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National Association of Steel-Framed Housing
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NASH NEWS

BUSHFIRE TESTING PROJECT–

Successful outcome amongst the devastation

NASH 25th ANNIVERSARY

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NATIONAL ASSOCIATION OF STEEL-FRAMED HOUSING INC.

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BUSHFIRE TESTING PROJECT

Following the devastating Victorian Black Saturday bushfires, the National Association of Steel-Framed Housing (NASH) investigated different methods of providing a non-combustible, robust and durable bushfire solution.

The ability to resist flame zone conditions with basically conventional steel-framed and steel roof construction would provide builders and homeowners in all rural and bushfire areas with a straightforward and affordable construction solution based on familiar and readily available materials and construction methods.

The purpose of this project is to:

- Assess the viability of such a construction method using full-scale testing; and
- Provide supporting evidence for Building Authority approval in all relevant state jurisdictions.

Wall frames being erected

Installation of wall cadding

BACKGROUND

This facility was designed to assess the resistance of bushfire fighting vehicles that may be caught directly in the path of a high-intensity bushfire. ”

“It is the only facility in the world that can model the immersion of a full scale vehicle or structure in a high-intensity bushfire flame front.”

The Building Code of Australia (BCA) 2010 states that for Class 1, 2 and 3 buildings, and any Class 10a buildings associated with them: “A building that is constructed in a designated bushfire prone area must be designed and constructed to reduce the risk of ignition from a bushfire while the fire front passes.” The associated Functional Statement states that: “A building constructed in a designated bushfire prone area is to provide a resistance to bushfires in order to reduce the danger to life and minimise the risk of the loss of the building.”

For BCA 2010, compliance with AS 3959-2009 is a Deemed-to-Satisfy Provision for each of the above building classes in all jurisdictions except for Class 1 and 10a in South Australia. Slight variations to class applicability apply in New South Wales.

Alternative Solutions to the Deemed-to-Satisfy Provisions are possible, provided it can be demonstrated to the relevant Building Authority that they satisfy the same Performance Requirements as the Deemed-to-Satisfy Provisions or that they are at least equivalent.

AS 3959-2009 specifies that for houses designated as being in the Flame Zone, systems should either meet deemed-to-satisfy provisions or pass a test to AS 1530.8.2. In most cases, this involves a thirty minute fire rating and measures to achieve this rating are likely to cost in excess of $20,000 per house. The AS 1530.8.2 test is conducted in a modified compartment fire test furnace that has accepted limitations in its ability to model actual fire conditions. Specifically, the time-temperature profile and availability of oxygen during the test exposure in the AS 1530.8.2 furnace test differs from the conditions associated with bushfire fire front behaviour.

From discussions with experienced fire researchers, it was considered that a steel roof together with steel trusses, steel wall studs with steel external cladding and exposed steel sub floor should be able to survive in the flame zone of a real bushfire and provide an inherently robust system that does not have the potential for external or cavity ignition, assuming that windows or other external openings have not been breached. The concept is that the entire non-combustible roof, wall and floor structure acts together to protect the habitable space.

NASH engaged the CSIRO and drew on the knowledge developed in the Bushfire Cooperative Research Centre (CRC) to conduct full scale fire testing using the Bushfire Flame Front Simulator (BFFS) at the NSW Rural Fire Service (RFS) Eurobodalla Training Centre near Mogo, NSW. This facility was designed to assess the resistance of bushfire fighting vehicles that may be caught directly in the path of a high-intensity bushfire. It is the only facility in the world that can model the immersion of a full scale vehicle or structure in a high-intensity bushfire flame front.

Fire loading intensified

PROJECT OBJECTIVES

- To design and successfully test a low-rise predominantly steel structure comprising steel roof, wall, floor and sub-floor framing under simulated bushfire flame zone conditions using a test structure with the widest possible use of common building materials and methods and with the widest possible regulatory acceptance.
- To secure acceptance as an Alternative Solution under the performance requirements of the BCA, including independent construction elements.
- To eventually include the Alternative Solution as a Deemed-to-Satisfy Building Solution specification in an appropriate regulatory or reference

"...using a test structure with the widest possible use of common building materials and methods..."

Flame immersion – maximum fire intensity

TEST DESCRIPTIONS

"The exposure was the most severe bushfire exposure ever conducted at this facility."

Experimental Structure

A low-rise building of nominal dimensions, 8m x 4m x 5m high, suitable for use or adaptation as a Class 1, 2 or 10a building was constructed in the designated test area. It consisted of an elevated steel-framed floor, steel wall framing with steel cladding and plasterboard lining and a steel truss roof with steel roof sheeting and a plasterboard ceiling. Steel fascia and various soffit lining arrangements were included. The fire exposed face included two windows and a door. The building included an exhaust flue and various penetrations typical of residential and low-rise buildings and was insulated to nominal 6 star level in line with draft BCA 2010 provisions.

Test Regime

The CSIRO heat profile adopted emulated the worst case exposure of an advancing fire front. This exposure allowed for debris deposition and ignition, radiation build-up from an advancing fire front, flame immersion and radiation decay of the declining fire front. The exposure was the most severe bushfire exposure ever conducted at this facility.

Experimental Apparatus

The bushfire flame front simulator (BFFS) constructed in the open at the NSW RFS Eurobodalla Training Centre allows repeatable assessment of different full-scale systems in bushfire burn-over conditions. The BFFS is designed to recreate actual bushfire flame characteristics (eg. flame temperature profiles and radiant heat flux) using a grid of liquid propane burners.

The burner grid allows the following stages to be simulated:

- fire front approach,
- burn-over, and
- continued advancement.

The flame body was designed to be sufficiently large to fully engulf the exposed side of the house in flames that approach 1000°C. The duration of the flame immersion emulated a full flame immersion of an advancing flame front until the flame front passed. The immersion phase was designed for an 18 MW/m fire line intensity.

Comparison with AS 1530.8.2

The test building, apparatus and regime described above are not directly comparable with the test described in AS 1530.8.2. AS 1530.8.2 is a laboratory test devised as a standard test to determine the performance of single or multiple external elements based on the standard heating regime of AS 1530.4. It is well suited to repeatable testing of elements for performance evaluation against limited criteria. Test elements are of relatively small scale and the time-temperature profile is not calibrated to actual bushfire flame front conditions. Some of these limitations are discussed in Clause 5 of the Standard.

BUSHFIRE TEST AND PRELIMINARY OUTCOME

Testing took place on 16 April 2010, in front of a large audience of representatives from fire services, media, material suppliers, industry representatives and NASH members.

"The test can be viewed in the Members only section of the NASH website www.nash.asn.au (available to NASH members only)."

The audience agreed that the building was subjected to a worst case bushfire with temperatures reaching in excess of 1100°C around the structure.

The test was covered in NSW by Channel 10 News at 5.00pm Friday. Nationally it was covered by Channel 10 Late News and Channel 7 Morning Sunrise program. An article was published in the Sydney Morning Herald and the test will also form part of an ABC Catalyst story on designing for bushfires.

The test can be viewed in the Members only section of the NASH website www.nash.asn.au (available to NASH members only).

On initial assessment of data and physical samples, the following points are apparent:

- The bushfire test was a frightening simulation of the real thing. The air temperature near the exposed face reached around 1100°C for two minutes during the flame immersion phase.
- Measured temperatures and radiation levels matched or exceeded the target levels described in the CSIRO test proposal.
- The fire virtually enveloped the house, with similar surface damage evident at the back corners compared with the fully exposed front face.
- The roof system performed extremely well. Some more attention needs to be given to the eaves and gable wall areas.
- The open floor system also performed well, but the fire loading on the posts was severe. They will need to be heavier or protected from the fire.
- Whilst surviving the fire, the wall system needs further development to reduce the rate of heat flow through the wall.
- Interior surfaces (mainly plasterboard with timber skirting and architraves) showed thermal effects but were basically intact after the test.
- Information gathered on window and door performance will assist manufacturers to calibrate other forms of testing with full-scale simulation.

CSIRO is currently analysing the extensive data captured during the test to gain a thorough understanding of how the test house behaved under the simulated bushfire attack. This information will be used to refine the current designs for housing in rural and bushfire areas and set the direction for future Standards.

THANKS

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Project Sponsor

BlueScope Steel

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