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Likely fire performance of a loadbearing framed wall system lined with FIRECRUNCH X-FIRE-10 with cavity insulation

Assessment Report

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Executive summary

This Division has examined the information referenced by you on the likely performance of a loadbearing steel framed wall system lined with 10-mm thick FireCrunch MBE-10 boards (Product stated by the manufacturer to be identical to X-FIRE-10) incorporating mineral wool slabs used as cavity insulation.

Based on test data and the factors detailed in this report, it is the opinion of this Registered Testing Authority that the loadbearing framed wall system, identical to the system reported in CSIRO test report FSV 2122 would provide a fire-resistance level (FRL) of 90/90/90 if tested in accordance with AS 1530.4-2005 with the following provisions:

- The load applied to the wall system does not exceed 18.3 kN/m (maximum load applied to the tested prototype wall system);
- The wall cavity insulation comprises mineral wool slabs with a density of not less than 75 kg/m^3;
- The wall cavity insulation is installed as a single piece to completely fill the wall void without through joints or gaps.

Likely fire performance of a loadbearing vertical separating element lined with FireCrunch X-FIRE-10 incorporating cavity insulation.

1 Introduction

The fire performance of a steel framed loadbearing wall system lined on each side with a product stated by the manufacturer to be identical to FireCrunch X-FIRE-10 magnesium oxide board has been the subject of a full scale fire-resistance test conducted in accordance with AS 1530.4-2005. This wall system incorporated two layers of Fletcher Insulation MW 450 mineral wool insulation slabs with a stated density of 64 kg/m^3 installed within the wall cavity.

2 Supporting Data

A fire-resistance test has been conducted on a loadbearing steel framed wall system lined with a product stated by the manufacturer to be identical to FireCrunch X-FIRE-10. This test report is described in Appendix A.

3 Proposal

The tested wall system incorporated two layers of Fletcher Insulation MW 450 mineral wool insulation slabs with a stated density of 64 kg/m^3 installed within the wall cavity. It is proposed to increase the density of the cavity insulation to at least 75 kg/m^3 to improve the insulation characteristics of the wall system during fire exposure.

4 Analysis

The tested prototype wall system comprised steel stud and noggin wall framing (90-mm x 45-mm x 1.0-mm BMT steel studs at 300-mm centres) lined with 10-mm thick product stated by the manufacturer to be identical to FireCrunch X-FIRE-10 wall linings. The wall system incorporated Fletcher Insulation (MW 450) mineral wool slabs with a density of 64 kg/m^3 within the wall cavity.

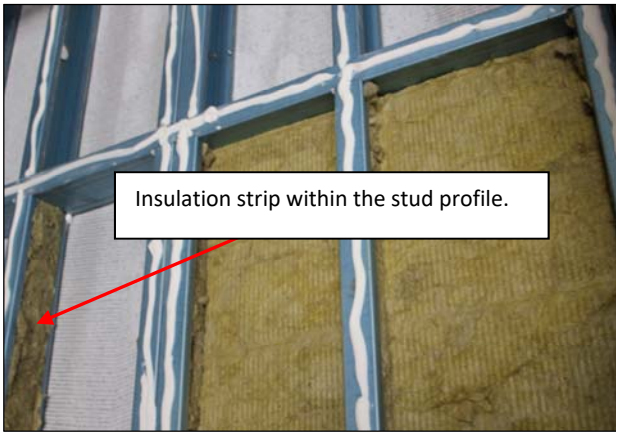
The fire performance of the full scale loadbearing wall system has been reported in CSIRO test report FSV 2122 (appendix A), where the tested system maintained structural adequacy and integrity for the 98 minute duration of the test. The maximum temperature rise insulation failure criterion of 180K was exceeded at 89 minutes on the unexposed face of the specimen.

The insulation failure at this time was isolated to a single thermocouple (T/C 24 – Appendix B) positioned on the exposed face of the wall lining over a wall stud which exceeded 203^{o}C at 89 minutes. The ambient temperature on the day of the test was 21^{o}C. After 95 minutes of testing a maximum temperature of 202^{o}C was recorded adjacent to a board joint on the unexposed face of the wall system (T/C 21 -Appendix B), 6 minutes after the first recorded failure.

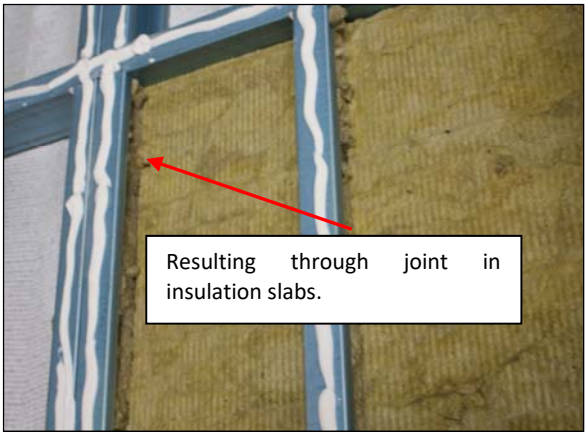
The average temperature recorded on the unexposed face of the FireCrunch X-FIRE-10 wall lining at the time of insulation failure measured 97°C and the maximum temperature measured at the head of the specimen was 146°C. Both of these recorded temperatures are below the average and maximum temperature rise failure criterion.

During construction of the test specimen the mineral wool slabs were installed in two layers, a 50-mm thick slab layer and a 40-mm thick slab layer installed back to back, used to fill the 90-mm deep wall cavity. An additional strip of 90-mm thick insulation material was cut to size and used to infill the steel stud frame sections (photograph 1).

The insulation installation method resulted in a through vertical joint between the mineral wool slabs at the intersection of the insulation strip used within the stud profile and insulation slabs (40-mm and 50-mm thick slabs) installed within the wall cavity (Photograph 2).



Photograph 1 – 90-mm thick strip of mineral wool insulation inserted within stud profile.



Photograph 2 – Vertical through joint in insulation slabs at intersection of 90-mm thick insulation strip in wall studs and 40-mm/50-mm slabs used in wall cavity.

The fire performance of the wall system is dependent on the exposed wall linings as well as the wall cavity insulation, which both contribute to delay the temperature rise of the wall framing and therefore the subsequent rise in temperature on the unexposed face of the specimen.

The presence of any through gap in the wall cavity insulation will allow the flow of hot furnace gases into the wall cavity when the exposed wall lining boards crack or the exposed board joints open up due to shrinkage and/or wall deflections.

One way to prevent this occurring within the wall cavity is to ensure that the insulation slabs are installed as a single piece without through joints. In addition to this, an increase in the density of mineral insulation used within the wall cavity will also provide additional insulation which will provide further protection to the wall cavity.

5 Conclusion

Based on test data and the factors detailed in this report, it is the opinion of this Registered Testing Authority that the loadbearing framed wall system, identical to the system reported in CSIRO test report FSV 2122 would provide a fire-resistance level (FRL) of 90/90/90 if tested in accordance with AS 1530.4-2005 with the following provisions:

- The load applied to the wall system does not exceed 18.3 kN/m (maximum load applied to the tested prototype wall system);
- The wall cavity insulation comprises mineral wool slabs with a density of not less than 75 kg/m^3;
- The wall cavity insulation is installed as a single piece to completely fill the wall void without through joints or gaps.

6 Term of validity

This assessment report will lapse on 25 June 2025. 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.

Appendix A - Supporting Data

A.1 CSIRO Sponsored Investigation report numbered FSV 2122

On the 21 September 2015 this Division conducted a full-scale fire-resistance test on load-bearing steel-framed wall system, lined on both sides with one layer of 10-mm thick product stated by the manufacturer to be identical to FireCrunch X-FIRE-10. The specimen comprised a load-bearing framed wall system with overall nominal dimensions measuring 3000-mm high x 3000-mm wide x 110-mm thick.

The steel wall frame comprised eleven (11) 90-mm x 45-mm x 1.0-mm BMT steel studs fixed into top and bottom steel tracks with nominal dimensions of 90-mm x 45-mm x 1.0-mm BMT steel. The steel studs were spaced at nominal 300-mm centres, with two back to back (double) studs used at 600-mm centres to correspond with each of the FireCrunch MBE-10 board product stated by the manufacturer to be identical to FireCrunch X-FIRE-10 joints, as shown in drawing numbered 2, undated, by FireCrunch Australia Pty Limited.

Steel noggings, with nom. dimensions 90-mm x 45-mm x 1.0-mm BMT were screw fixed between the wall studs at 1000-mm vertical centres. The back to back (double) studs were first sealed at the a joining faces using PROMASEAL A acrylic sealant prior to being screw fixed together using 12-14 x 20-mm long hex head Tek screws at 400-mm centres. The remainder of the steel wall framing was screwed together using 10 gauge x 25-mm long steel screws.

The steel wall framing was lined on each face with a single layer of 10-mm thick product stated by the manufacturer to be identical to FireCrunch X-FIRE-10 orientated vertically. The sheets measured nominally 1200-mm wide x 3000-mm long x 10-mm thick, with stated density of 950 kg/m^3.

Prior to the wall boards being screw fixed to the wall studs, a nom. 10-mm wide x 3-mm deep bead of PROMASEAL A acrylic sealant was applied to the flanges of the tracks and studs and left to cure overnight. The FireCrunch MBE-10 boards (Product stated by the manufacturer to be identical to X-FIRE-10) were then screwed to the wall studs using 8-gauge x 25-mm long bugle head drywall screws at 200-mm centres, through pre-drilled holes 15-mm from the board edges. All board joints were offset by 600-mm. A nominal 3-mm gap was left between all board joints which were later sealed to the full board depth using PROMASEAL A acrylic sealant, and then taped and set using a setting compound.

The wall cavity was filled with two layers of Fletcher Insulation mineral wool insulation batts. The batts had a stated density of 64 kg/m^3 and measured 1200-mm in length x 900-mm in width. One layer of 50-mm thick batts was laid against the exposed boards while the 40-mm thick batts were laid against the unexposed boards. Insulation strips were cut to fit within the metal studs.

A total load of 55 kN was applied to the specimen for the duration of the test.

The wall system failed with respect to insulation when the maximum temperature rise criterion of 180K was exceeded at 89 minutes on the unexposed face of the wall lining over a wall stud. The wall system maintained structural adequacy and integrity for 98 minutes at which time the test was terminated.

Appendix B - Thermocouple locations

B.1 Unexposed face thermocouple locations

Unexposed face of test specimen detailing external face thermocouple locations

References

The following informative documents are referred to in this Report:

AS 1530.4--2005	Methods for fire tests on building materials, components and structures Part 4: Fire-resistance tests of elements of building construction.
CSIRO report FSV 2122	Fire-resistance test on a loadbearing vertical separating element.

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