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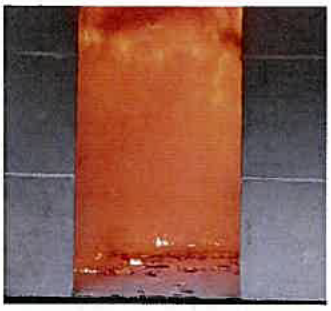

BRANZ REPORT

FD1882/CF02/1

REPORT ON COMPLIANCE OF A FACADE SYSTEM AT 12 SELWYN ROAD, COCKLE BAY, AUCKLAND WITH NZBC FIRE SAFETY CLAUSES

CLIENT
Ministry of Business Innovation and Employment
15 Stout Street
Wellington
New Zealand

PROJECT NUMBER:	ISSUE DATE:	PAGE:
FD1882	**31 October 2017**	**1 of 24**

LIMITATIONS

This is an independent report prepared for the Ministry of Business, Innovation and Employment (MBIE) by an Assessor contracted by the Chief Executive of the MBIE to provide specific information on buildings as part of the Determination process described in The Building Act 2004 section 187.

On completion, this report is to be provided to the MBIE official who requested the report on behalf of the Chief Executive of the MBIE. Drafts or copies of the report are not to be provided to any other person except as directed by the MBIE.

The investigation for this report was carried out to provide information required by the MBIE.

Documents referred to in the preparation of this report were provided by the MBIE, as listed in section 2 of this report.

The report is provided for the use of the MBIE only. No other party should rely on its findings and no liability to any third parties is accepted.

This report is subject to the accuracy and completeness of the information supplied.

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This report is issued in accordance with the Terms and Conditions as detailed and agreed in the BRANZ Services Agreement for this work.

CONTENTS

SIGNATORIES

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DOCUMENT REVISION STATUS

ISSUE NO.	DATE ISSUED	DESCRIPTION
1	15 September 2017	Initial Issue – Draft Report
2	20 September 2017	Revised to consider Auckland Council submission and technical literature from the applicant – Draft Report
3	22 September 2017	Final
4	26 October 2017	Draft addendum added after review of additional documents following issue of draft determination
5	31 October 2017	Final report with addendum added

1. BACKGROUND

MBIE have asked the author to review material provided in relation to an application for determination on the compliance of a proposed façade system at 12 Selwyn Road, Cockle Bay, Auckland 2014 with the Fire Safety Clauses of the New Zealand Building Code (NZBC).

The building owner is proposing to use a façade system using Trespa Meteon panels as the exterior cladding to an existing building in Auckland. The building has 4 levels of apartments over a basement carpark; the exterior walls are timber-framed.

Trespa Meteon panels are made of a fire-retardant high pressure laminate phenolic-impregnated Kraft paper with a decorative finish. The proposed system incorporates:

- Timber wall framing
- Cavity insulation (unknown)
- 6mm fibre-cement sheet on outside of framing
- Breathable membrane barrier
- Proprietary aluminium frame (T50) supporting the 8mm Trespa Meteon panels.

Fire testing to NFPA 285 on a similar system was conducted by Intertek in the USA in 2009 which is being relied on to support the proposed system's compliance with the fire safety clauses (the fire test cited in para 5.8.2 of C/AS2). The tested system incorporated:

- Steel wall framing
- Unfaced R-19 thermal insulation batts
- Mineral wool insulation at each floor level
- Type X gypsum plasterboard (to both faces)
- 'Weather resistant' membrane barrier
- Proprietary aluminium frame (TS110-285) supporting the 8mm Trespa Meteon panels

An opinion by Origin Fire Consultants dated May 2017 has been provided comparing the Intertek test results with the likely performance of the façade system proposed to be used in NZ; i.e., whether the façade system would pass the NFPA 285 fire test and therefore satisfy the NZBC in relation to spread of fire. Their report provides an assessment for a range of permitted variations to two different Trespa Systems previously subjected to NFPA 285 fire tests including the proposed system to be installed at the property at 12 Selwyn Road.

Their report has not been accepted by Auckland Council.

2. DOCUMENTATION

The Author was supplied with the following documentation.

1. Letter (Ref No: LNZ-A-0844) from Maynard Marks to MBIE dated 23 August 2017.
2. Application for Determination completed by Maynard Marks dated 23 August 2017.
3. Report on Trespa Meteon External Surface Finish Compliance (Ref No: 17037 Issue: C), Origin Fire Consultants, 30 May 2017.
4. Test Report on METEON-KRAFT FR 8mm Unicolor Panels installed using a TS110-285 System (Ref No: 3166173-10 Rev.3) tested to NFPA 285 2006 edition by Intertek dated 29 April 2009.
5. Drawings. T50 + Trespa HPL + RWU + Rivet (7 pages, Ref No: various) by Prime Design.
6. Letter on Analysis and Extension of NFPA 285 Tests with Trespa Panels and Cladding System Components (Ref No: HAI Project #1JJB00043.000) from Hughes Associates dated 14 February 2014.
7. Letter from Auckland Council to Maynard Marks dated 21 August 2017.
8. Report from FIRENZE 'Auckland Council Submission in relation to Building Consent Application BCO10251571, 12 Selwyn Road, Cockle Bay, Howick, Auckland' dated 19 September 2017.
9. Trespa Meteon Exterior Panels, Masterspec Section 4254TM and 4254XF. Decortech. 1 July 2016. 4 pages.
10. Material property datasheet. Trespa® Meteon®. Code U8001 version 3.2 date 01-10-2012.

3. SCOPE

This report is limited to whether the proposed façade system would pass the NFPA 285 full scale façade fire test and therefore would comply with C/AS2 paragraph 5.8 and therefore with the relevant clause(s) of the NZBC. The supporting information provided by the applicant is examined to determine if it gives 'reasonable grounds' to be satisfied that the façade system would pass the NFPA 285 fire test.

Note that all mention of the Trespa Meteon panel in this report refers to the fire retardant panel: grade EDF (Meteon® FR).

4. DISCUSSION

4.1 Relevant NZBC Requirements

NZBC Clause C3.5 says:

C3.5 *Buildings* must be designed and constructed so that fire does not spread more than 3.5 m vertically from the *fire source* over the external cladding of multi-level *buildings*.

NZBC Clause C3.7 says:

C3.7 External walls of *buildings* that are located closer than 1 m to the *relevant boundary* of the property on which the *building* stands must either:
(a) be constructed from materials which are not *combustible building materials*, or
(b) for *buildings* in importance levels 3 and 4, be constructed from materials that, when subjected to a radiant flux of 30 kW/m², do not ignite for 30 minutes, or
(c) for *buildings* in Importance Levels 1 and 2, be constructed from materials that, when subjected to a radiant flux of 30 kW/m², do not ignite for 15 minutes.

One means of complying with all the C Clauses of the NZBC for the building in question is to satisfy the requirements of Acceptable Solution C/AS2 including Amendment 4. Regarding the external walls, C/AS2 states the following:

External walls

5.8.1 The *external wall* cladding system shall be tested in accordance with the relevant *standard test* in Appendix C C7.1 and shall satisfy the following requirements:

a) If the distance to the *relevant boundary* is less than 1.0 m, the peak *heat release rate* shall not exceed 100 kW/m² and the total heat released shall not exceed 25 MJ/m², and

b) If the distance to the *relevant boundary* is
1.0 m or more and the *building* height is greater than 7.0 m the peak *heat release rate* shall not exceed 150 kW/m² and the total heat released shall not exceed 50 MJ/m²

5.8.2 The requirements in Paragraph 5.8.1 do not apply if:

a) *Surface finishes* are no more than 1 mm in thickness and applied directly to a *non-combustible* substrate, or

b) The entire wall assembly has been tested at full scale in accordance with NFPA 285 and passed the test criteria.

It should be noted that the NFPA 285 fire test does not explicitly provide data that would permit Clause C3.7 to be evaluated based on the heat flux and time of exposure. This aspect is not specific to this particular determination and is not discussed further in this report. I have assumed that meeting the NFPA 285 acceptance criteria is sufficient to comply with C/AS2 5.8.2 b).

No information has been provided to me on whether the proposed Trespa cladding system meets the performance criteria given in C/AS2 Paragraph 5.8.1 or not. The standard fire test in C/AS2 Appendix C7.1 is ISO 5660 Part 1, a small-scale test measuring the rate of heat release from a sample of the cladding exposed to a radiant heat flux of 50 kW/m^2. The test can accommodate a maximum sample with substrate depth of 50 mm. Due to the small-scale, this test is not capable of evaluating the potential influence of any joints and fixings in an external wall cladding system, or the contribution of significant quantities of combustibles located within the external wall (e.g. combustible cavity insulation). It can however, identify when the outer cladding material alone poses a risk of propagating upward flame spread at the heat flux level specified. The test is not suitable for all materials but would be expected to applicable to a non-melting high pressure laminate material.

This could be an alternative pathway to demonstrating compliance.

4.2 NFPA 285 Fire Test

4.2.1 General

The NFPA 285 test protocol uses a 26ft high two-storey assembly. It is intended to allow observations to be made of what would happen if a fire started on one storey of the building, determining if fire could spread to the floor immediately above. If that did occur then it is presumed that fire spread to the floor above that might also occur and so on.

Ultimately, the combination of all the exterior wall components (air gaps, fixings, insulation etc) and details contribute to whether the fire will propagate up the exterior wall. Changing one component in the assembly could change the result from pass to fail or vice versa. Figure 1 shows a side view of the test rig with a base wall for calibration included. Two gas burners are used for the fire source: one inside the lower room, and a second in the window opening.

The basic test procedure is as follows.

- Room burner on at 0 min
- Window burner on at 5 min
- Gas flow turned off at 30 min
- Data collection shall be continued until residual burning has stopped or 10 minutes has elapsed after gas flow was shut off. Any residual burning on the wall assembly shall be permitted to continue until extinguishment or until 10 minutes has elapsed after the gas flow was shut off.

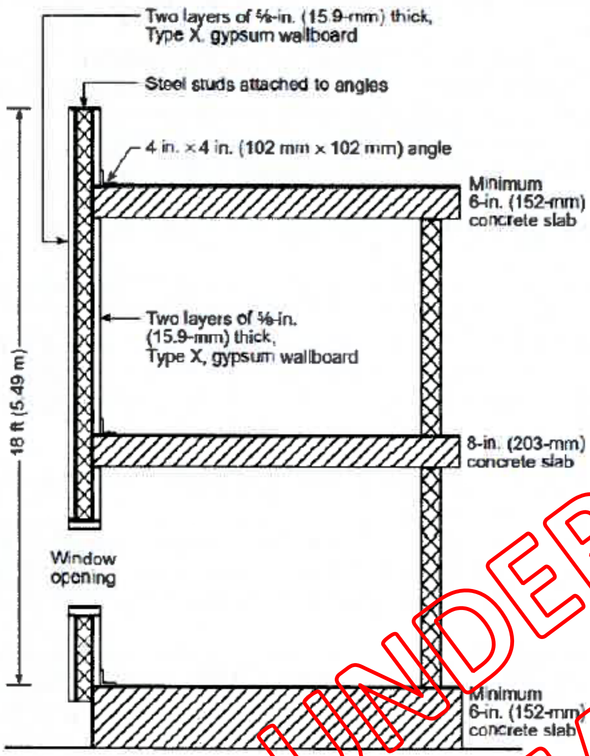

Figure 1 Side view of NFPA 285 calibration wall system (not to scale)

4.2.2 Acceptance Criteria

NFPA 285 (1998 edition) clause 8-1.1 states:

8-1.1 The performance of the test wall assembly shall be judged on the basis of visual observations both during and after the test in conjunction with the temperature data obtained during the test. An exterior non-load-bearing wall assembly shall be considered as meeting the requirements for acceptable performance if during the 30-minute test period 8-1.2 through 8-1.6 are met.

The acceptance criteria for the NFPA 285 (1998 edition) test are:

8-1.2 Flame propagation shall not occur either vertically or laterally beyond the area of flame plume impingement on the exterior face of the wall assembly. Propagation shall be judged to occur if one of the following conditions is present:
(a) Temperatures of 1000°F (538°C) are attained at any of Thermocouple Nos. 11 and 14–17 *[see Figure 4-1.2(a)]*.
(b) Flames emitting from the surface of the exterior face reach a vertical elevation of 10 ft (3.05 m) above the top of the window opening.
(c) Flames emitting from the surface of the exterior face reach a lateral distance of 5 ft (1.52 m) from the vertical centreline of the window opening. Figure 8-1.2 provides a sketch showing these limits.

8-1.3 Flame propagation shall not occur either vertically or laterally through the core components as determined by the following:

(a) For wall systems constructed of exterior wall panels greater than 1/4 in. (6.4 mm) thick having combustible components *[see Figure 4-1.2(a) and Figure 4-1.2(b), Details A and B]*, temperatures in the combustible components shall not exceed 750°F (417°C) above ambient as measured by Thermocouple Nos. 28 and 31–40.

(b) For wall systems constructed of exterior wall panels that are 1/4 in. (6.4 mm) thick or less, have combustible components, and utilize a wall cavity with an air space *[see Figure 4-1.2(a) and Figure 4-1.2(b), Detail C]*, the following conditions shall be met:

1. Temperatures in the air cavity shall not exceed 1000°F (538°C) as measured by Thermocouple Nos. 28 and 31–40.

2. Temperatures in the wall cavity insulation shall not exceed 750°F (417°C) above ambient as measured by Thermocouple Nos. 55–65.

(c) For wall systems constructed of exterior wall panels that are 1/4 in. (6.4 mm) thick or less, have combustible components, and utilize a wall cavity without an air space *[see Figure 4-1.2(a) and Figure 4-1.2(b), Detail D]*, temperatures in the cavity insulation shall not exceed 750°F (417°C) above ambient as measured by Thermocouple Nos. 28 and 31–40.

8-1.4 Flame propagation shall not occur laterally beyond the limits of the burn room. This determination shall be made based on the following:

(a) Flames do not occur over the surfaces of the exterior face beyond the concrete block fixture walls.

(b) Flames do not occur beyond the intersection of the test wall assembly and the concrete block fixture walls.

(c) Flame propagation does not occur laterally through the core components in the first floor area based on the following:

1. For wall systems constructed of exterior wall panels that are greater than 1/4 in. (6.4 mm) thick and have combustible components *[see Figure 4-1.2(a) and Figure 4-1.2(b), Details A and B]*, temperatures in the combustible components shall not exceed 750°F (417°C) above ambient as measured by Thermocouple Nos. 18 and 19.

2. For wall systems constructed of exterior wall panels that are 1/4 in. (6.4 mm) thick or less, have combustible components, and utilize a wall cavity with an air space *[see Figure 4-1.2(a) and Figure 4-1.2(b), Detail C]*, the following condition shall be met:

a. Temperatures in the air cavity shall not exceed 1000°F (538°C) as measured by Thermocouple Nos. 18 and 19.

b. Temperatures in the wall cavity insulation shall not exceed 750°F (417°C) above ambient as measured by Thermocouple Nos. 66 and 67.

3. For wall systems constructed of exterior wall panels that are 1/4 in. (6.4 mm) thick or less, have combustible components, and utilize a wall cavity without an air space *[see Figure 4-1.2(a) and Figure 4-1.2(b), Detail D]*, temperatures in the cavity insulation shall not exceed 750°F (417°C) above ambient as measured by Thermocouple Nos. 18 and 19.

8-1.5 Temperatures 1 in. (25 mm) from the interior surface of the test wall assembly within the second floor area shall not exceed 500°F (278°C) above their initial ambient temperature. This criterion is based on Thermocouple Nos. 49–54 *[see Figure 4-1.2(c)]*.

8-1.6 Flames shall not occur in the second floor room.

C/AS2 Paragraph 5.8.2 calls up the 1998 version of NFPA 285. However, the fire test conducted by Intertek was conducted to the 2006 version. There were significant editorial changes in the 2006 version. Technical changes addressed details about the test specimen, documentation of the fire test, and testing instrumentation. However, the performance criteria for passing the test appeared to be largely unchanged but with some subtle changes in wording.

For example, from NFPA 285 (2006 edition):

10.2 Performance Criteria.
Exterior nonloadbearing wall assemblies and panels used as components of curtain wall assemblies shall be considered as passing the fire test when the performance criteria specified in 10.2.1 through 10.2.5 are met during the conduct of the fire test.

This contrasts with the 1998 edition which said "An exterior non-load-bearing wall assembly shall be considered as meeting the requirements for acceptable performance if during the 30-minute test period 8-1.2 through 8-1.6 are met."

The submission from Auckland Council argued that, since the fire test had been conducted to the 2006 edition, thermocouple data from the entire 40-minute period of data collection be evaluated against the criteria and not only for the 30-minute period as stated in the 1998 edition. They noted that Thermocouple 11 exceeded the criteria of 1000°F at 31 minutes and therefore the assembly did not pass the test criteria.

In the Intertek fire test report, it was stated that the assembly met the requirements of the 30-minute test. It also stated flames on the exterior panels were within the established limit (10 ft above the top of the window opening); there were no flames that spread within the core components or infiltrated the second storey room and none of the thermocouples exceeded their maximum limits.

I also have examined clause 10.2 in the 2012 edition of NFPA 285 which was changed to read:

10.2 Performance Criteria.
The test specimen shall be considered as passing the fire test when the performance criteria specified in 10.2.1 to 10.2.6 are met during the 30-minute fire exposure specified in Chapter 8.

I therefore conclude that the failure to specify the 30-minute test period in the 2006 edition was probably unintentional since it existed in the 1998 edition and was reintroduced in the 2012 edition. I also noted that Intertek applied the 30-minute duration in evaluating the fire test data for the Trespa Meteon panel and in concluding that the specimen had met the requirements of the test standard.

I have no reason to dispute the conclusions made in the Intertek test report. I also conclude that the fire test conducted to the 2006 edition of NFPA 285 should be accepted as valid and if the test had been conducted to the 1998 edition the same result would have been expected.

4.3 Trespa System as Tested in NFPA 285

Details of the Trespa exterior wall cladding system are not reproduced here. They are described in the Origin Fire Consultants report and other associated documentation. However, for clarity we make a distinction between the Trespa Meteon exterior wall assembly and the base wall assembly. In the NFPA 285 fire test, the Trespa Meteon exterior wall assembly was installed over a framed base wall assembly.

4.3.1 Base Wall Assembly

The base wall assembly was described in the Intertek Test Report on the METEON-KRAFT FR 8mm Unicolor Panels installed using a TS110-285 System. The main elements of the base wall assembly in the fire test were:

- 20g steel studs 6" x 1-5/8" (150 x 41 mm)
- 5/8" (15.8 mm) Type X gypsum board both sides
- R-19 unfaced thermal insulation batts (the material was not stated but was most probably glass fibre) in the cavity between the steel studs
- 14g steel backing plate fitted horizontally between the steel framing and the Type X gypsum board on the exterior side of the assembly. This provided support for the fixing hat channels of the Trespa System with screws through the gypsum board.
- Mineral wool insulation (as firestopping) at each floor level.

It is noted these components provide little additional fuel should an exterior fire breach the outer layer of gypsum board and reach the framing and cavity insulation.

4.3.2 Trespa Meteon Exterior Wall Assembly

In the Trespa Meteon exterior wall assembly with the TS 110 exposed fastener system, Vaproshield Wallshield weather resistant barrier was installed over the outermost gypsum plasterboard of the base wall assembly. The 8 mm thick Meteon-Kraft FR panels were fixed to aluminium hat channels which in turn were fixed over the base wall assembly.

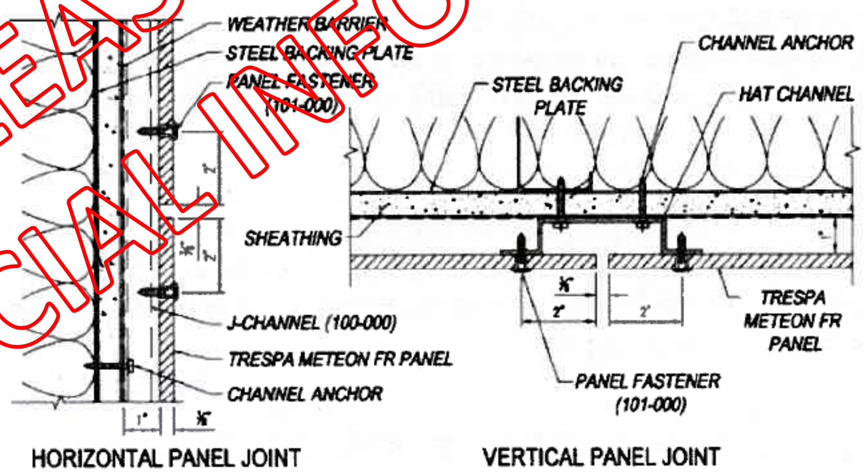

FIGURE 2 - TS110 EXPOSED FASTENER SYSTEM

Figure 2.6 from the ICC Evaluation Service report ESR-1687 showing the panel support method

Figure 2 TS110 exposed fastener system

4.4 Variations to a Tested System

It is accepted that variations to tested systems are commonly proposed for various reasons. Some standards are specific about what kinds of variations are acceptable, while others are silent.

For example, NZS 4520 Section 4.3.1 (2010) states "For fire-resistant doorsets, variations shall be permitted only if supported by a formal assessment that the fire-resistant doorset is capable of achieving the FRR despite the minor departure from the tested system, unless variation is permitted by AS1530.4".

NZS 4520 Section 4.3.2 goes on to give requirements for the preparation and presentation of formal assessments, including the statement that "*they be prepared by competent persons experienced in both testing and writing laboratory reports on fire-resistant doorsets, as appropriate, of similar construction to that proposed*".

AS 1530.4 (2005) includes the permissible variations from tested specimens that do not require reference to the testing authority in each section, to facilitate greater direct application of test data. For example, Section 10.11.2 d) says "*results obtained from framed wall systems may be applied to similar walls having studs of the same material with sizes greater than the tested prototype.*"

NFPA 285 does not make any explicit comment about what variations might be permitted or otherwise. I note that the NZBC permits expert testimony or opinions obtained from credible organisations to be used as evidence of compliance, at least for an alternative solution. It is also common practice for specifications of many fire-rated systems to be based on a combination of fire resistance test reports and assessments from test laboratories.

BRANZ operates an IANZ accredited fire testing laboratory providing AS1530.4 (and other) fire resistance testing services and has a long history of preparing assessments of variations made to fire rated constructions. While BRANZ does not conduct NFPA 285 fire tests and current staff do not have first-hand experience in conducting NFPA 285 fire tests, BRANZ does have experience in providing assessments for other types of fire test. When preparing assessments on variations to fire rated construction, the general approach taken by BRANZ is to consider each change for the effect that it might have on the overall performance of the assembly. In doing so, both scientific and engineering principles will be applied along with past experiences obtained from conducting and observing fire tests on similar constructions. As a rule, BRANZ tries to satisfy itself that any proposed variation(s) would perform at least as well or better than the tested component or method. The same philosophy might be applied to other types of fire test such as NFPA 285 when evaluating possible variations to the tested system.

4.5 Hughes Associates Report

A letter from Hughes Associates dated 14 February 2014 provided an analysis and extension of NFPA 285 fire tests that incorporated various exterior Trespa Meteon wall panels and certain fixing systems used to install these panels. The exterior wall configurations were a combination of Trespa Meteon wall panels, panel cladding system components supplied by Trespa and other base wall assembly components not part of panel cladding system.

The extension of NFPA 285 test results did not significantly change or introduce new combustible components to the assembly, and overall the changes were of a relatively minor nature and considered the use of different types of weather-resistive barriers. The author of the letter was Mr Jesse J. Beitel, who has extensive first-hand experience with the NFPA 285 fire test method and he is a long-standing member and past-chair of the NFPA 285 technical committee. I would consider Mr Beitel to be qualified to provide technical assessment on the potential effect of a variation to a specimen tested to NFPA 285.

4.6 Changes to Trespa System for use in New Zealand

The Origin Fire Consultants report summarises the changes made to the Trespa System as it is intended to be used in New Zealand. I have included only information relevant to the system intended to be installed at 12 Selwyn Road. The following table is an abridged extract of the table given in section 2.8.1 of the Origin Fire Consultants report.

Component	TS110-285 USA	TS50 NZ	Origin Fire Comments
Wall substrate	150mm wide steel studs at 400mm crs. Wall cavity filled with R-19 batts, with mineral wool at each floor level. 14 gauge steel backing plate horizontally at 400mm crs to provide nogging for the TS110 fixing points. Wall lined both sides with 16mm Type X plasterboard. All joints stopped to level 2 finish. Vaproshield wallshield weather resistant barrier was installed over the exterior of the plasterboard. Note Vaproshield wallshield is no longer manufactured. It has been	Timber or steel stud framed walls to NZS 3604 or specific engineering design. Studs typically 90mm x 45mm timber or 90mm x 45mm steel. Exterior cladding 6mm James Hardie RAB board. Stamisol FA wrap, Vaproshield Wrapshield SA or Vaproshield Revealshield SA. Internal lining 10mm standard plasterboard or thicker dependant on whether the wall requires a fire rating.	Wall framing should remain in place for the duration of the 30-minute test and not contribute to the fire growth. The New Zealand wall construction exterior lining is non-combustible so should be equivalent to plasterboard. The vapour barriers included the tested barrier are either polypropylene or polyester and all less than 1mm thick The Stamisol FA wrap is 0.35mm, the Wrapshield SA is 0.57mm thick and the

	superseded with wallshield IT which is 0.63mm thick.		Revealshield SA is 0.48mm thick. These should not contribute any more to fire spread than the original wrap.
Bracket system	Trespa's TS110 exposed fastener system (see Figure 2) for use with 5/16-inch, 3/8-inch and 1/2-inch (8 mm, 10 mm and 13 mm) panels utilizes two aluminum substructure components: a J-channel and a hat channel (see Figure 1). The J-channel has an overall width of 3 inches (76 mm) and a total depth of 1 inch (25 mm). The hat channel has an overall width of 53/4 inches (146 mm) and a total depth of 1 inch (25 mm).	T50VR and T50BR aluminium brackets	Similar concepts
Bracket material	The TS110 system bracket is manufactured from 6063 T5 aluminium.	Aluminium	Similar
Bracket spacing	300mm to 600mm centres in the test.	400mm to 600mm horizontally dependant on wind loading and 800mm vertically.	Similar
Bracket fixing to wall	The J-channels and hat channels are installed vertically and connected to the underlying structure of the building. The spacing of the channels and their attachment to the substrate must be in accordance with the project-specific structural calculations provided by the building designer. The substructure channel anchorage to attach the channels to the building must be of stainless steel. Vertical fixings at 610mm centres.	14g x 75mm timber tek screw. One per bracket. Bracket spacing listed above.	Similar

Panel fixing to bracket	Trespa Meteon FR wall panels must be secured to the TS110 substructure system using 1-inch-long (25 mm), Torx head, No. 12-11, stainless steel screws. Each wall panel, at the panel attachment point, must be predrilled maintaining a minimum fastener edge distance of 2 inches (50 mm).	4.8mm dia aluminium rivets with 16mm dia heads	Steel vs aluminium rivets. Rivets less robust in a fire as it has a lower melting point. Several panels fell off in the test suggesting that in fire the panel rather than the fixing is the weak link. The temperature in the cavity 3m above the window in the test peaked at 254°C so the panels beyond the fire area are unlikely to fall off.
No of fixings per sheet	584mm maximum spacing	If two fixings in one direction then maximum spacing 600mm. If three or more fixings in one direction then 750mm centres.	Larger spacing for NZ system.
Panel thickness	8mm	8mm	Same.

The Origin Fire Consultants report concluded:

"Provided the following guidelines are followed it is our opinion that the above three mentioned systems (TS45, T50 and TSEQ) using Trespa Meteon FR exterior cladding panels would pass the NFPA 285 test and therefore demonstrate compliance with the New Zealand Building Code Clauses C3.5 and C3.7.

1. If the cladding is fixed to a steel stud or timber framed wall, the exterior of the framing must be lined with a noncombustible cladding system such as fibre cement sheet to protect the framing from the effects of fire.

2. The fixing method of the support structure and the panels to the support structure must not deviate from the Trespa, Profix and Prime Design Technical literature listed in section 3.

3. Fixings at closer spacings are acceptable when required to meet structural requirements."

I have the following remarks to make:

Base Wall Assembly

The reference to 'non-combustible cladding material such as fibre cement' without further qualification is inadequate. In my opinion, it is necessary to provide a reasoned basis or evidence for why it is expected that the non-combustible material would remain in place during the period of fire exposure, and therefore prevent flames/gases penetrating into the cavity and spreading to combustible material such as timber framing and combustible insulation. As a general comment 15.8 mm thick gypsum plasterboard used in the NFPA 285 test would be expected to have better fire resistant properties than 6 mm fibre cement board.

Some fibre cement products are known to crack and fall away during fire exposure. On the other hand, some fibre cement products are used as part of a fire rated system, where a minimum board thickness and fixing type and spacing would also be expected to apply to achieve the performance claimed. Therefore, I would suggest that reference could to be made to fire resistance test data on a timber-frame and steel-frame wall assembly with fibre cement board exposed to the fire, and that it should be shown that the fibre cement board has remained in place for an adequate period and that temperatures reached inside the cavity would be low enough to prevent combustible framing or combustible insulation materials from igniting. This would mean that proprietary base wall assemblies should be identified using named products and installation details.

A perhaps less important remark is that due to organic fibre content in fibre cement board it might not pass the AS 1530.1 fire test and therefore might not be classified as a non-combustible material. However, usually the heat contribution is very low and therefore some building codes deemed fibre cement to be a non-combustible material, while others use a classification known as 'limited combustibility'.

In the context of the NFPA 285 fire test, it is very important that any variation should not result in additional fuel contributing to the external flaming. Allowing light timber frame construction protected by 6 mm fibre cement board to be used instead of steel frame protected by 15.8 mm thick gypsum plasterboard is questionable without far greater justification. There needs to be evidence provided that the board protecting the framing will stay in place during the period of exposure. Based on the information provided, the variation proposed to the base wall assembly could reasonably be expected to perform more poorly in comparison to the tested assembly.

Panel fixing to the bracket

Fixing Trespa Meteon FR wall panels to the substructure with aluminium rivets rather than steel screws would most probably cause more panels to fall, or panels to fall sooner than for the case where steel screws have been used. This change does not improve or maintain the performance of the system compared to that in the fire test. While it might not result in increased flaming above the windows opening, it is generally undesirable behaviour increasing the hazard of falling materials onto fire fighters or others located below. Depending on the combustibility of the panels, there is also the possibility of fire spread if the panels are flaming when they fall. It is however noted that the NZBC does not specifically address this type of failure mode of non-structural panels.

<u>Number of fixings per sheet</u>

I note that increasing the spacing of the fixings is not likely to improve the performance of the system compared to that in the fire test. It is not really known if the performance would be maintained or not.

<u>Mineral fibre insulation as firestopping</u>

There is no mention of the need for mineral fibre insulation as firestopping at each floor level in the conclusion in Origin Fire Consultants report. This should not be omitted from the specification unless justification is provided.

<u>Trespa Meteon FR panels</u>

I have assumed that the Trespa Meteon FR panels used in the Intertek fire test are identical in formulation to the panel proposed to be used in New Zealand and they are the fire-retardant grade as per the product datasheet provided.

4.7 Auckland Council Submission

I have the following comments to make on the FIRENZE report dated 16 September 2017 on behalf of Auckland Council.

Sections 1 – 4. No comment.

Section 5.

C/AS2 5.8.2 b) is the compliance option proposed by the applicant. i.e. exterior surface finish requirements in C/AS2 would be satisfied if: “The entire wall assembly has been tested at full scale in accordance with NFPA 285 and has passed the test criteria.”

Auckland Council submission argues the cladding system has not been tested to NFPA 285 because it varies from the tested specimen and therefore the design is an alternative solution. I do not accept this and believe that variations made to a tested system should be considered on their merits.

I agree that, if considered as an alternative solution, the NFPA 285 fire test does not provide sufficient data to demonstrate compliance with NZBC Clause C3.7. However, if considered as an acceptable solution, passing the NFPA 285 fire test along together with satisfying all other requirements in C/AS2 is sufficient to demonstrate compliance with NZBC Clause C.

The submission from Auckland Council also argues that the 10 ft (3.05 m) flame height limit in NFPA 285 does not satisfy the fire spread height of 3.5 m given in Clause C3.5 due to the elevation of the fire source. They argued that the fire source was the burner inside the lower room and the vertical distance should be measured from the position of the burner rather than from the top of the window opening.

The Building Code defines fire source as follows:

> *fire source means the combination of the ignition source and the item first ignited within a room, space, or firecell, which combination is considered to be the origin of the fire for the purposes of design.*

While I accept that it is valid for Auckland Council to offer their interpretation, it is by no means conclusive. As someone who was personally involved in advising on the quantification of Clause C3.5, I can say that it was intended in this case that the opening in the exterior wall be treated as the fire source and that the flame spread distance be measured from the top of the opening. This was so that existing full scale façade tests such as NFPA 285 could be directly used to demonstrate compliance with Clause C3.5.

Section 6

No comment.

Section 7

I have discussed the matters raised concerning the acceptance criteria and test duration in section 4.2.2 of this report.

Section 8

The fire test on the 10-mm thick panel was not provided to me and I have no comment to make.

Section 9

The 1998 edition of the standard is silent on whether variation by formal opinion is permitted. This is not the same as 'providing no scope' as stated in the Auckland Council submission.

Section 10

I have independently reviewed the Origin Fire Consultants Report as discussed in section 4.6 of this report and have no further comment to make here.

Section 11

No comment.

Section 12

As is the case for fire resistance testing, replicate tests are not required. However, when carrying out assessments on variations to tested assemblies, it is prudent to err on the side of caution.

Section 13

This is not relevant as the NFPA 285 is a means of compliance with C/AS2.

Section 14.

No comment.

Section 15.

Only the differences between the 1998 and 2006 editions of the standard are relevant to this determination.

5. CONCLUSION

The proposed cladding system for building at 12 Selwyn Road, Cockle Bay is substantively different from the tested system.

- The base wall assembly is to be timber frame with unspecified cavity insulation instead of steel frame with (mostly likely) glass fibre insulation as tested.
- 6 mm thick fibre cement sheet is to be used on the outside of the framing instead of 15.8 mm thick gypsum plasterboard. The latter would be expected to have much better fire-resistant properties than the former.
- The aluminium support structure for the Trespa panels differs from that tested.
- The panels are fixed to the support structure with aluminium rivets instead of steel screws as tested.
- The panel fixings may have larger spacings compared to that tested.
- The mineral fibre insulation firestopping at each level is possibly omitted but was present in the test assembly.

I do not think the information provided to me contained sufficient justification to be satisfied that the proposed cladding system would pass the NFPA 285 acceptance criteria and therefore comply with the NZBC. In my opinion, greater justification and more detailed specification of the components would be necessary.

There is an alternative pathway using C/AS2 paragraph 5.8.1 to achieve compliance i.e. fire test to ISO 5660.1. No information regarding this option was provided.

While it is still possible the proposed cladding system could pass the NFPA 285 acceptance criteria if it were subjected to the fire test, I could not be confident of that result based on the information provided to me.

6. ADDENDUM

This addendum contains material subsequent to the issue of Draft Determination 2976 dated 26 September 2017.

6.1 Documentation

The following additional documents were reviewed.

1. BRANZ Fire Assessment Report FAR4206 dated 14 March 2014.
2. BRANZ Fire Resistance Test Report FR2494 dated 12 March 1999.
3. MBIE Draft Determination 2976 dated 26 September 2017.
4. Letter from Firenze (for and on behalf of Auckland Council) to MBIE dated 27 September 2017.
5. Letter from Decortech to Maynard Marks dated 04 October 2017. 5 pages.
6. Letter from Origin Fire Consultants to Maynard Marks dated 10 October 2017. 15 pages.
7. Letter from Maynard Marks to MBIE dated 19 October 2017. 2 pages.
8. AWTA Test Report dated 22 July 2010 (BCA Group No. Classification). 2 pages.
9. Letter from Maynard Marks dated 25 October 2017 (ref LNZ-A-0844). 3 pages. With attachments 12 pages.

6.2 Base Wall Structure

The applicant now proposes to upgrade the base wall to a James Hardie JHETGR60a wall with an FRR 60/60/60 fire rating. This is an external wall assembly with a fire rating achieved from both sides separately constructed as shown in Figure 3. The timber cavity battens and outer cladding are to be replaced with the aluminium framework supporting the Trespa FR panels. Additionally, it is proposed to install a layer of 13 mm thick Fyreline gypsum plasterboard between the RAB and the timber framing on the exterior side. The applicant also proposes to replace the previously proposed aluminium rivet fixings with 5.0mm stainless steel blind rivets with a 16mm head and 304 stainless steel mandrel with fixing centres as per the NFPA 285 tested system.

The cavity insulation in the NFPA 285 test specimen is now stated to be a mineral wool (non-combustible) as confirmed by Christine Tromp from Trespa. This was not explicitly stated in the NFPA 285 test report. I had previously assumed it was a glass fibre blanket.

The BRANZ fire test report FR2494 from which the JHETGR60a specification was derived provided observations about the behaviour of a 6.0 mm thick Villaboard and a 7.5 mm thick Harditex board fixed to a timber frame and directly exposed to the furnace gases in a fire resistance test. It stated that at 10.5 minutes there was a 3 mm crack in the Villaboard and at 20 minutes, the Harditex had a 5 mm wide crack with flaming coming from the timber stud behind. These observations are made from a viewing port into the furnace so that the face exposed to the furnace gases can be seen. I would expect the proposed 6.0 mm thick RAB proposed to be used in the wall at 12 Selwyn Road would perform no better than either of these boards.

Fire resistance ratings are determined based on limiting the temperature and spread of flames/gases reaching the unexposed side of the wall. Consideration of conditions within the cavity and the possible involvement of combustible materials in the cavity is not part of the required performance criteria in a standard fire resistance test. However, observations in the fire resistance test indicated that neither 6.0 mm thick Villaboard nor 7.5 mm thick Harditex board are sufficiently thick/robust to prevent flame entry into the wall cavity. I would surmise that 6.0 mm thick RAB board would also not be sufficient. To address this concern, the applicant proposes to add a layer of 13 mm thick Fyreline gypsum plasterboard between the RAB and the timber framing.

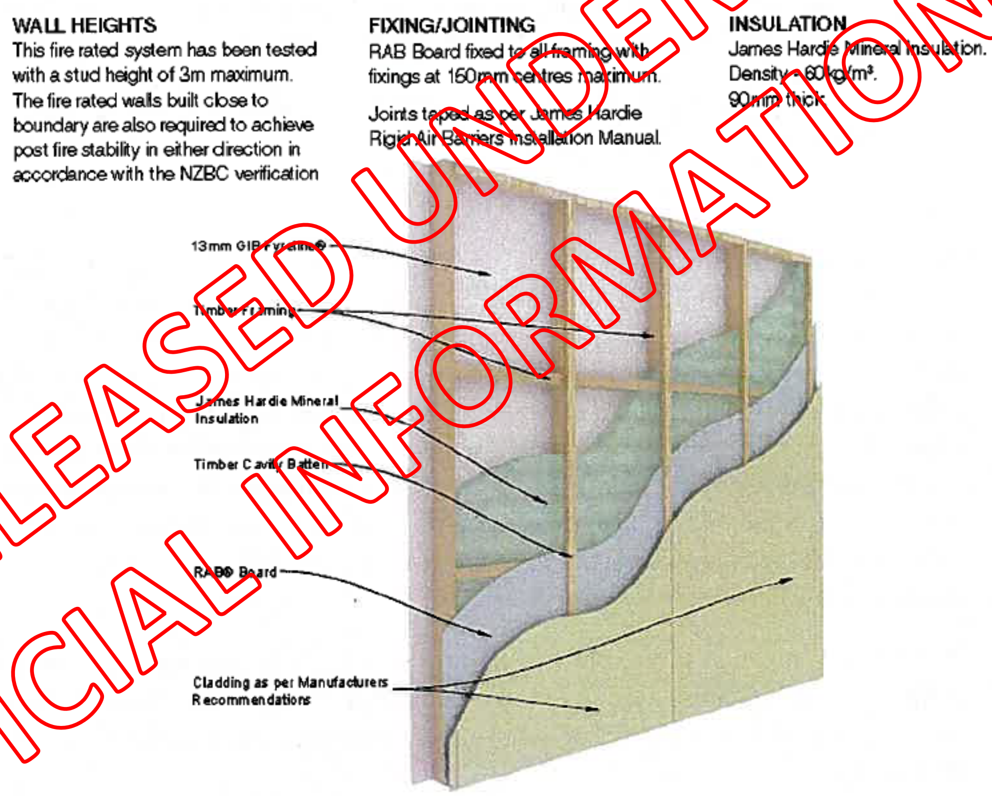

Figure 3 Extract from James Hardie Specification JHETGR60a

6.3 12 Selwyn Road - Conclusion

I have reviewed the proposed exterior wall assembly as described in the Maynard Marks letter of 25 October 2017 which now includes installing a layer of 13 mm Fyreline gypsum plasterboard between the timber framing and RAB of the base wall assembly. The applicant also agrees to use 5.0 mm stainless steel blind rivets with a 16mm head and 304 stainless steel mandrel with fixing centres as per the NFPA 285 tested system.

With these changes, I am satisfied that the exterior wall system now proposed for installation at 12 Selwyn Road, Auckland would most likely pass the NFPA 285 fire test.

6.4 Application of C/AS2 Paragraph 5.8.1

In their letter of 10 October 2017, the applicant has asked for advice "on whether a cladding system meets the external fire spread requirements of the Acceptable Solutions based on successful testing of only the outer cladding to Clause 5.8.1, whether or not the cladding system incorporates combustible components or component configurations that may affect vertical fire spread."

Paragraph 5.8.1 has been commonly interpreted by industry to apply to the outer cladding material and any supporting substrate material to a depth of up to 50 mm. This is because the ISO 5660 is a bench-scale test and is only able to accommodate small samples of cladding 100 mm square and up to 50 mm thick. It is therefore obvious that the performance of joints and fixings (and the performance of any substructure supporting the outer cladding) is not and cannot be evaluated using this method. The exterior surface finish requirements have been in effect been treated in a similar fashion to interior finish requirements where only the effect of fire exposure to the surface lining (or cladding) was considered. This also means that combustible materials (such as timber framing, battens and insulation boards or blankets) located within the wall cavity between the interior lining and the exterior cladding materials have not been required to meet the minimum fire property requirement as given in C/AS2 (other than some specific requirements where foamed plastics are used).

The use of a bench-scale fire test such as ISO 5660 to evaluate risk of vertical fire spread has significant limitations especially if the substructure supporting the cladding contains combustible materials. For materials that do not meet the requirements, the option of a full-scale test of the external wall system such as NFPA 285 is provided. Clearly this type of larger scale fire test of the entire external wall system provides a much more comprehensive evaluation of the risk of vertical fire spread compared to ISO 5660, however it is many times more expensive to carry out (tens of thousands of dollars) compared to around $2000 for the ISO 5660 test. The NFPA 285 or similar large-scale fire test facilities are also not available within New Zealand at this time.

Over recent months and particularly in light of the Grenfell Tower fire in London, the potential hazards associated with combustible external wall construction has been highlighted with devastating effect. It is also apparent that combustible materials within the wall cavity as well as, or in combination with, a combustible outermost cladding material can greatly influence external vertical fire spread. This raises the question of whether past practice of only considering fire properties of the innermost lining and outmost cladding materials needs to be reconsidered – at least for higher risk buildings.

In my opinion, it is necessary to match the building fire risk with the level and cost of fire compliance testing to be required by the compliance documents. It might be considered that for lower risk applications the ISO 5660 test is suitable, however for higher risk applications NFPA 285 or similar would be more appropriate or the paragraph 5.8.1 criteria could be extended to apply to other (some or all) combustible materials within the cavity. These are not straight forward technical decisions. Guidance from the regulator is needed based on considerations of the relative costs and benefits.

Regarding the building at 12 Selwyn Road, the applicant has provided fire test data which indicates that the Trespa FR Panel narrowly fails to meet the paragraph 5.8.1 criteria based on the total amount of heat released per unit area over a 15 minute period from the start of the test. It is also noted that only one test result was provided. The ISO 5660 test procedure requires a minimum of three samples be subjected to the test procedure.