

Fire performance of Trimesh and Vermitex TH wall and ceiling membrane systems

Assessment Report

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Commercial-in-confidence

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1 Introduction

This is a report of the fire performance of Trimesh and Vermitex TH wall and/or ceiling composite membrane systems when employed as a horizontal/vertical membrane barrier subjected to:

- a) ISO 834 /AS 1530 /BS 476.20 /ASTM E119 Cellulosic fire; and
- b) BS 476-20 (Appendix D) /UL 1709 /ASTM E1529 /RABT (train and vehicle) /RWS & HC modified rapid rise/Hydrocarbon fires.

This report is prepared for the purpose of meeting the evidence of suitability requirements of NCC Volume 1 Schedule 5 Clause 2 (c) for FRL.

This report reviews and confirms the extent to which the reference fire resistance tests listed in section 2 meet the requirements of the standard fire test standards listed in section 4 of the report. The proposed variations to the tested construction presented in section 3 are subject to an analysis in Appendix B and the conclusions are presented in Section 5 of this report.

The field of applicability of the results of this assessment report is presented in Section 6 and is subject to the requirements, validity and limitations of Sections 7, 8 and 9.

2 Supporting Data

This assessment report refers to various test reports to support the analysis and conclusions of this report. They are listed below;

| Test/Report Reference | Test Standard | Outline of Test Specimen |
|-----------------------|--|---|
| FS 3049/1696 | General Accordance with AS1530.4-1990 | Variation of sprayed construction panels. |
| SI 1589 | AS 1530.4-1975 | Fire-resistance test on a roof-ceiling construction comprising a conventional metal deck roof with a ceiling system suspended beneath it. |
| FSP 0836 | AS 1530.4-1997 & BS 476, Part 20, Appendix | Slab and wall elements protected by Vermitex sprayed insulation. |
| FSP 0837 | AS 1530.4-1997 & BS 476, Part 20, Appendix | Slab and wall elements protected by Vermitex sprayed insulation. |
| FSH 0981 | BS 476 Parts 20 & 21 – 1987, Appendix D. Hydrocarbon curve | Three loadbearing beam sections, three reinforced concrete panels and one partially exposed timber joist sample. |
| FSP 1070 | ISO 834-1:1999 AS/NZS 3013:1995 | Vermitex “TH” surface adhered cementitious compound used to fire protect various construction elements. |
| FSP 1071 | BS 476: Part 20- 1987 | An 1150-mm x 1150-mm x 150-mm thick concrete slab protected by Vermitex “TH” cementitious compound. |
| FSV 1198 | ASTM E119 – 2005 | Trimesh and Vermitex TH spray applied wall panel system. |
| FSZ 1206 | ASTM E119 – 2005 | Trimesh and Vermitex TH spray applied wall system. |

| Test/Report Reference | Test Standard | Outline of Test Specimen |
|-------------------------|---|--|
| FSV 1208 | BS 476: 1987 Part 20 and Part 22 | Trimesh and Vermitex TH spray applied wall system. |
| FSP 1305 | AS 1530 Part 4-2005 BS 476: Part 20: 1987 EN 1363-1:1999 RABT (train) time/temperature curve | An 1150-mm x 1150-mm x 150-mm thick reinforced concrete slab protected by Vermitex 'TH' cementitious compound on the exposed face. |
| FSH 1345 | Heating conditions UL 1709 – 2005 Heating conditions (upper limit) specified in Section 4 of ASTM E1529-06 Instrumentation of beam sections in accordance with Clause 16.2.4 of ASTM E1529-06 Instrumentation in accordance with ASTM E119-08a | Four loaded structural beam sections and a ceiling system, all protected with Vermitex TH, spray applied, cementitious compound insulation material. |
| FSV 1374 | ASTM E119-2008a Heating curve specified in TNO Report 1998-R116-rev 1 (RWS curve) | Trimesh and Vermitex TH sprayed wall system. |
| FSV 1375 | EN 1363-1:1999 EN 1363-2:1999 EN 1366-3:2009 EN 1366-4:1999 Heating curve specified in TNO Report 1998-R116-rev 1 (RWS curve) | Trimesh and Vermitex TH spray applied ceiling systems incorporating penetrations and a control joint. |
| FSZ 1406 | ASTM E119-2008a Heating curve specified in TNO Report 1998-R116-rev 1 (RWS curve) ASTM E2226 – 2002 | Trimesh and Vermitex TH sprayed wall system |
| FSH 1420 | Heating conditions specified in "Specification and Guidelines for Testing of Passive Fire Protection for Concrete Tunnel Linings", Appendix A Modified Hydrocarbon Curve (HCinc). General conditions of AS 1530.4 - 2005 | Three hollow-core precast concrete slabs were sprayed with different thicknesses of Vermitex TH. |
| FSH 1468 | Heating conditions specified in "Specification and Guidelines for Testing of Passive Fire Protection for Concrete Tunnel Linings", Appendix A Modified Hydrocarbon Curve (HCinc). | Two hollow core concrete slabs are protected on the underside with Vermitex TH, spray applied, and cementitious compound insulation material. |
| DOC- HCM/JUNE 2010/TEST | Eurocode 1 & 2 and EN 1363-1 & 2 | Post-test analysis numbered DOC-HCM/JUNE 2010/TEST on a fire-resistance test to the HC inc (MOD) fire curve and reported in FSH 1420. |

The test reports listed above were undertaken by CSIRO and sponsored by L & A Fazzini Manufacturing.

3 Proposed Variations

The proposed construction shall be horizontal ceiling membranes and vertical wall membranes using the spray material Vermitex TH as tested in FSH 1345 and subject to the following variations

Horizontal ceiling membranes exposed to fire from below or from above

- At rod support points either
 - 100mm x 100mm x 5mm square washer/plate shall be at suspension points to provide support to the ceiling as shown in Figure 1 or
 - 300mm x 300mm SL81 mesh connected with nuts and washers and embedded mid-depth of spray.
- Where the ceiling system is exposed to fire from below, the rods and connections supporting the ceiling to the structure above shall be designed to support the weight of the ceiling at ambient temperature.
- Where the ceiling is exposed to the effects of fire from above,
 - the rods and connections supporting the ceiling to the structure above shall be designed to support the weight of the ceiling as unprotected steel, and
 - Whatever structure supports the ceiling shall have a fire resistance at least that required of the ceiling.
- Example installation details are shown in Figure 1

Wall membranes exposed to fire from either side

- Fix the Trimesh to the surrounding construction with a track before the spray application

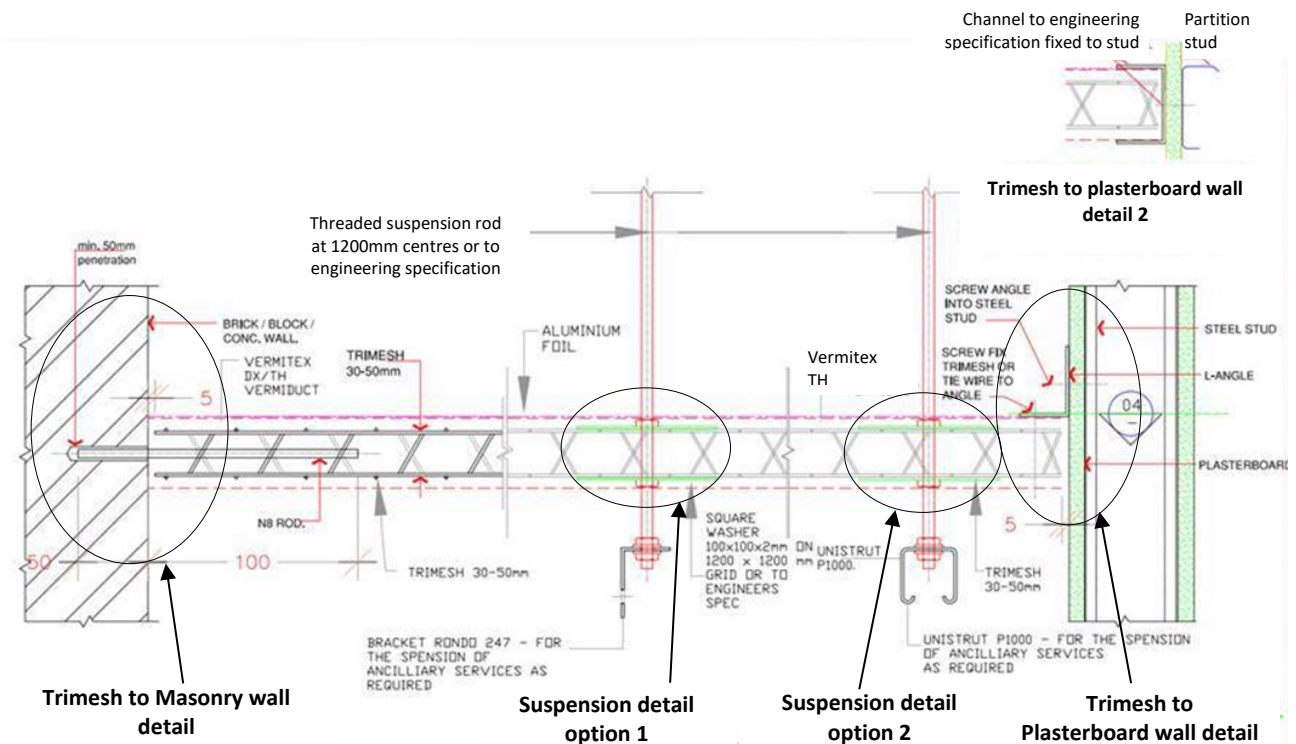


Figure 1: Vermitex TH & Trimesh ceiling installation detail

Reference can be made to FCO-3087 for the performance of service penetrations in various barriers including Trimesh and TH.

4 Referenced Standards

ISO 834-1999

AS 1530.4-2014

BS 476, Part 20 and 22

ASTM E119-2005

EN 1363:1 -1999

EN 1363:2 -1999

BS 476 Parts 20 & 21 – 1987, Appendix D. Hydrocarbon curve

UL 1709-2005

ASTM E1529-06

Rapid Rise /Hydrocarbon Fires to RWS, RABT (Train & Vehicles) and HC French Modified

ASTM E-2226-2006

5 Conclusion

Based on the observed performance of the Vermitex TH sprayed protection systems including horizontal ceilings and wall membranes during standard fire tests and to various fire curves including European, American and International codes, it is the opinion of this Accredited Testing Laboratory that you could use the combination of the Trimesh and Vermitex TH to construct walls, ceilings and air plenums for the conveying of fresh air or smoke spill systems as listed in Tables 1 to 4.

Based on the test evidence and performance from the fire-resistance tests conducted at this facility, it is the opinion of this Accredited Testing Laboratory that the Vermitex TH sprayed cementitious coating when sprayed in approved thicknesses in conjunction with Trimesh panels will:

- a) remain stable, and your proprietary termination details combined with the adhesion to the abutting non-combustible surface, negate the passage of hot products of combustions as well as prevent the leakage of fresh air during non-fire conditions;
- b) ensure the temperature on the cold face of the plenum does not exceed 180°C for specific periods of time during fire events according to the thickness of the composite system;
- c) Successfully pass the Hose Stream Test to ASTM E-2226 when sprayed with a minimum thickness of 70 mm of Vermitex TH.

Reference can be made to FCO-3087 for the performance of service penetrations in various barriers including Trimesh and TH.

Table 1 – Performance in accordance with ISO 834, AS 1530.4, BS 476 Part 20 & Part 22 and ASTM E119

| TRIMESH & VERMITEX TH SYSTEM THICKNESS FOR VERTICAL AND HORIZONTAL SEPARATIONS | | | | |
|--|---|-----------|-----------|-----------|
| Form of construction | Fire Resistance in minutes for Integrity / Insulation | | | |
| | -/60/60 | -/120/120 | -/180/180 | -/240/240 |
| Ceiling unlimited size or wall of height 3000 mm | 45 | 55 | 65 | 75 |
| Ceiling unlimited size or wall of height 5000 mm | 50 | 60 | 70 | 80 |
| Ceiling unlimited size or wall of height 7000 mm | 55 | 65 | 75 | 85 |

Table 3 – RISF (time to reach 250°C) Performance for ISO 834, AS 1530.4, BS 476 Part 20 & Part 22 and ASTM E119 exposure

| TRIMESH & VERMITEX TH SYSTEM THICKNESS FOR VERTICAL AND HORIZONTAL SEPARATIONS | |
|--|---------------------------------|
| Ceiling barrier thickness | RISF (time to reach 250°C) mins |
| 45 | > 60 minutes |
| 50 | > 120 minutes |
| 55 | Not reached at 240 |
| 60 | Not reached at 240 |
| 65 | Not reached at 240 |
| 70 | Not reached at 240 |
| 75 | Not reached at 240 |
| 80 | Not reached at 240 |
| 85 | Not reached at 240 |

Table 4 - Performance in accordance with Hydrocarbon Fires to EN 1363:1 & 2, BS 476-20 App. D, UL 1709, ASTM E1529

| TRIMESH & VERMITEX TH SYSTEM THICKNESS FOR VERTICAL AND HORIZONTAL SEPARATIONS | | | | |
|--|---|-----------|-----------|-----------|
| Form of construction | Fire Resistance in minutes for Integrity / Insulation | | | |
| | -/60/60 | -/120/120 | -/180/180 | -/240/240 |
| Ceiling unlimited size or wall of height 3000 mm | 48 | 58 | 68 | 78 |
| Ceiling unlimited size or wall of height 5000 mm | 53 | 63 | 73 | 83 |
| Ceiling unlimited size or wall of height 7000 mm | 58 | 68 | 78 | 88 |

Table 5 – Performance in accordance with RWS, RABT (Train & Vehicles) and HC French Modified

| TRIMESH AND VERMITEX TH SYSTEM THICKNESS FOR VERTICAL AND HORIZONTAL SEPARATIONS | | | | |
|--|---|-----------|-----------|-----------|
| Form of construction | Fire Resistance in minutes for Integrity / Insulation | | | |
| | -/60/60 | -/120/120 | -/180/180 | -/240/240 |
| Ceiling unlimited size or wall of height 3000 mm | 51 | 61 | 71 | 81 |
| Ceiling unlimited size or wall of height 5000 mm | 56 | 66 | 76 | 86 |
| Ceiling unlimited size or wall of height 7000 mm | 61 | 71 | 81 | 91 |

6 Direct Field of Application of Results

The results of this report are applicable to vertical wall membranes exposed to fire from either side or horizontal ceiling membranes exposed to fire from above or below.

7 Requirements

It is required that the supporting construction be tested or assessed to achieve the required FRL up to the required FRL based on the assessed design in accordance with the referenced standard as appropriate for the design.

Horizontal ceiling membranes are exposed to fire from below, it is required the rods and connections supporting the ceiling to the structure above shall be designed to support the weight of the ceiling at ambient temperature.

Horizontal ceiling membranes exposed to fire from above, it is required the rods and connections supporting the ceiling to the structure above shall be designed to support the weight of the ceiling at a temperature appropriate for full fire exposure at the required FRL period. The floor-ceiling/roof-ceiling above the ceiling is also required to be tested or assessed to achieve the required FRL.

Any variations with respect to size, constructional details, loads, stresses, edge or end conditions that are other than those identified in this report, may invalidate the conclusions drawn in this report.

8 Term of Validity

This assessment report will lapse on 30 June 2027. Should you wish us to re-examine this report with a view to the possible extension of its term of validity, would you please apply to us three to four months before the date of expiry. This Division reserves the right at any time to amend or withdraw this assessment in the light of new knowledge.

9 Limitations

The conclusions of this assessment report may be used to directly assess the fire resistance performance under such conditions, but it should be recognised that a single test method will not provide a full assessment of the fire hazard under all fire conditions.

Because of the nature of fire resistance testing, and the consequent difficulty in quantifying the uncertainty of measurement, it is not possible to provide a stated degree of accuracy. The inherent variability in test procedures, materials and methods of construction, and installation may lead to variations in performance between elements of similar construction.

This assessment report does not provide an endorsement by CSIRO of the actual products supplied to industry. The referenced assessment can therefore only relate only to the actual prototype test specimens, testing conditions and methodology described in the supporting data, and does not imply any performance abilities of constructions of subsequent manufacture.

This assessment is based on information and experience available at the time of preparation. The published procedures for the conduct of tests and the assessment of test results are the subject of constant review and improvement and it is recommended that this report be reviewed on or, before, the stated expiry date.

The information contained in this assessment report shall not be used for the assessment of variations other than those stated in the conclusions above. The assessment is valid provided no modifications are made to the systems detailed in this report. All details of construction should be consistent with the requirements stated in the relevant test reports and all referenced documents.

Appendix A Supporting Test Data

CSIRO test numbered FS 3049/1696

On 30 July 1998, an indicative fire test was conducted on Vermiduct and Rein Panel in general accordance with AS 1530.4-1990. The specimen comprised a five (5) sided cube protected with Vermiduct, Vermiduct WP and Vermitex 7WP sprayed insulation. The cube had a 1050 x 1050 mm clear opening on the underside.

CSIRO test report numbered SI 1589

On 14 July 1982, this Division conducted a fire resistance test on a 4600 mm x 3700 mm low-slope metal-deck roof comprising steel purlins and bracing and steel roof sheeting. The underside of the roof sheeting was insulated with fibreglass insulation supported on a steel wire mesh. A ceiling system was suspended beneath the roof on steel hanger rods. The ceiling membrane comprised a 60-mm thick 'Vermitex 7' a Vermiculite based product. The spray was applied in two layers. The first layer onto expanded steel lath fixed to a grid of steel channels. A galvanised steel mesh was fixed beneath the first layer and the second layer was sprayed over it. Some sections of the lower layer of the spray were lost within the first 15 minutes. The roof/ceiling structure did not fail at the test termination time of 242 minutes.

CSIRO test report numbered FSP 0836

The specimen comprised an 1150-mm x 1150-mm x 125-mm thick concrete slab supported on all four sides by a 500-mm high steel frame. The specimen was protected by Vermitex TH sprayed insulation. The test was conducted on 19 December 2000 in accordance with AS 1530.4-1997 and British Standard 476, Part 20, Appendix D.

CSIRO test report numbered FSP 0837

The specimen comprised an 1150-mm x 1150-mm x 125-mm thick concrete slab supported on all four sides by a 500-mm high steel frame. The specimen was protected by Vermitex TH sprayed insulation. The test was conducted on 22 December 2000 in accordance with AS 1530.4-1997 and British Standard 476, Part 20, Appendix D.

CSIRO test report numbered FSP 0981

The sponsor identified the specimen as three loadbearing beam sections, three reinforced concrete panels and one partially exposed timber joist sample. The specimen was protected by Vermitex TH and AF sprayed insulation. The test was conducted on 28 June 2003 in accordance with BS 476, Parts 20 & 21, Appendix D, Hydrocarbon curve.

CSIRO test report numbered FSP 1070

The sponsor identified the specimen as a Vermitex TH surface adhered cementitious compound used to fire protect various construction elements. Test 1, comprising a concrete slab, steel beam, metal cable tray and electrical cables, CFRP strip and Trimesh perimeter walls was conducted on 30 June 2004 in accordance with ISO 834-1:1999– Part 1, 6.1.1 Heating Curve and AS/NZS 3013:1995, Appendix A. Test 2 comprising a concrete slab, steel beam, metal cable tray and electrical cables, CFRP strip and Trimesh perimeter walls was conducted on 2 July 2004 in accordance with AS/NZS 3013:1995, Appendix A.

CSIRO test report numbered FSP 1071

The fire tests were conducted on 9 July 2004 (Test1) and 14 July 2004 (Test 2) under the guidelines specified in British Standard 476: Part 20: 1987, Fire tests on building materials and structures, Part 20, Appendix D, Method for determination of fire resistance of elements of construction (general principles)

The specimens comprised an 1150-mm x 1150-mm x 150-mm thick concrete slab protected by Vermitex “TH” cementitious compound. The Vermitex “TH” spray material was applied to the exposed face of the concrete slabs in successive coats until the final levelled target thickness was achieved. A single layer of texture was then applied to the specimen surface.

Spray Application

| Test Number: | TARGET THICKNESS (mm) |
|--------------|-----------------------|
| Test 1: | 25 |
| Test 2: | 10 |

Vermitex ‘TH’ had a dry density of 400 kg/m³ (± 10 %).

Test 1: The test specimen did not qualify for Fire Resistance due to the reduced size of the test specimen. The specimen fulfilled the Integrity and Insulation criteria of BS476: Part 20 for the duration of the test period.

Test 2: The test specimen did not qualify for Fire Resistance due to the reduced size of the test specimen. The specimen fulfilled the Integrity and Insulation criteria of BS476: Part 20 for the duration of the test period

CSIRO test report numbered FSV 1198

The specimen comprised Trimesh wall panels sprayed with Vermitex TH cementitious compound to form a non-loadbearing partition with overall nominal dimensions of 3020-mm high x 3000-mm wide x 70-mm thick in accordance with ASTM E119 – 2005, Standard Test Methods for Fire Tests of Building Construction and Materials on 15 June 2006.

Performance observed in respect of the following ASTM E119 - 2005 criteria for fire-resistance:

| | |
|----------------------|---------------------------|
| Structural stability | Not applicable |
| Integrity | No failure at 241 minutes |
| Insulation | No failure at 241 minutes |

Therefore the specimen provides an ASTM E119 classification period for fire resistance of 4 hours. The fire-resistance classification is applicable for fire exposure from the direction tested.

CSIRO test report numbered FSZ 1206

The specimen comprised Trimesh wall panels sprayed with Vermitex TH cementitious compound to form a non-loadbearing partition with overall nominal dimensions of 3020-mm high x 3020-mm wide x 70-mm thick. Specimen construction comprised a steel perimeter track section (Rondo Part No. 661C) bolted to the top, bottom and one vertical side of the specimen containing frame using M12 bolts at 600-mm centres. The steel perimeter track used on the remaining vertical edge of the specimen was fixed to the top and bottom track only. A 50-mm wide x 10-mm thick strip of Insufoam was inserted within the steel bottom perimeter track section. Hilti CP611A fire rated mastic was used to provide a seal between the steel perimeter frame and the specimen containing frame. The top perimeter track incorporated five vertical M12 threaded rods located at nominally 600-mm centres extending to nominally 300-mm above the bottom perimeter track. The wall panel system incorporated Trimesh R100 wall panels measuring 1200-mm wide x 2200-mm long x 30-mm thick. These Trimesh panels incorporated a layer of aluminium foil fixed to one face of the panel using speed clips at 300-mm and 400-mm centres. The Trimesh R100 wall panels were installed inside the steel perimeter frame and incorporated the vertical M12 threaded rods located within the panels. The M12 threaded rods were wire tied to the Trimesh panels on the side opposite to the aluminium foil backing. All butt joints between the Trimesh panels of the partition system were reinforced using 300-mm wide RG1 lapping strip installed centrally over the joint and wire tied to the Trimesh panels using 1.25-mm diameter tie wire at 300-mm centres. The Vermitex TH cementitious based spray compound was spray applied directly to the foil backing of the Trimesh R100 wall panels. Construction is detailed in drawings numbered 01 and 02 by L & A Fazzini Manufacturing Pty Ltd.

Performance observed in respect of the following ASTM E119 - 2005 criteria for fire-resistance:

Integrity – no failure at 241 minutes

Insulation – no failure at 241minutes

The element of construction described above also satisfied the ASTM –E119, Section 11 Hose Stream Test criteria for a duration of 5 minutes.

The element of construction described above satisfied the Conditions of Acceptance of ASTM –E119, for a 4-hours fire rated non-loadbearing wall system. The fire endurance test was conducted on 15 June 2006 and the hose stream test was conducted on 3 July 2006.

CSIRO test report numbered FSV 1208

The specimen comprised Trimesh wall panels sprayed with Vermitex TH cementitious compound to form a non-loadbearing partition with overall nominal dimensions of 3020-mm high x 3000-mm wide x 70-mm thick. The testing was conducted under the guidelines specified in:

British Standard 476: 1987, Fire tests on building materials and structures; Part 20, Method for determination of the fire resistance of elements of construction (general principles); and Part 22, Methods for determination of the fire resistance of non-loadbearing elements of construction.

The fire-resistance test was conducted on 15 June 2006.

CSIRO test report numbered FSP 1305

The specimen comprised an 1150-mm x 1150-mm x 150-mm thick reinforced concrete slab protected by Vermitex 'TH' cementitious compound on the exposed face. The testing was conducted under the guidelines specified in:

Australian Standard 1530, Methods for fire tests on building materials, components and structures, Part 4-2005, Fire-resistance tests of elements of building construction.

British Standard 476: Part 20: 1987, Fire tests on building materials and structures, Part 20, Appendix D, Method for determination of fire resistance of elements of construction (general principles).

European Standard EN 1363-1:1999, Fire Resistance Tests – Part 1: General requirements.

The testing was conducted following the heating conditions specified by the RABT (train) time/temperature curve.

The fire-resistance test was conducted on 29 November 2007.

CSIRO test report numbered FSH 1345

The specimen tested on the 20th of April 2009 comprised of a Trimesh ceiling that spanned 3020-mm x 6020-mm constructed using Trimesh R200 panels. The panel thickness was 50 mm and incorporated a layer of aluminium foil fixed on the external face. The foil was secured with 5mm speed clips at 300 and 400-mm centres.

One coat of Vermitex TH was sprayed to a thickness of 30-35 mm over the Trimesh plane and allowed to dry. The final thickness was then built up with Vermitex TH to provide an overall cover of 60 mm. The ceiling system was instrumented in accordance with ASTM E119-08a, Standard Test Methods for Fire Tests of Building Construction and Materials. The ceiling was exposed to the heating conditions specified in Figure 3.1 of UL 1709 – 2005, Rapid Rise Fire Tests of Protection Materials for Structural Steel, for the first half of the fire endurance test, and as specified in Section 4 of ASTM E1529-06, Standard Test Methods for Determining Effects of Large Hydrocarbon Pool Fire on Structural Members and Assemblies, for the second half of the fire endurance test.

The specimen satisfied the integrity and insulation criteria as specified in ASTM E119 – 2008a criteria for fire endurance for the 241 minute duration of the test.

CSIRO test report numbered FSV 1374

The specimen comprised Trimesh wall panels sprayed with Vermitex TH cementitious compound to form a non-loadbearing wall with overall nominal dimensions of 3020-mm high x 3000-mm wide x 90-mm (average) thick.

Specimen construction comprised a steel perimeter track section bolted to the top, and bottom and one vertical side of the specimen containing a frame using M12 bolts at 600-mm centres. The steel perimeter track used on the remaining vertical edge of the specimen was fixed to the top and bottom track only. A 75-mm wide x 10-mm thick strip of Insufoam was inserted within the steel bottom perimeter track section. Hilti CP611A fire rated mastic was used to provide a seal between the steel perimeter frame and the specimen containing frame on two vertical sides and the bottom. The top perimeter track incorporated five vertical M12 threaded rods 1800-mm long located at nominally 600-mm centres extending to nominally 300-mm above the bottom perimeter track. The wall panel system incorporated Trimesh R200 wall panels measuring 1200-mm wide x 2280-mm long x 50-mm thick. These Trimesh panels incorporated a layer of aluminium foil fixed to one face of the panel using speed clips at 300-mm and 400-mm centres. The Trimesh R200 wall panels were installed inside the steel perimeter frame and incorporated the vertical M12 threaded rods located within the panels. The M12 threaded rods were wire tied to the Trimesh panels on the side opposite to the aluminium foil backing. All butt joints between the Trimesh panels of the wall system were reinforced using 300-mm wide RG1 lapping strip installed centrally over the joint and wire tied to the Trimesh panels using 1.25-mm diameter tie wire at 300-mm centres. The Vermitex TH cementitious based spray compound was spray applied directly to the foil backing of the Trimesh R200 wall panels.

The fire endurance test was conducted on 13 October 2009 in accordance with ASTM E119-2008a, Standard Test Methods for Fire Tests of Building Construction and Materials. Heating curve specified in TNO Report 1998-R116-rev 1 (RWS curve).

The element of construction described above satisfied the following criteria for fire endurance for the period stated when subjected to the RWS heating curve.

| | |
|----------------------|---------------------------|
| Loadbearing capacity | not applicable |
| Integrity | 93 minutes |
| Insulation | No failure at 120 minutes |

CSIRO test report numbered FSV 1375

The specimen comprised two horizontal panels ceiling with overall dimensions of 1800 mm long x 600-mm wide built from Trimesh R100 panel. Each panel was nominally 65 mm thick to include the 6 mm “Vitrapanel” CFC panel bolted to the bottom face. The panels were supported by a 50-mm x 25-mm x 2.5-mm RHS steel frame to the panel perimeter. The two panels were installed leaving a 30-mm gap. The gap, as well as the space between the two RHS sections (approximately 75 mm wide) running along the longitudinal joint of the two adjoining panels, was later filled to a depth of 80 mm with Vermitex THc. The panel was terminated 75 mm away from the central spandrel panel. A 100-mm x 100-mm x 1.0-mm angle was fixed into the lightweight concrete spandrel panel and lightweight AAC blocks at 600-mm centres. The angle was then backfilled from the top with “Vermitex THc” and finished with a 90-mm coving onto the wall. A number of services were then cut into the LAF composite panel with a hole-saw and these included;

- a) 65 mm galvanised malleable iron pipe,
- b) 38 mm galvanised malleable iron pipe;
- c) CCTV camera enclosure, and
- d) 8-mm, 12-mm and 16-mm galvanised threaded rods.

A mesh cage was placed around all penetrations and “Vermitex TH” mixture was used to seal the entire depth of the penetration whilst Hilti 611 A was used to provide a 10-mm deep smoke seal around the penetration through the CFC board.

The camera enclosure had internal clearances of 250-mm by 300-mm high and was manufactured from Trimesh and secured with 1.0-mm galvanised tie wire to the upper layer of the Trimesh panel with Quikmesh (25-mm x 25-mm x 1.0-mm). The Quikmesh was later hand patched with Vermitex THc to form a 90-mm thick coving around the perimeter of the enclosure.

All penetrations were finished with a 90-mm coving around the penetration.

The element of construction described above satisfied the following criteria for fire resistance for the period stated when subjected to the RWS heating curve.

| | | |
|----------------------|---|---------------------------|
| Loadbearing capacity | - | not applicable |
| Integrity | - | No failure at 120 minutes |
| Insulation | - | No failure at 120 minutes |

The test was conducted on 13 October 2009 in accordance with EN 1363-1:1999 – Fire resistance tests. General requirements, EN 1363-2:1999 – Fire resistance tests. Alternative and additional procedures, EN 1366-3:2009 – Fire resistance tests for service installations. Penetration seals and EN 1366-4:1999 – Fire resistance tests for service installations. Linear joint seals.

CSIRO test report numbered FSZ 1406

The specimen comprised Trimesh wall panels sprayed with Vermitex TH cementitious compound to form a non-loadbearing wall with overall nominal dimensions of 3020-mm high x 3000-mm wide x 90-mm (average) thick. Specimen construction comprised a steel perimeter track section bolted to the top, and bottom and one vertical side of the specimen containing frame using M12 bolts at 600-mm centres. The steel perimeter track used on the remaining vertical edge of the specimen was fixed to the top and bottom track only. A 75-mm wide x 10-mm thick strip of Insufoam was inserted within the steel bottom perimeter track section. Hilti CP611A fire rated mastic was used to provide a seal between the steel perimeter frame and the specimen containing frame on two vertical sides and the bottom. The top perimeter track incorporated five vertical M12 threaded rods 1800-mm long located at nominally 600-mm centres extending to nominally 300-mm above the bottom perimeter track. The wall panel system incorporated Trimesh R200 wall panels measuring 1200-mm wide x 2280-mm long x 50-mm thick. These Trimesh panels incorporated a layer of aluminium foil fixed to one face of the panel using speed clips at 300-mm and 400-mm centres. The Trimesh R200 wall panels were installed inside the steel perimeter frame and incorporated the vertical M12 threaded rods located within the panels. The M12 threaded rods were wire tied to the Trimesh panels on the side opposite to the aluminium foil backing. All butt joints between the Trimesh panels of the wall system were reinforced using 300-mm wide RG1 lapping strip installed centrally over the joint and wire tied to the Trimesh panels using 1.25-mm diameter tie wire at 300-mm centres. The Vermitex TH cementitious based spray compound was spray applied directly to the foil backing of the Trimesh R200 wall panels. Construction is detailed in drawing numbered 004 by L & A Fazzini Manufacturing Pty Ltd. The element of construction described above satisfied the ASTM – E119, Section 11 Hose Stream Test criteria for a duration of 2 minutes and 30 seconds. The test was conducted on 13 October 2009 in accordance with ASTM E119 – 2005 Standard Test Methods for Fire Tests of Building Construction and Materials – Section 11 Hose Stream Test.

CSIRO test report numbered FSH 1420

The specimen comprised nominally 4995-mm x 900-mm x 300-mm thick prestressed hollow-core precast R.C slabs, sprayed on the underside with different thicknesses of Vermitex TH, labelled as Specimen 1 – 25-mm thick, Specimen 2 – 30-mm thick and Specimen 3 – 17-mm thick. The test was conducted in accordance with the Heating conditions specified in “Specification and Guidelines for Testing of Passive Fire Protection for Concrete Tunnel Linings”, Appendix A Modified Hydrocarbon Curve (HCM) on 3 June 2010.

CSIRO test report numbered FSH 1468

The specimens comprised nominally two 5000-mm x 900-mm x 300-mm thick hollow core concrete slabs and one 5000-mm x 1200-mm x 150-mm thick solid concrete slab, all protected on the underside with Vermitex TH, spray applied, cementitious compound insulation material. The test was conducted in accordance with the Heating conditions specified in “Specification and Guidelines for Testing of Passive Fire Protection for Concrete Tunnel Linings”, Appendix A Modified Hydrocarbon Curve (HCM) on 7 April 2011.

L & A Fazzini post-test analysis numbered DOC- HCM/JUNE 2010/TEST

On 3 June 2010, L & A Fazzini Manufacturing conducted a post-test analysis on hollow core precast slab test to HC modified curve. The fire-resistance test was conducted on 3 June 2010 in accordance with Eurocode 1 & 2 and EN 1363-1 & 2 and reported on in CSIRO Sponsored Investigation report numbered FSH 1420.

Appendix B Analysis of Variations

The proposed construction shall be horizontal ceiling membranes and vertical wall membranes using the spray material Vermitex TH as tested in FSH 1345 and subject to the following variations

Horizontal ceiling membranes exposed to fire from below or from above

- At rod support points either
 - 100mm x 100mm x 2mm square washer/plate shall be at suspension points to provide support to the ceiling as shown in Figure 1 or
 - 300mm x 300mm SL81 mesh connected with nuts and washers and embedded mid-depth of spray.
- Where the ceiling system is exposed to fire from below, the rods and connections supporting the ceiling to the structure above shall be designed to support the weight of the ceiling at ambient temperature.
- Where the ceiling is exposed to the effects of fire from above,
 - the rods and connections supporting the ceiling to the structure above shall be designed to support the weight of the ceiling as unprotected steel, and
 - Whatever structure supports the ceiling shall have a fire resistance at least that required of the ceiling.
- Example installation details are shown in Figure 1

Wall membranes exposed to fire from either side

- Fix the trimesh to the surrounding construction with a track before the spray application

As indicated by the documentation listed in Appendix A, this Division has conducted fire-resistance tests incorporating your sprayed insulation system applied to various elements. The applied thicknesses in these tests varied approximately from 45 mm to 85 mm.

As a result of this series of hose stream tests, fire tests and fire-resistance tests the stickability of your spray insulation to concrete elements was verified and the insulation performance established.

In June of 2010 and on 19 December 2008 this Division conducted fire-resistance tests numbered FSH 1420 (HC^{inc} Mod) and FSH 1345 (ASTM E1529) on the Vermitex TH sprayed directly (unreinforced) to concrete elements and a suspended membrane ceiling system comprising your Vermitex TH and Trimesh sprayed over a compressed fibre cement (CFC) panel as well as a further portion of suspended membrane ceiling system comprising your Vermitex TH and Trimesh only.

The above systems represent the Vermitex TH as standalone spray applied coating or the Vermitex TH and Trimesh prefabricated as a sprayed panel system. Your Vermitex TH system has now been extensively tested in various configurations. The materials and construction systems adopted above have been originally tested as a ceiling system since 1982 and were also successfully tested (refer to fire test SI 1589) in 1982.

Your Trimesh panels have been capable of supporting both your ceiling as well as a wall separating construction for periods of up to 4 hours. The wall was supported off 10 mm rods placed at 600 mm centres whilst the ceiling was supported at 1200 x 1200 centres with 12mm rods centres without the aid of a suspended sub-frame.

On the 15 of October 2009, this Division completed tests FSV 1374 and FSV 1375 which were carried out to comply with the RWS Fire curve noted in TNO Standard 1998-CVB-RI161-rev 1 and included a non-load-bearing wall system and your Vermitex TH Panel and Panel jointing system with numerous penetrating elements suitable for bearing loads from electrical and mechanical services.

As required under NFPA 5000 the wall was instrumented to comply with ASTM E-119 and heated to the requirements of the RWS curve. On completion, the wall was subjected to and passed the required Hose stream Test required by NFPA and ASTM wall tests to comply with ASTM E 2226.

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