# FAR 3112

# ASSESSMENT REPORT ON AN INSULATED CONCRETE FORMWORK WALL TO AS 3600 and AS ISO 9705


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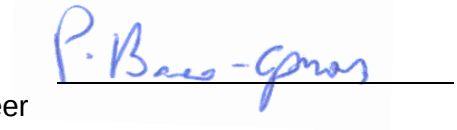

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   vi. The liability of BRANZ in respect of any claim for loss, damage or expense of any nature and howsoever arising shall in no circumstances exceed a total aggregate sum equal to 10 times the amount of the fee paid in respect of the specific service which gives rise to such claim or NZD$50,000 (or its equivalent in local currency), whichever is the lesser.
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c. Without limiting clause b above, the Client shall guarantee, hold harmless and indemnify BRANZ and its officers, employees, agents or subcontractors against all claims (actual or threatened) by any party for loss, damage or expense of whatsoever nature including all legal expenses and related costs arising out of:
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# ASSESSMENT REPORT ON AN INSULATED CONCRETE FORMWORK TO AS 3600 and AS ISO 9705

## 1. CLIENT

Formcraft Pty Ltd
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## 2. INTRODUCTION

This report gives BRANZ's assessment of the fire resistance of Formcraft Pty Ltd insulated concrete formwork walls 220 mm, 270 mm and 320 mm thick if it had been tested in accordance with fire resistance test standard AS 1530.4-2005 and compliance with AS 3600-2001, and of the BCA Group Classification if it had been tested in accordance with AS ISO 9705 - 2003.

The proposed modification to the existing wall system consists of a 10 mm increase in the thickness of the polystyrene formwork panels from 50 mm to 60 mm thick, and a corresponding change in the thickness of the concrete core. The core is to be filled with 100 mm, 150 mm or 200 mm thick concrete complying with AS 3600-2001. Through the depth of the core the plastic webs remain unchanged in section, consisting of a t-section nominally 25 mm high x 2 mm thick with the horizontal cross nominally 16 mm wide x 2 mm thick. The webs are spaced at approximately 200 mm centres in both horizontal and vertical orientations.

## 3. BACKGROUND

In State quality supervising and testing centre of fire-resistant building materials test report No. 200520229, an insulated concrete formwork was reported to be tested in accordance with GB/T 9978-1999. The specimen consisted of a 3m x 3m wall made up of 120 mm thick concrete with permanent formwork. The formwork panels were nominally 1200 mm wide x 600 mm high x 50 mm thick, each side with plastic webs through the core. The formwork was assembled with 12 mm diameter reinforcing steel in the cavity at 300 mm centres horizontally and 600 mm centres vertically. Overall the specimen was 3000 mm x 3000 mm x 220 mm thick. The specimen achieved a fire rating of 126 minutes due to flaming of a cotton pad. This is deemed an integrity and insulation failure in accordance with the test standard.

If a concrete wall is built to comply with AS 3600-2001 from, for example, a minimum of 120 mm thick concrete it is deemed to be able to achieve an Insulation rating of 120 minutes if tested in a fire resistance test (Section 5.7.2 of AS 3600: 2001). If the wall is built to comply with the requirements of section 5.7.4 "Structural Adequacy for walls" it is deemed to achieve Structural Adequacy for 120 minutes. If the wall complies

with AS 3600-2001, section 5.7.2 and 5.7.4 it is deemed the wall will maintain the Integrity criteria of the test standard for 120 minutes.

In BRANZ assessment report FAR 2602, the considered fire resistance ratings of the Formcraft wall construction were taken from AS 3600-2001 on the basis of the thickness of the concrete core and that the concrete complied with AS 3600-2001.

In BRANZ fire test FI 3672, nominally 50 mm thick Formcraft polystyrene formwork panels were tested in accordance with AS ISO 9705-2001. The test comprised a single layer of polystyrene secured to three walls and the ceiling with screws placed through the plastic formers directly into the structure of the test room. The screw fastening was specifically placed to replicate the degree of support that would otherwise be achieved by the Formcraft wall system when constructed with the plastic webs and filled with concrete. Four courses of panels were used to line the walls, with each course in a brick-bond style of layout. Fire grade paper faced plasterboard nominally 10 mm thick was used to line the room. Along the walls, the plasterboard was laid horizontally two sheets high with single sheets spanning the full length of each wall. The plasterboard was screw fixed to the plastic formers at 200 mm centres around the sheet perimeter and at 400 mm centres horizontally and vertically. On the ceiling, the plasterboard was secured at the same spacings but screwed directly through to the structure of the test room. The test was run for the full 20 minutes as defined in the standard, and in accordance with the BCA, achieved a Group 1 Classification and a smoke growth rate index ($SMOGRA_{RC}$) of 0.6 ($m^2/s^2$ x 1000).

# 4. DISCUSSION

## 4.1 General

It is proposed that the Formcraft insulated formwork wall will comply with AS 3600-2001 except that the formwork has plastic webs through the core. The Formcraft 220 model formwork consists of expanded polystyrene panels nominally 60 mm thick with a plastic web slotted into each panel forming a cavity which is then filled with concrete 100 mm thick. The 270 and 320 model permanent formworks are the same construction as the 220 model above except with a 150 mm thick and a 200 mm thick concrete core respectively.

## 4.2 Fire Resistance

As additional information to support the assessment against AS 3600, the wall system has been subjected to a fire resistance test by “State quality supervising and testing centre of fire-resistant building materials” China, test report No. 200520229, in accordance with GB/T 9978-1999. Information has been supplied by the client which indicates the GB/T testing standard is similar to AS 1530.4. An analysis of the information supplied has been conducted and although there are some differences between test standards it is expected that if the specimen had been tested in accordance with AS 1530.4-2005 it would have achieved a similar result.

## 4.3 AS 3600 - 2001

### 4.3.1 Structural Adequacy

The cavity of the formwork with 100 mm, 150 mm and 200 mm or thicker concrete is as defined in AS 3600-2001 Table 5.7.2. for 90, 180 and 240 minutes respectively. Therefore it is considered that, on the condition that the concrete meets the requirements of section 5.7.4 of AS 3600-2001, the constructed walls with 220, 270 and 320 model formwork would meet the fire resistance rating of 90 minutes, 180 minutes and 240 minutes respectively for structural adequacy as listed in table 5.7.2.

### 4.3.2 Integrity

In accordance with section 5.7.3 of AS 3600-2001, and the test result on the concrete wall system, it is considered that Integrity failure will occur after 90 minutes, 180 minutes and 240 minutes for the 220, 270 and 320 model formworks respectively.

### 4.3.3 Insulation

If the wall complies with section 5.7.2 of AS 3600-2001 then it is expected that the constructed 220, 270 and 300 model formwork walls will achieve Insulation of at least 90, 180 and 240 minutes respectively as defined in Table 5.7.2 of AS 3600-2001.

## 4.4 BCA Specification C1.10a

### 4.4.1 AS ISO 9705 - 2003

Compliance with BCA Specification C1.10a for wall and ceiling linings is achieved by testing in accordance with AS ISO 9705. The test room measures 2.4 m wide by 3.6 m deep by 2.4 m high with a 0.8 m wide by 2.0 m high door located centrally in one of the short walls. The ceiling and the three walls excluding that with the door are lined with the test specimen. A gas burner is located in one corner opposite the door and supplied with fuel sufficient to achieve an output of 100 kW for the first 10 minutes followed by a further 10 minutes at 300 kW. The Group Classification is based on the time during the 20 minute test at which flashover occurs. Flashover is deemed to be a peak heat release rate exceeding 1000 kW. A smoke growth rate index ($SMOGRA_{RC}$) is also determined from the test, an index of not more than 100 ($m^2/s^2$ x 1000) permits the lining system to be used in buildings with or without a complying sprinkler system.

Post test observation of the FI 3672 specimen indicated that the burner fire had not spread on the linings. Only the paper facing of the plasterboard was consumed where it had been subjected to direct flame impingement from the burner. Similarly, only the polystyrene located within the direct flame impingement zone had been involved in the fire.

### 4.4.2 BCA Group Classification

In the BRANZ fire test FI 3672, the peak heat release rate recorded was 377 kW (at 1113 seconds), and a $SMOGRA_{RC}$ index of 0.6 ($m^2/s^2$ x 1000) was determined.

It is therefore considered that if the same Formcraft system were constructed and tested as in FI3672 but with 10 mm thicker polystyrene panels (up from the 50 mm as tested to 60 mm thick), it is unlikely that the peak heat release rate would exceed 1000 kW, and the $SMOGRA_{RC}$ index exceed 100 ($m^2/s^2$ x 1000).

# 5. CONCLUSION

## 5.1 Fire Resistance

It is considered that a concrete wall manufactured using the Formcraft Ltd 220, 270 and 320 model insulated concrete formwork system would provide at least the fire resistance in accordance with AS 1530.4-2005 as given in AS 3600-2001 for the 100 mm, 150 mm and 200 mm thick concrete core walls.

| Formcraft Wall Model Number | Concrete core thickness (mm) | Fire Resistance Rating |
|---|---|---|
| 220 | 100 | 90/90/90 |
| 270 | 150 | 180/180/180 |
| 320 | 200 | 240/240/240 |

## 5.2 BCA Specification C1.10a

It is considered that a concrete wall manufactured using the Formcraft Ltd 220, 270 and 320 model insulated concrete formwork systems, if tested in accordance with AS ISO 9705-2003 would achieve a BCA Group 1 Classification and a $SMOGRA_{RC}$ index less than 100 ($m^2/s^2$ x 1000).

# 6. LIMITATIONS

This assessment report is subject to the accuracy and completeness of the information supplied. BRANZ reserves the right to amend or withdraw this assessment if information becomes available which indicates the stated fire performance may not be achieved.

PNW PBC