes, as required in locations where specified in F6/AS1/1.2 and with exit signage to facilitate escape in accordance with F8/AS1
  - type 18c fire hydrant system (required where fire service hose run distance from the Fire Service vehicular access to any point on any floor is greater than 75 metres).
- 2.5 The office firecell has passive smoke control between the levels and two means of escape from the upper level.

### **3. The background**

- 3.1 The architect, on behalf of the owners, made an application for a building consent dated 28 May 2011. The application described the proposed building as a 'new single storey warehouse building with loading canopy and associated [two] level administration office ...' and contained a fire safety report prepared by the fire engineer.
- 3.2 The fire safety report produced by the fire engineer provides the following justification in an Appendix to his report, as to effective fire venting being achieved by a roof construction incorporating GRP roof panels as follows (paraphrased):
- There is a cost/benefit basis to the Act, and which is inherent in C/AS1.
  - GRP is already used in industrial buildings and therefore is justified on cost benefit grounds.
  - The intent of C/AS1 Subparagraph 4.2.4 is to reduce the impact of fire upon a fire rated boundary wall, and is not required for smoke venting.
  - There is historical evidence (through the reported views of C/AS1 committee members, reports etc) suggesting GRP roof panels were intended to be acceptable.
  - Manufacturers' letters support the use of the product as effective fire venting.
  - There is evidence of performance of the GRP roof panels from a number of fires.
  - The New Zealand Fire Engineering Design Guide 3<sup>rd</sup> Edition 2008 references skylights made of plastic or other material.
- 3.3 The authority provided the NZFS with a copy of the building consent application in accordance with section 46 of the Act.
- 3.4 On 17 June the NZFS sent a memorandum to the authority in accordance with section 47 of the Act. The NZFS advised the authority that the proposed fire safety

design did not demonstrate compliance with the Building Code and made the following comments (relevant to the items to be considered in this determination):

- The NZFS do not consider the Eurocode method used in ... the fire report is valid as the area used for  $A_v/A_f$  is 0.004. The Eurocode time equivalence method states that the value for  $A_v/A_f$  should be within 0.025 and 0.25.
- The design proposes to use GRP [roof] panels as effective fire venting. ... The NZFS note that this method has been formally rejected on numerous occasions... The NZFS recommends that in [the] future [the authority] requires the applicant to propose solutions for effective venting that are either certified for this purpose or have the proper research and scientific tests to validate their use.
- The NZFS consider that the ready and adequate provision of a fire fighting water supply and the ability to convey it into the building should be demonstrated as this is essential for the NZFS to have any chance of firefighting in this building.
  - The location or adequacy (flow and pressure) of the in-ground hydrants are not indicated in this fire report.
  - The location of the hardstanding fire service attendance point is not shown on the drawings.

3.5 In a letter dated 21 June 2011, the authority requested further information in respect of the building consent application including thirteen items relating to the fire safety design.

3.6 The fire engineer provided further information in a response dated 30 June 2011 and made the following comments (relevant to the items to be considered in this determination):

- If we were to increase our design  $A_v/A_f$  factor as they propose the only resulting change in calculated fire rating would be a decrease in S rating [sic]. ... This proposal has the same warehouse characteristics relating to S rating calculation as [the building in Determination 2010/105]. The only difference is that this proposal has increased fire wall thicknesses and higher S240 [fire resistance rating] as a consequence of increased structural seismic loadings.
- We acknowledge that this warehouse building proposal is at the upper limit of the draft new Code<sup>5</sup> area proposals before sprinklers may be required, however it is virtually identical to [the building considered by Determination 2010/105] which was not required to be changed in any way by the Determination for Code compliance and hence is considered to comply with present day Code requirements and also the draft of the future Code yet to be enacted. ... We note that since the issue of Determination 2010/105 GRP as the most common place, cost effective and durable fire venting material available has continued to be used as the preferred fire venting material in many Council jurisdictions ..., providing the same justification is provided, as was attached to our fire report.
- Provision of fire fighting water supply from street hydrants or other acceptable sources is not a Building Code compliance issue and not required by C/AS1 Part 8. NZS PAS 4509:2008 is not a mandatory but advisory standard and is not referenced in C/AS1 Part 8 or in the referenced standards.

3.7 The authority did not grant the building consent and, in a letter dated 28 July 2011, applied for a determination about the Building Code compliance of aspects of the fire safety design that the authority considered still to be in dispute:

---

<sup>5</sup> A proposal for a single Building Code C Clause, a new Verification Method and a revised Acceptable solution has been publicly consulted on and agreed by Government.

We request this determination in relation to the proposal to use GRP roofing for effective fire venting and the fire safety requirements proposed with focus on the proposed fire hydrant installation for compliance with the New Zealand Building Code clauses C2, C3 and C4.

3.8 The construction firm wrote to the authority on 23 August 2011, noting points about the compliance of the fire design, and that a determination is inappropriate and should be withdrawn. The letter commented that C/AS1 requires specific fire engineering design for a fire hazard category 4 building, therefore it is an anomaly to request by determination whether full compliance with C/AS1 has been met as C/AS1 provides for specific engineering design to prove compliance.

3.9 The construction firm subsequently provided a peer review by a fire engineer (“the peer reviewer”) dated 5 September 2011, that concluded:

The building proposes to use GRP in the roof for venting. It is supported in the fire report. The product has a long history of use and the [Department] has not banned the product as not suitable for use, therefore as the reviewer, I am accepting it.

The intermediate floor within the office has been addressed as an alternative solution and accepted.

The canopy requires a sign from the occupier.

#### **4. The submissions**

4.1 The application for determination from the authority was received on 29 July 2011. The application included a copy of the building consent application documentation, the memorandum from the NZFS, and the correspondence between the parties relating to the authority’s request for further information.

4.2 Although there was no formal acknowledgement of the application for determination from the other parties or persons with an interest in this determination, there was subsequent correspondence from the fire engineer and the construction firm that I have described in paragraph 3.8 and 3.9.

4.3 There have also been a series of related emails discussing the generic issues relating to effective fire venting, including the methodology and criteria that might be used for possible testing of GRP.

4.4 I issued a draft determination to the parties for comment on 12 September 2011.

4.5 The authority accepted the draft determination without comment.

4.6 The construction firm, as a person with an interest in this determination, and acting on behalf of the owners, did not accept the draft determination and noted that comprehensive information was available from the fire engineer to justify the S rating, and also made the following points:

- GRP Roof Panels: little or no consideration appears to have been given to statements in [Clause 3.2 and 3.8 of the determination]. Meanwhile it is intended to proceed with some testing of GRP products in conjunction with the Manufacturer, BRANZ, and the DBH, provided that a commonsense approach to the testing can be agreed upon with all parties. We also note the GRP product has been in use as effective fire venting over 40 years, the law is ‘gray’ and there is no ‘definition’ for effective fire venting in

the Code (not to be confused with smoke venting) and in fairness to councils, the construction industry and the clients, the status quo should remain whilst the product testing is refined. We also note that the product has not been banned for this application as this is a specific process.

- Fire fighting water supply – the site is well serviced with hydrants at the end of the R.O.W and in the road berm directly in front of the building. A resource consent for the project was granted on the 19 July 2011, with no specific requirements relating to fire fighting water supply. We have met on site with the local fire service ... who stated that they would use the hydrant at the end of the ROW and on the road berm in front of the site. We discussed the proposed hydrant outlets adjacent to the doors of the building and the Fire Service commented “nine times out of ten we wouldn’t use them” therefore we see no point in providing them if they are not a [Building Code] requirement.

4.7 The fire engineer also made a submission to provide the further information required regarding the S rating calculation. The fire engineer submitted:

- The [expert’s] letter states that the use of the Eurocode is acceptable. ... The expert’s opinion appears to be on the basis of privileged communications with the [Department] that are not available to the public nor have they had any public debate as to the cost benefit of this approach. There is no technical supporting evidence that 150mm thick concrete panel walls are allowing damage to neighbouring property, let alone 165mm thick walls.
- In practice 240/240/240 – 165mm thick concrete fire walls have proven performance in real fires. For a single storey warehouse such as this building, venting at the roof and possible subsequent roof collapse are expected actions from the fire. The end result of these fire/building actions are that the fire has become ventilated and responds in general more like an external fire. An external fire is characterised by increased ventilation and cooler flame temperatures. Thereby effectively increasing the time the wall will remain intact to protect the neighbouring property beyond the 240/240/240 furnace results. This phenomenon is quantified in a paper that was internationally peer reviewed and published in the SFPE Fire Safety Journal, vol 17 number 2 entitled “A new T-Equivalent Method for fire rated wall construction using cumulative radiation energy” by CR Barnett. This alternative method of calculation would result in reduced S ratings in comparison with the Eurocode Method which is conservative for single storey buildings with an unrated roof.

4.8 The NZFS, as per my request under section 170, responded to the draft determination on 26 September 2011. The NZFS were in agreement with the draft determination and noted that the product assurance framework provided formality for the process of gaining acceptance of products.

4.9 I have carefully considered the submissions from the parties and I have taken account of the information in preparing the final determination.

## **5. The expert’s report**

5.1 As stated in paragraph 1.8, I commissioned a fire safety engineer (“the expert”) who is an expert in fire safety design and is a Chartered Professional Engineer with a Master of Engineering in Fire Engineering. The expert provided a report dated 5 September 2011. I have included the substantive text of the report in Appendix B (section 9). I also provided a copy of the report to the parties for comment on 6 September 2011.

5.2 The expert was of the opinion, in respect of the three main items being considered in this determination, that:

- The use of Eurocode is acceptable; however the calculation itself required justification and further discussion, particularly the fire load energy density value (“FLED”). The calculation gives an output of 240 minutes, which is described as the maximum value achievable. There have been recent discussions with the Department about maximum S ratings. If the S Rating calculation exceeds 240 minutes without sprinklers the fire design may need to install sprinklers to reduce the Eurocode value to 240 minutes or less.
- The use of GRP has been the subject of a previous determination where it was not demonstrated that it complied with the Building Code. Nothing has changed with the manufacture or testing of GRP since the previous determination.
- Fire fighting water supplies as per SNZ PAS 4509: 2008<sup>6</sup> is not a requirement that can be enforced through a building consent application.

## 6. Discussion

### 6.1 Framework for assessing Building Code compliance

6.1.1 The authority did not grant a building consent for the proposed building (although it has subsequently agreed to a staged consenting approach, refer to paragraph 1.5) and has identified a number of issues of Building Code compliance that require consideration of:

- the adequacy of the S rating and the validity of the methodology that has been used to calculate the rating
- the adequacy of the fire design with GRP roof panels and the applicability of Subparagraphs 4.2.3 and 4.2.4 of C/AS1
- the adequacy of the fire fighting water supply, ground hydrants (in terms of distance, volume and pressure), and the fire service attendance point.

### 6.2 The adequacy of the S rating and the validity of the methodology that has been used to calculate the rating

6.2.1 The fire report states:

The [S rating] ... is derived from [a spreadsheet calculation] using the Eurocode method. The required fire resistance rating has a value of S240 ... This generally applies for external warehouse boundary walls which are structurally designed as base fixed cantilevers.

6.2.2 C/AS1 is clear that fire hazard category 4 firecells require specific fire engineering design. In Determination 2010/105, I said ‘The specific engineering design, whatever methodology is chosen, may use the Eurocode method, and should include a full analysis of the fire effects within the building, describing the method used and all the assumptions made.’

---

<sup>6</sup> SNZ PAS 4509: 2008 New Zealand Fire Service firefighting water supplies code of practice

- 6.2.3 I note the comments of the expert that the values of the S rating calculation are not justified and need to be, in particular the FLED.
- 6.2.4 I took the view that the values of the S rating calculation were not adequately justified in the first draft determination. In the fire engineer's submission in response to the draft, (refer to paragraph 4.7), the fire engineer noted that:
- the FLED used was based on 20TJ in the warehouse firecell which 'we understand may be a future Code limit before sprinklers may be required'
  - this 'equates to an average of 4,300 MJ/m<sup>2</sup>,' which is realistic based on the intended use of the building
  - 'the FLED ... resulted in a calculated S243 rating such that the default S240 value referred to in our design was not significantly exceeded'.
- 6.2.5 In Determination 2010/105, I accepted the calculation, methodology, and supporting information. However, my acceptance of this was as a result of supplementary information and analysis that was provided during the determinations process.
- 6.2.6 Determination 2010/105 found that full engineering calculations should be provided as a part of the fire design. I continue to hold the view that the specific engineering design, whatever methodology is chosen, which may include the Eurocode, should include a full robust analysis of the building and should justify, explain, and use best design practice to document any of the assumptions made and the methodology used.
- 6.2.7 It is my view that, in this case, the fire safety design and the further information provided does not provide adequate analysis and robust justification of the inputs of the calculation. I also note that instead of calculating what the actual FLED in the building would be based upon the proposed storage, the fire engineer has back calculated from a proposed future Code limitation. Therefore no justification of the actual FLED for the product being stored in the building has been provided.
- 6.2.8 Therefore, I conclude the fire safety design does not adequately demonstrate compliance with Clauses C2 and C3 in respect of the calculation of the S rating, in particular the FLED.
- 6.2.9 I also note that in some cases, the calculated design fire severity could be greater than 240 minutes for a non sprinklered building and therefore the achievable fire resistance would be less than the design fire severity. Just because 240 minutes is presented as a maximum for fire resistance, doesn't justify calculations that yield a fire severity of greater than 240 minutes.

### **6.3 The adequacy of the fire design with GRP roof panels and the applicability of Subparagraphs 4.2.3 and 4.2.4 of C/AS1**

- 6.3.1 C/AS1 is structured to look at fire safety requirements on a firecell by firecell basis. The application of subparagraph 4.2.4 is to a large, single floor building. Subparagraph 4.2.4 can be applied to the single storey warehouse firecell, however, effective fire venting is required, although this is not well defined.



6.3.2 In Determination 2010/105, I evaluated the Building Code compliance of a warehouse building that included GRP panels as an element of the fire safety design. In that Determination, I discussed, in some detail, the application of the Building Code with respect to the requirements for the protection of firefighters and the purpose and use of effective fire venting. I noted the following key points about the Building Code and purpose of effective fire venting:

- The Building Code has significant requirements for the protection of firefighters, requiring time for firefighters to carry out firefighting operations without injury due to loss of structural stability, and fire safety systems to facilitate the specific needs of firefighters to control the spread of fire and protect property.
- The functional requirement C4.2 requires that ‘Buildings shall be constructed to maintain structural stability in fire.’
- Clause C4.3.1 requires that ‘Structural elements of buildings shall have fire resistance ratings appropriate to the function of the elements...’
- The means of maintaining structural stability during fire could include protection (e.g. rating), the size of building elements (e.g. over design), or limiting the assault (e.g. fire venting or sprinklers).
- Effective fire venting is required by Subparagraph 4.2.4 of C/AS1 for unsprinklered, single floor buildings, with unlimited floor area and non rated roof elements as a mechanism to limit the assault, as the effective fire venting allows the fire to vent through the roof thereby reducing the temperature in the building and allowing structural elements to maintain their stability for a longer period of time.

6.3.3 In Determination 2010/105, with respect to the use of GRP panels in particular, I noted the following points:

- there is no definition for effective fire venting, consequently it is difficult for any manufacturer to market their product as satisfying this criteria
- the use of GRP roof panels as effective fire venting is common practice, and such panels have been in use to provide venting for 15 years
- historically, the industry has been of the view, and made the assumption, that GRP roof panels melted to some extent to provide heat and smoke venting
- there is some evidence starting to emerge that the GRP roof panels commonly used in New Zealand may not perform to the assumed performance level of the product, however, at the current time, this evidence is in the form of small scale, limited testing
- the evidence supporting the use of GRP roof panels to provide effective roof venting is subjective and empirical at best, and does not have a very strong scientific basis.

6.3.4 In Determination 2010/105, I evaluated the arguments of the parties and came to a view as follows:

...I am of the view that the evidence and information provided to me about the rationale and means of effective fire venting through using the GRP roof panels is not sufficient to demonstrate Building Code compliance. Therefore, due to the lack of scientific evidence available at this time, I conclude there is insufficient information to

demonstrate that [the fire design], in respect of the GRP roof panels, meets the performance requirements of Building Code Clause C4.3.1.

- 6.3.5 I have carefully considered the information presented to me about the efficacy of the GRP roof panels, in particular the arguments presented by the fire engineer and the construction firm. I am of the view that no information has been submitted to me in support of the fire design in the course of this determination that would cause me to form a different view from that I held in Determination 2010/105. I therefore conclude that, due to the lack of scientific evidence available at this time, there is insufficient information to demonstrate that the fire design, in respect of the GRP roof panels, meets the performance requirements of Building Code Clause C4.3.1.
- 6.3.6 I note there has been ongoing debate about the methodology for obtaining the scientific evidence. I note the comments of the construction firm that it is intended to proceed with product testing, however, a commonsense approach must be agreed upon by all parties, and that there is no definition of effective fire venting and in fairness to the industry, the status quo should remain whilst the product testing is refined.
- 6.3.7 These comments cannot change my view of the matter, as expressed in paragraph 6.3.5 and Determination 2010/105, which is that due to the lack of scientific evidence available to me at this time, I have insufficient grounds to accept that the fire design, in respect of the GRP roof panels, meets the performance requirements of Building Code Clause C4.3.1
- 6.3.8 In the course of processing this determination, the Department has provided the fire engineer with a guidance document (the Department's guidance document called 'Using the Product Assurance Framework to Support Building Code Compliance – A Guide for Manufacturers and Suppliers of Building Products'<sup>7</sup>) outlining options for achieving product assurance and demonstrating that a product (such as GRP roof panel in a fire venting context) complies with the Building Code.
- 6.3.9 I make the following general comments about the nature of the methodology described in that guideline:
- The development of the criteria and testing methodology should involve the key stakeholders and relate to the performance being assessed, which in this case is effective fire venting.
  - The testing should be conducted by an independent body.
  - The results should be published in a clear and succinct manner which clearly states the performance claim being made.
- 6.3.10 For avoidance of doubt, I record that I have not received any information regarding the performance of GRP sheeting in this application in terms of 6.3.9 above. I also note that the reference to the Department not having banned the product (refer to paragraph 3.9) I believe is a reference to powers available to the Chief Executive of the Department under section 26 of the Act. I do not believe that this reasoning as adequate to provide reasonable grounds for compliance.

---

<sup>7</sup> The document is available on the Department's website: <http://www.dbh.govt.nz/UserFiles/File/Publications/Building/Compliance-documents/Product-Assurance-Framework-guidance.pdf>

#### **6.4 The adequacy of the fire fighting water supply, ground hydrants (in terms of distance, volume and pressure), and the fire service attendance point**

6.4.1 I note the comments of the expert that the requirement to provide for fire fighting water supplies as per SNZ PAS 4509: 2008 is not a Building Code requirement, and I understand from the submission of the construction firm that it was not a resource consent requirement either.

6.4.2 With regard to the hard standing areas and fire service attendance points, I note the fire engineer has stated that the building has heavy duty pavement fill over virtually the entire yard area and two fire appliance access points from the street, all in accordance with C/AS1 Part 8. It appears that this is adequate, however the details need to be shown on the plans to the satisfaction of the authority. I note the comment of the expert that this is a simple matter to resolve between the parties.

### **7. Decision**

7.1 In accordance with section 188 of the Act I hereby determine that the fire design submitted for the proposed building does not provide reasonable grounds for compliance with the Building Code in respect of:

- the information provided to support the design of the GRP roof panels to provide effective roof venting
- the information provided to support the design in terms of justifying the S rating.

Signed for and on behalf of the Chief Executive of the Department of Building and Housing on 27 October 2011.

John Gardiner  
**Manager Determinations**

## 8. Appendix A: The legislation

8.1 The relevant key clauses of the Building Code as discussed in this determination are:

Clause C2—Means of Escape

Clause C3—Spread of Fire

Clause C4—Structural stability during fire

C4.2 Buildings shall be constructed to maintain structural stability during fire to:

- (a) allow people adequate time to evacuate safely,
- (b) allow fire service personnel adequate time to undertake rescue and firefighting operations, and
- (c) avoid collapse and consequential damage to adjacent household units or other property.

C4.3.1 Structural elements of *buildings* shall have *fire* resistance appropriate to the function of the elements, the *fire load*, the *fire intensity*, the *fire hazard*, the height of the *buildings* and the *fire* control facilities external to and within them.

8.2 The relevant key parts of the compliance document C/AS1 referred to in the determination are:

Subparagraph 4.2.3

Except as permitted by Paragraph 4.2.4, the floor area of an unsprinklered firecell to which an S rating applies, shall not exceed the maximum firecell floor area given in the following table.

Fire hazard category (from Table 2.1)	Maximum firecell floor area (m <sup>2</sup> )
1	5000
2	2500
3	1500
4	Specific fire engineering design required

Subparagraph 4.2.4

In an unsprinklered single floor *building* where the *building elements* supporting the roof are not *fire* rated, the *firecell* floor area may be unlimited provided that no less than 15% of the roof area (distributed evenly throughout the *firecell*) is designed for effective *fire* venting.

## 9. Appendix B: The expert's report

9.1 The expert has reviewed the fire engineer's report and provided information on the following issues relating to this application:

- The use of glass reinforced plastic (GRP) as a means of providing effective fire venting.
- The use of the Eurocode to determine the boundary fire rating (S rating).
- The efficiency of the fire fighting water supplies and fire service attendance point.

9.2 The expert provided the following information about the C/AS1 compliance of the fire safety report:

Other than the use of GRP to provide effective venting the [fire safety] report is mostly C/AS1 compliant except as detailed below in which there isn't necessary non-compliance – just some queries/comments.

1. There is no detail in the report regarding what the fire rating should be between the offices and the warehouse. A fire rating of 60 minutes is probably adequate but has not been justified or detailed. This issue also formed part of [Determination 2010/105] and the outcome was that 60 minutes was acceptable.
2. Does C/AS1/4.2.4 apply given that the building is not single storey due to the upper level of the intermediate floor. This is an issue that relates to how the clause is read. Reading it literally would suggest that the clause doesn't apply given the intermediate floor which deems the building to no longer be a single storey building. However I suspect the intent of the clause would be for a predominantly single storey building and a small office intermediate floor would not rule out use of this clause.
3. The S Rating calculation uses specific design but is detailed for use in C/AS1 so it is an acceptable method to use. The NZFS [Design Review Unit] questioned the use of the Eurocode however it is what is commonly used and we accept the [fire engineer's] justification to use this. However the values used in the S Rating calculation are not justified and need to be to determine that the calculation is accurate. In particular the FLED has not been justified. [The fire engineer has] commented that the S Rating calculation shouldn't matter on the basis that the maximum S Rating value that can be constructed is being used (240mins). However we understand that there has been recent discussion within the [Department] regarding maximum S Rating values. Its common to hear that 240mins is the maximum that can be achieved in construction. However the argument has recently been put forward that the maximum that could be achieved is actually 240 minutes in a sprinklered building – which would equate to a 480 minute Eurocode value. The S Rating is then achieved by applying the sprinkler factor of 0.5 to get to 240 minutes. Therefore the maximum rating that can be achieved is a sprinklered building with a 240 minute fire rating.

9.3 The expert provided the following information about the effective fire venting:

The requirement for effective venting in C/AS1 has been the object of discussion and debate for some time. The reason why effective venting is a requirement has often been questioned.

Effective venting has been the discussion of previous determinations (2010/105 and 2010/004). The effective venting was said in these determinations to be necessary for fire fighters to undertake their duties as per C4.3.1, C4.3.2 and C1.3.3 of the Building Code.

C/AS1/4.2.4 allows an unlimited floor area of single-storey buildings where effective venting is provided. The comment to C/AS1/4.2.3 also discusses a fire load limitation.

Limiting of firecell size and fire load is also a requirement of the proposed new Building Code which is discussed in [paragraph 9.4]. Where the limitations of the proposed Building Code are not met fire fighter tenability must be shown. Therefore it is clear in the proposed new Building Code that firecell size and fire load limitations are directly related to fire fighter tenability as well as protection of other property.

In the [fire engineer's] letter of 30 June 2011 it is stated in item 45 that the [Department] have said that the Code requires roof fire venting for neighbours property protection and not for fire fighter tenability. We're not sure where the [Department] have said this however it is contrary to the information given earlier in this section where the [Department] have said effective venting is for fire fighter tenability.

#### 9.4 The expert provided the following information about the proposed Building Code:

[The fire engineer has] used information from a [Building Code] development meeting (May 2011) at the [Department], where the proposed new [Building Code] was discussed, to justify the use of GRP. The proposal discussed was a building (less than 15m to the boundary) with the one or more of the following attributes would not require protection by automatic fire sprinklers or fire fighter tenability to be shown (which could use a venting solution):

- Less than 5000m<sup>2</sup>
- Less than 20TJ (20,000,000MJ)

[This] building is outside of both of these limits – this is contrary to the [fire engineer's] letter which states it is at the upper limits.

Therefore under the proposed new Building Code the building would either need to be sprinkler protected or fire fighter tenability shown. Fire fighter tenability must be shown by proving the following two limitations:

- a limit to the radiation flux at 1.5m above the floor, and
- a smoke layer no less than 2m above the floor.

These could be shown using a venting solution however it would need to be proven – ie. Modelling, justification, technical product data etc..

#### 9.5 The expert provided the following information about the fire service water and attendance point:

The requirement to provide for fire fighting water supplies as per SNZ4509 is not a [Building Code] requirement. The [authority] have requested information on compliance with this as part of the Building Consent process. This can only be requested as part of a Resource Consent and information needs to be requested as part of this process, not the Building Consent process.

The attendance point and hard standing areas is not really a matter that needs to go for determination in my view. Although it is a Building Code issue, the Building Consent applicant simply needs to provide further details of compliance to satisfy the BCA. Some information has been given however it appears the [authority] is not satisfied with this and has therefore sent the issue for determination. It would perhaps be better if this was dealt with between the [authority] and Building Consent applicant to resolve rather than becoming a determination issue.

9.6 Although outside of the matters to be determined, the expert also provided information about the testing of GRP roof panels:

The [fire engineer] has suggested to the Department that testing of GRP roof panels at BRANZ could be carried out using the pilot test apparatus and an ISO834 fire curve. ... the applicability of this type of testing and the results achieved are questionable. There are a number of issues that arise with testing on the pilot scale apparatus using ISO834, these include:

- Test standard ISO834 is a fire resistance test that provides a performance in post flashover conditions and not designed to test whether or not a product melts and provides venting.
- The proposal by the fire engineer to undertake testing does not detail any particular test criteria. ...
- Using the pilot scale test rig is very small and not indicative of actual conditions in a warehouse. In the pilot scale test it is likely the flames would be hitting the GRP and there could be greater pressure on the GRP than in an actual fire where the GRP is at high level and the fire at lower level.
- Some of the recent fires where GRP has been shown to provide venting may have been because the NZFS hose stream was applied to the melted panel. ...
- BRANZ have undertake research which is detailed in Study Report number 199 (2008) Parts 1-3. Within this report there is discussion on developing a potential test method for roof panels that might be used for fire venting. Before any testing is undertaken this report should be carefully read and discussed with the authors to determine that the correct test procedure and criteria are used so that the results are applicable and reliable.