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SUBJECT:

Fire resistance test on a non-loadbearing 'Besta' hollowcore Almgo panel system submitted by Well & Able International Pte Ltd.

TESTED FOR:

Well & Able International Pte Ltd. 23 Genting Road, #03-01, Singapore 349481

DATE SUBMITTED:

18 MAR 2015

DATE OF TEST:

23 MAR 2015

PURPOSE OF TEST:

 To determine the fire resistance of the specimen when tested in accordance with BS 476: Part 22: 1987: "Methods for Determination of the Fire Resistance of Non-loadbearing Elements of Construction - Determination of the Fire Resistance of Partition".





Laboratory: TÜV SÜD PSB Pte. Ltd. No.1 Science Park Drive Singapore 118221



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LA-2007-0380-A LA-2007-0381-F LA-2007-0382-B LA-2007-0383-G LA-2007-0384-G LA-2007-0385-E LA-2007-0386-C LA-2010-0464-D

0382-B laboratory': 0383-G - Singapor 0384-G "Not SAC-0385-E SINGLAS I 0386-C

The results reported herein have been performed in accordance with the laboratory's terms of accreditation under the Singapore Accreditation Council - Singapore Laboratory Accreditation Scheme. Tests/Calibrations marked *Not SAC-SINGLAS Accredited* in this Report are not included in the SAC-SINGLAS Accreditation Schedule for our laboratory.

Regional Head Office:

TÜV SÜD Asia Pacific Pte. Ltd. 3 Science Park Drive, #04-01/05 The Franklin, Singapore 118223



TEST PROCEDURE:

- 2. Before the commencement of test, the ambient temperature in the general vicinity of the test specimen construction was ensured to be not exceeding 35°C. The datum values for each individual temperature and deflection measurements were also taken not more than 15 minutes before the commencement of test.
- 3. During the test, with commencement of heating of the specimen, the furnace temperature and pressure were controlled to comply with the requirements specified in BS 476: Part 20: 1987: Clause 3.1 and 3.2 respectively. The pressure was controlled such that a linear pressure gradient of 8.5±2 Pa per 1000mm height exist above a neutral pressure axis at a height of approximately 1000mm above the notional floor level. However, the maximum pressure at the top of a vertical test construction shall not exceed 20Pa.
- 4. Throughout the heating period, the behaviour of the specimen was observed and monitored for compliance with the relevant performance criteria stated in clause 10 of BS 476: Part 20: 1987 (A summary is given in clause 9 of this report.) and the appropriate clause of BS 476: Part 22: 1987.
- 5. For insulated specimen, the mean temperature on the unexposed face were measured by five number of surface mounted thermocouples, with one placed approximately at the centre of each quadrant. In the presence of stiffener, through member or jointing, the thermocouples were located at least 50mm away.
- 6. For insulated specimen, the maximum temperature on the unexposed face were measured by thermocouples placed on locations on one vertical jointing side and one at stiffener which may be hotter than the average on the face. The thermocouples were placed at least 50mm away from edge of stiffeners or any jointing.
- 7. Observations, on the behaviour of the test specimen throughout the heating period, were made and recorded. As appropriate, cotton pads, gap gauges and roving thermocouple were used to establish the occurrence of failure.
- The test was terminated when one or more failures as stated in the performance criteria occurred, or otherwise at a time agreed between the sponsor of test and the test laboratory.

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PERFORMANCE CRITERIA:

- 9. The specimen is assessed against the following test criteria:
- 9.1 Integrity

Failure shall be deemed to have occurred when one of the following occurs:-

- When collapse or sustained flaming for more than 10 seconds on the unexposed face.
- When the cotton pad test is conducted, flames and/or hot gases causing flaming or glowing of the cotton pad.
- Where the cotton pad test cannot be conducted because of the level of radiation from the specimen, a through gap into furnace exceeding 6mm in width by 150mm in length exists or develops in the specimen.
- When a through gap into furnace exceeding 25mm diameter exists or develops in the specimen.

9.2 Insulation

Failure shall be deemed to have occurred when one of the following occurs:-

- If the mean unexposed face temperature increases by more than 140°C above its initial value.
- If the temperature recorded of at any position on the unexposed face is in excess of 180°C above the initial mean unexposed face temperature.
- When integrity failures occur.

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DESCRIPTION OF TEST SPECIMEN:

10. The overall size of the non-loadbearing 'Besta' hollowcore Almgo panel system was 3000mm (W) x 2750mm (H) x 90mm thick with a 25mm vertical free edge at one side of the system filled with ceramic wool, was erected onto the test furnace (PSB Asset No. 20009077) with lintel and skirting using bricks of size 210mm x 100mm x 70mm to the perimeter of the test carrier.

The 'Besta' hollowcore Almgo panel system comprised of 'Besta' hollowcore Almgo panels of size 600mm x 2750mm x 90mm (thick) and 'Hilti' firestop mortar CP636. The density of the panel was found to be 712 kg/m³. The claimed composition of the panel are Magnesium Oxide, Magnesium Chloride, Foaming Agent and Additives. The panels were erected on the test carrier with ordinary cement/sand filling along the perimeter and the void of the vertical seams between panels were filled with 'Hilti' firestop mortar. The top and bottom of the system of the fire side a 75mm x75mm x 3mm thick mild steel angle supported the panels.

- 11. The test was conducted at TÜV SÜD PSB Pte Ltd fire test laboratory located at No. 10, Tuas Avenue 10, Singapore 639134.
- 12. An inspection on the panel system was conducted by a TÜV SÜD PSB staff to verify on its dimensions and designs. Detailed constructions of the panel system are shown in drawings title "Plan Elevation/Section Layout' and 'Section Layout Details' provided by the sponsor of the test.
- 13. Erection of the test specimen onto the test furnace was arranged and carried out by Well and Able International Pte Ltd.

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TEST RESULTS:

- 14. Table 1 shows the temperature rise for the furnace and the standard curve. In addition, the table shows the percentage difference between the area under the standard curve and the area under the furnace curve compared with the percentage tolerance allowable within the standards.
- 15. Table 2 and 3 show the mean and maximum unexposed face temperature above the initial temperature. Location of the thermocouple points are shown in the drawing.
- 16. Table 4 shows the deflection measurement on the specimen.
- 17. Figure 1 shows the actual time-temperature curve of furnace in relation to the specified time-temperature curve.
- 18. Photographs of the test are shown in Plates 1 to 4.
- 19. Observations were made during the test on the unexposed face of the test specimen and these are given in Appendix 1 of this report.
- 20. The results only relate to the behaviour of the specimen of the element of construction under the particular conditions of the test. They are not intended to be the sole criteria for assessing the potential fire performance of the element in use nor do they reflect the actual behaviour in fires.

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CONCLUSION:

21. The specimen satisfied the requirements of the BS 476: Part 22: 1987 for the periods stated below :-

Integrity

: 260 minutes

Insulation

: 260 minutes

REMARKS:

22. Integrity

There were no integrity failure throughout the test. Therefore, the integrity of the specimen system meets the standard for 260 minutes.

23. Insulation

There were no insulation failure throughout the test. Therefore, the insulation of the specimen meets the standard for 260 minutes.

WITNESSES:

24. The following representative witnessed the test :-

Well & Able International Pte Ltd

: Mr. Ho Shyan Cher

: Mr. Low Yuih-Sin

Teo Siew Ming Engineer

Assistant Vice President

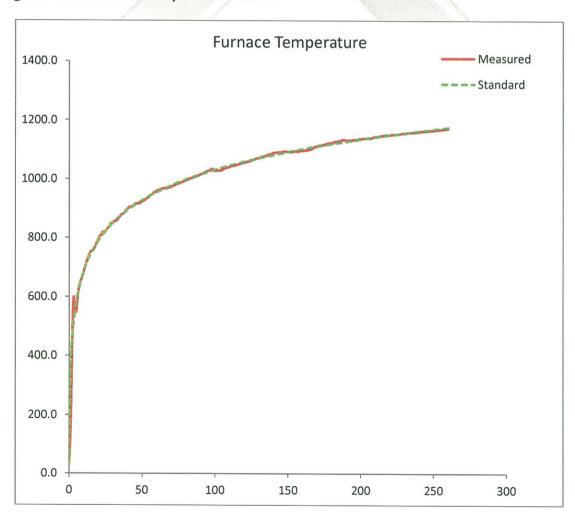
(Fire Property) Mechanical Centre



Table 1: Comparison of area under the curve

Time	Temperature rise (°C)		Area under curve (°C min)		Percentage difference	Standard tolerance
(min)	Standard	Furnace	Standard Furnace		(%)	(±%)
5	556.4	519.2	2188.1	1992.2	-9.0	
10	658.4	655.2	5402.7	5179.2	-4.1	15.0
30	821.8	821.4	15692.6	15727.1	0.2	10.0
60	925.3	930.6	27284.3	27272.1	0.0	
120	1029.0	1026.8	88071.6	87945.7	-0.1	
180	1089.7	1094.1	153557.6	153474.4	-0.1	
240	1132.8	1131.7	222096.0	222105.3	0.0	5.0

Figure 1 : Time and temperature curve



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Table 2: Unexposed face temperature on panel system

Time (min)	Thermocouple no.					Mean Temp		itial mean o (°C)
	T-01	T-02	T-03	T-04	T-05	(°C)	Mean temp	Max. temp
0	29.9	29.7	29.8	29.9	29.8	29.8	-	-
30	54.0	49.0	54.0	50.2	42.1	49.9	20.0	24.1
60	83.8	79.8	83.1	79.8	76.6	80.6	50.8	53.9
120	113.6	111.1	113.7	107.9	107.1	110.7	80.9	83.9
180	131.7	128.3	131.0	124.7	123.0	127.7	97.9	101.8
260	158.8	149.7	156.8	150.6	143.7	151.9	122.1	128.9

Table 3: Additional unexposed face temperature on panel system

Time	Thermo	couple no.	Mean Temp	Above initial mean temp (°C) Max. temp	
(min)	T-06	T-07	(°C)		
0	29.7	29.9	29.8	E -	
30	61.4	43.8	52.6	31.7	
60	90.6	78.5	84.5	60.9	
120	124.1	107.3	115.7	94.4	
180	143.4	121.4	132.4	113.6	
260	179.3	142.1	160.7	149.5	

Table 4: Deflection of the panel system measure at mid height

Time	Measurement of deflection (mm)							
(min)	Α	В	С	D	Е			
10	5	9	13	20	13			
30	8	16	20	`26	18			
45	8	18	22	30	20			
60	10	21	27	35	21			
120	18	41	45	55	33			
180	25	61	75	82	47			
240	40	101	125	120	67			

Notes:

1) The position deflection points towards the furnace at mid-height are indicated on the drawing.

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Photographs of test



Plate 1: The unexposed face of specimen before the test.



Plate 2: At about 60 minutes of test.

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Photographs of test (Cont'd)



Plate 3: At about 180 minutes of test.

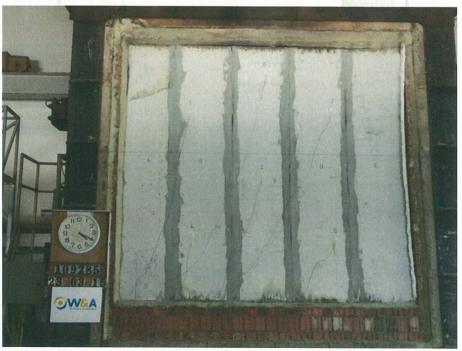


Plate 4: At about 260 minutes of test.

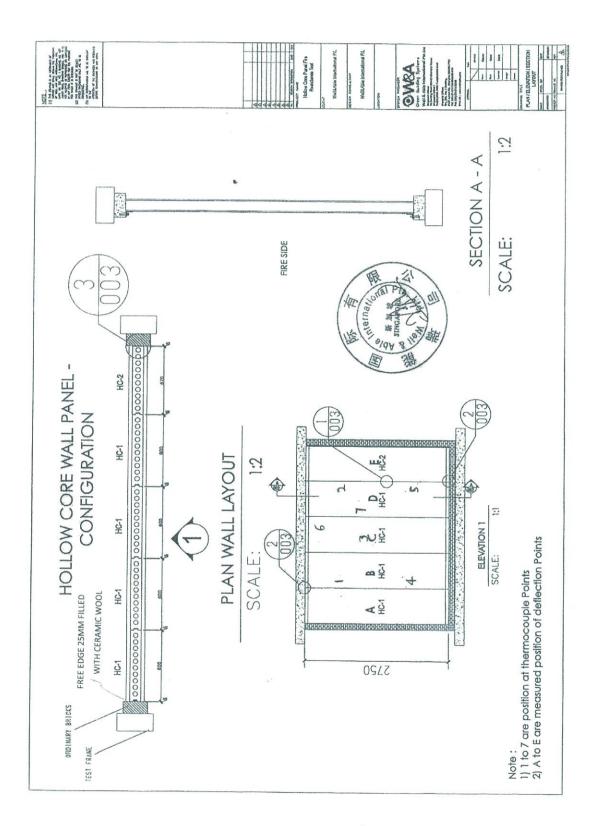




APPENDIX 1

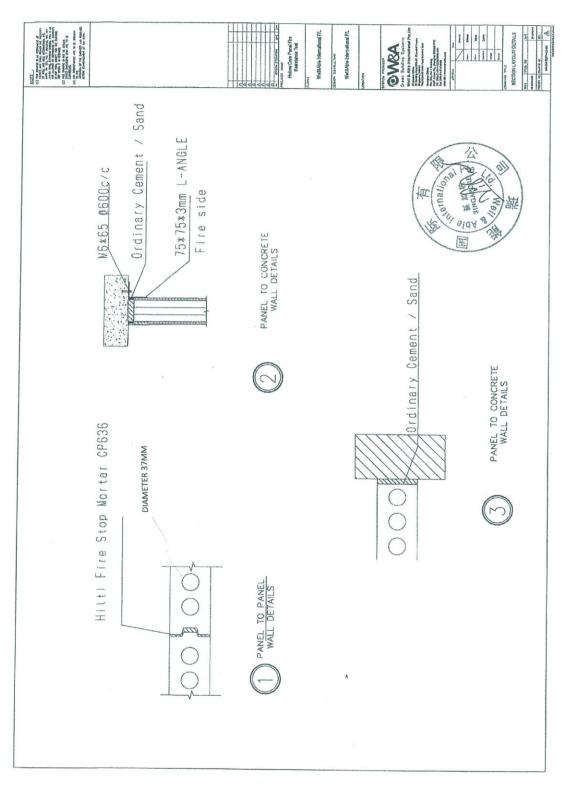
Time (min:sec)	Observation on the unexposed face
00:00	Test commenced.
11:00	Steam emitted along second vertical seam from the left and slight damp on the surface around the location.
17:00	Slight damp on the surface along fourth vertical seam from the left.
29:00	Slight damp along the third vertical seam.
30:00	Wall system remained stable.
55:00	Surface cracks appeared along the vertival seams.
60:00	Wall system remained stable.
90:00	Surface crack appeared on the left panel top location of the system.
120:00	Wall system remained stable.
240:00	Wall system remained stable.
260:00	Test was discontinued. Beside some surface cracks the system remained intact.





Store





Show



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July 2011

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