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TECHNICAL REPORT

Report No	201909-A			
Job Address	Non-Specific			
Client	Centurion Framing Systems Pty Ltd			
Report Date:	22.01.19	Inspection Date: N/A	Weather Conditions: N/A	Temperature: N/A
Subject	STRUCTURAL ADEQUACEY OF RESCOM BOARD ASSEMBLY			

SCOPE OF PROFESSIONAL SERVICES

Special Note:

This office has been further engaged to examine additional evidence towards a full-size test specimen(3.0mx3.0m), in order to satisfy various building regulatory bodies within Australia.

Further Pilot test results were provided by Centurion Framing Systems which have been carried out by Shanghai Test Facilities. Please refer to tables 2-4 and Ignis Solutions revised report dated 13.12.2018.

Tables 2 - 4 have been added showing the results of fire tests and the relevant temperatures for 3.0mx3.0mx12mm Rescom boards.

In our previous assessment it was indicated that, this office;

At the request of the client, this office has been engaged to provide the Structural adequacy for wall framing having a ResCom board of 16mm thickness and steel Cold formed C section studs (90x40mm with 0.75 BMT). The battens used were 25mmx 0.75mm steel. The ResCom board was affixed to the steel frame via 20mm Hex Head screws with a R2.0 Knauf Earthwool Insulation. Reference must be made to clause 1.2 "Specimen" of Ignis Solutions, for full description of the specimen.

1. The specimen under consideration was fire tested by Ignis Chartered Professional Safety Engineers (Hereinafter called IGNIS). Due to dependency of this technical report's findings, a comprehensive reference must be made to IGNIS's report

No IGNS-6259 I01 R00, Revised on 13.12.2018.

It is noted that the testing was undertaken in accordance with BCA Clause A2.2(a)(v) and (a)(vi), and Clause A2.3, BCA Specification A2.3 as well as AS 1530.4:2014.

PRELIMINARY ASSESSMENT

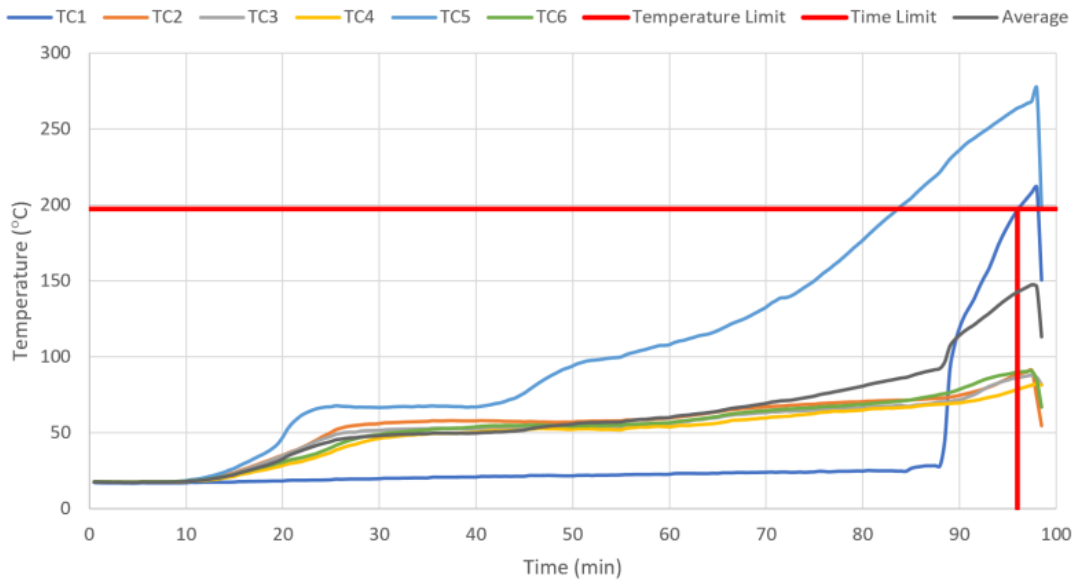
Specimen

The wall panel specimen as detailed above, was fire tested by IGNIS, in September 2018 which comprised a non-loadbearing, steel frame MgO and plasterboard lined external wall system. The overall dimensions of the wall were 900mm high x 900mm wide by 131mm thick. Please refer to photo No 1.



Photo 1

By referring to Time vs Temperature chart, IGNIS has assessed that the average temperature reached on the non-fire side of the specimen, the average temperature reached was recorded to be 150 (°C), please refer to the diag.1 attached.



Diag.1

YIELD STRENGTH/MODULUS OF ELASTICITY ASSESSMENT OF STEEL

By referring to AS 4100, Clause 12.4 stipulate that the formula given below, there will be a reduction in steel yield strength and modulus of elasticity.

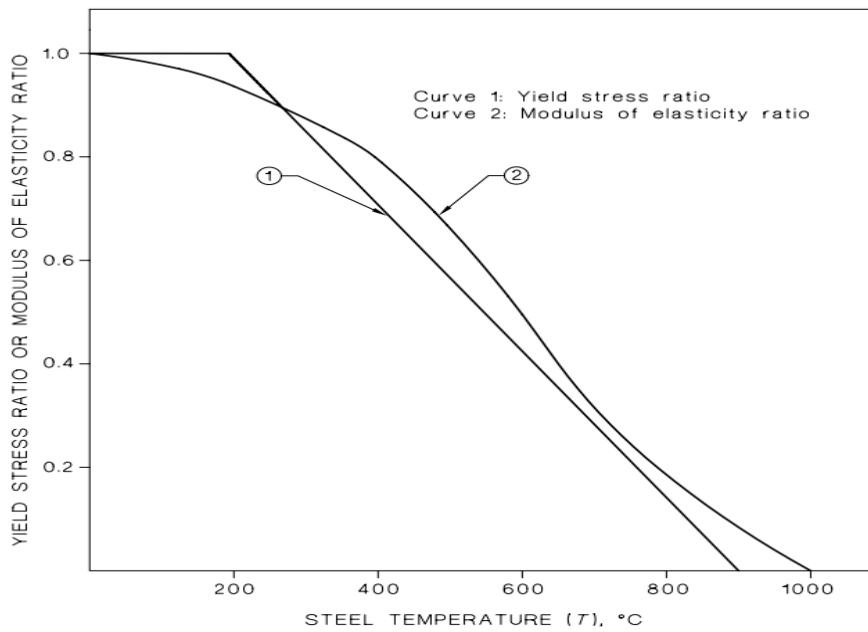
i) Yield Strength:

$$\frac{f_y(T)}{f_y(20)} = 1.0 \quad \text{when } 0^\circ\text{C} < T \leq 215^\circ\text{C}; \text{ and}$$

ii) Modulus of elasticity:

$$\frac{E(T)}{E(20)} = 1.0 + \left[\frac{T}{2000 \left[\ln\left(\frac{T}{1100}\right) \right] \right]} \quad \text{when } 0^\circ\text{C} < T \leq 600^\circ\text{C}.$$

The graph 1 below (Extract form AS 4100-Steel Structures), illustrates the relationship, for Yield Strength and Modulus of elasticity



Graph 1

Both table 1(Extract from QUT study on cold form sections) and Graph No 2 Extract from (University of Coimbra), are indicative of similar findings with the research carried out on cold formed sections.

Table 3.6 Yield Strength Reduction Factors (f_{yT}/f_{y20}) based on Various Strain Levels

Temperature (°C)	0.60 mm G550 steel				0.60 mm G250 steel			
	0.2%	0.5%	1.5%	2.0%	0.2%	0.5%	1.5%	2.0%
20	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
100	0.970	0.968	1.000	1.000	0.937	0.935	0.958	0.978
200	0.956	0.947	0.996	0.994	0.922	0.901	0.938	0.965
350	0.838	0.814	0.897	0.896	0.526	0.539	0.711	0.758
500	0.403	0.402	0.461	0.471	0.323	0.338	0.398	0.413
600*	0.118							
650	0.097	0.099	0.105	0.107	0.163	0.166	0.179	0.183
800	0.030	0.030	0.031	0.031	0.036	0.036	0.37	0.037
Temperature (°C)	0.80 mm G550 steel				0.80 mm G250 steel			
	0.2%	0.5%	1.5%	2.0%	0.2%	0.5%	1.5%	2.0%
20	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
100	1.000	1.000	0.990	0.990	0.960	0.958	0.968	0.965
200	0.992	1.004	0.978	0.980	0.918	0.922	0.947	0.943
350	0.876	0.870	0.899	0.901	0.586	0.629	0.786	0.844
500	0.429	0.425	0.464	0.469	0.360	0.383	0.443	0.455
600*	0.123							
650	0.093	0.102	0.111	0.114	0.180	0.187	0.200	0.202
800	0.051	0.050	0.055	0.056	0.081	0.082	0.085	0.086
Temperature (°C)	0.95 mm G550 steel				0.95 mm G250 steel			
	0.2%	0.5%	1.5%	2.0%	0.2%	0.5%	1.5%	2.0%
20	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
100	0.976	0.976	0.985	0.988	0.906	0.906	0.910	0.921
200	0.963	0.963	0.970	0.977	0.823	0.865	0.855	0.930
350	0.877	0.861	0.944	0.953	0.510	0.565	0.715	0.774
500	0.471	0.450	0.537	0.541	0.327	0.355	0.411	0.427
600*	0.113							
650	0.082	0.089	0.105	0.108	0.164	0.175	0.185	0.189
800	0.044	0.045	0.055	0.056	0.059	0.061	0.067	0.067

Note: 0.60, 0.80 and 0.95 mm are nominal thicknesses and * indicates that limited tests were undertaken to obtain the yield strength of G550 steel.

Table 1

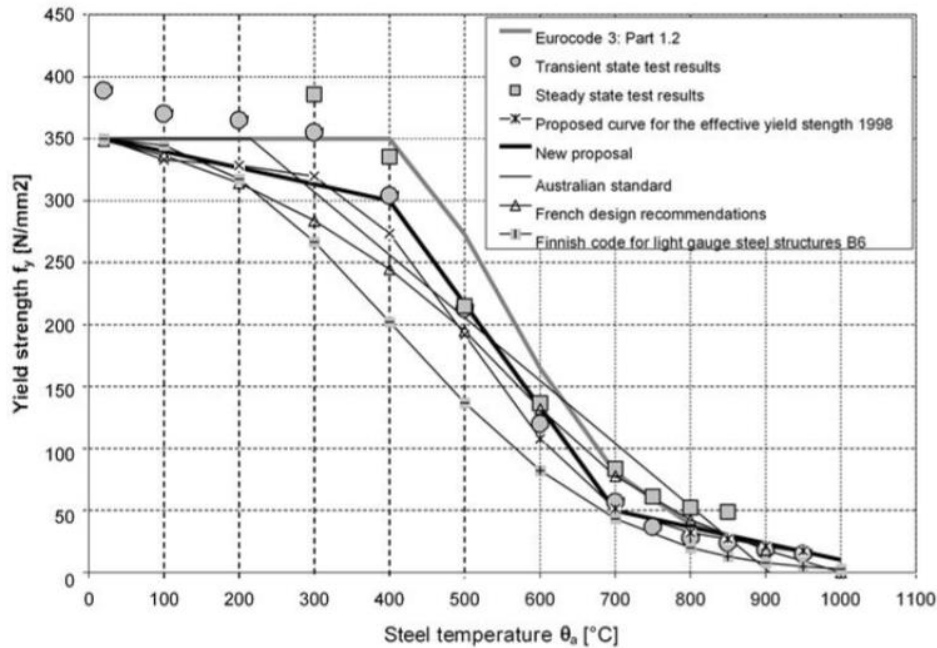


Figure 2.3. Yield strength of structural steel S350GD+Z and comparison with different design codes (Outinen et al., 2000)

Graph 2

Therefore, from i) the yield strength at 150 °C will be: less than 1% (Approx.) reduced and, from ii), Modulus of elasticity will be reduced by 4% (Approx.), at 150 °C.

Given the factor of safety outlined in AS Codes, and in particular AS4100, AS4600, in structure design of steel members a reduction of up to 10% may be allowable, depending on design parameters and building types.

CONSIDERATIONS

The following items are deemed to be necessary in the application of ResCom boards:

1. All connections and details must be adhered to as per ResCom instruction manuals.
2. All connection screws must be well insulated by applying the Fire rated approved silicon or similar.
3. Screws must be of minimum of class 3 to 4 no corrosion or stainless steel screws in accordance with the ResCom Technical Installation Manual.
4. All joints must be sealed and fireproofed, as per ResCom installation manual.



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UNEXPOSED SURFACE TEMPERATURES (°C)

Time (min)	TC#8 (°C)	TC#9 (°C)	TC#10 (°C)	TC#11 (°C)	TC#12 (°C)	TC#13 (°C)	Average (°C)
0	13	13	13	12	11	12	12
1	13	13	13	12	12	12	12
2	13	13	13	12	12	12	12
3	13	13	13	12	12	12	12
4	13	13	13	12	11	12	12
5	13	13	13	12	12	12	12
6	13	13	13	12	12	12	13
7	13	13	13	12	13	12	13
8	13	13	13	12	23	12	16
9	14	13	13	13	42	12	22
10	20	13	13	15	58	12	27
11	27	14	15	19	69	12	33
12	33	19	17	24	76	13	38
13	39	26	20	30	80	13	43
14	43	34	22	36	82	13	47
15	47	43	25	43	83	14	51
16	49	50	28	48	84	15	54
17	51	56	30	53	85	15	57
18	53	61	32	56	85	16	60
19	55	65	34	60	86	17	62
20	56	68	35	62	86	18	64
21	57	70	37	65	87	19	65
22	59	72	39	68	87	20	67
23	60	73	41	69	87	20	69
24	61	74	43	71	87	21	70
25	61	74	45	72	87	22	71
26	62	74	47	73	87	23	72
27	62	74	49	73	87	24	73
28	62	74	51	74	87	25	73
29	62	74	53	74	86	26	73
30	62	74	55	74	86	27	74
31	62	74	56	74	85	27	74
32	62	74	58	73	85	28	74
33	62	74	59	73	84	29	74
34	62	74	60	73	83	29	74
35	61	73	61	73	83	30	74
36	61	73	62	73	82	31	74
37	61	72	63	72	81	31	74
38	61	72	64	72	80	32	75
39	61	72	64	72	80	32	75
40	60	71	64	72	79	33	75

Table 2



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UNEXPOSED SURFACE TEMPERATURES (°C)

Time (min)	TC#8 (°C)	TC#9 (°C)	TC#10 (°C)	TC#11 (°C)	TC#12 (°C)	TC#13 (°C)	Average (°C)
41	60	71	65	72	79	33	76
42	60	71	65	73	79	34	76
43	60	70	65	73	78	35	77
44	60	70	65	73	78	35	77
45	59	69	65	74	78	36	78
46	59	69	64	74	78	37	78
47	59	69	64	75	78	37	79
48	59	68	64	75	78	38	80
49	59	68	63	76	78	39	81
50	59	68	63	76	79	39	82
51	59	67	63	77	79	40	83
52	59	67	62	77	80	41	84
53	59	67	62	78	80	42	85
54	59	67	62	78	81	42	86
55	58	67	61	77	81	43	87
56	58	67	61	77	82	44	88
57	58	67	61	78	83	45	89
58	59	67	61	78	84	46	90
59	59	68	61	79	85	47	91
60	59	68	61	80	87	48	92
61	59	68	61	80	88	49	94
62	59	69	61	81	89	50	95
63	60	69	62	83	90	50	96
64	60	70	62	84	91	51	97
65	60	71	63	85	92	52	98
66	61	71	64	87	93	53	99
67	61	72	64	88	94	54	101
68	62	73	65	90	96	55	102
69	62	74	66	92	98	56	103
70	63	75	67	93	100	56	104
71	63	76	68	95	103	57	106
72	64	77	69	97	105	58	107
73	64	79	70	99	108	59	108
74	65	81	71	101	111	60	110
75	66	82	72	103	113	62	111
76	66	84	74	105	116	63	112
77	67	86	75	106	118	64	114
78	67	88	76	108	121	65	115
79	68	90	77	110	123	66	116
80	69	92	79	111	126	68	118

Table 3



UNEXPOSED SURFACE TEMPERATURES (°C)



Time (min)	TC#8 (°C)	TC#9 (°C)	TC#10 (°C)	TC#11 (°C)	TC#12 (°C)	TC#13 (°C)	Average (°C)
81	70	95	80	113	128	69	119
82	70	97	81	115	129	71	120
83	71	99	83	118	131	72	122
84	72	101	84	121	133	74	123
85	73	104	85	126	134	76	125
86	74	106	86	126	136	78	126
87	75	108	88	140	137	80	129
88	76	110	89	153	138	82	131
89	77	112	90	146	140	85	132
90	78	115	91	140	141	87	132
91	80	116	93	137	142	89	134
92	81	118	94	140	144	91	135
93	82	120	95	141	145	94	137
94	84	122	96	142	146	96	138
95	85	124	98	141	147	98	140
96	86	126	99	141	148	100	141
97	88	126	100	141	150	102	142
98	89	128	101	142	151	104	144
99	91	129	102	143	152	103	145
100	92	131	103	144	153	104	147
101	94	132	104	146	154	105	148
102	95	133	105	148	155	107	150
103	97	133	106	149	157	108	151
104	98	134	108	151	158	110	153
105	100	135	109	152	159	112	155
106	101	136	110	154	161	114	156
107	102	136	111	156	162	115	158
108	104	137	112	158	164	117	160
109	105	138	113	160	166	118	162
110	107	139	114	163	168	120	164
111	108	139	115	165	170	121	166
112	109	140	116	168	172	122	168
113	111	141	116	171	174	123	170
114	112	142	117	175	177	124	172
115	113	143	118	179	179	125	174
116	114	144	119	184	182	126	177
117	116	144	120	190	185	127	179
118	117	145	121	195	188	128	182
119	118	146	121	201	191	129	185
120	120	147	122	207	195	129	187

Table 4

FINDINGS

In our opinion and Given the testing and technical information supplied by IGNIS Fire Engineering, ResCom Building Products the evidence reviewed supports that the CENTURION Steel frame system will achieve a combined FRL of 90/90/90 when installed as per the prototype tested. Furthermore, the Structural adequacy of the specimen under consideration with reference to NCC, BCA and AS4100, AS4600, is 90 minutes.

This observation has been reinforced by referring to table 4 which indicates that at 90 minute interval the maximum temperature reached was 132 °c, with perceived reduction of steel being less than 10%.

NOTE:

It should be noted that any significant variation with respect to size, construction details, loads, stresses, strains, edge and end support conditions, other than those allowed under the field of the relevant test method, (Including Shanghai Testing Facility, but not limited to) is outside of the scope of this report and Atech Civil and Structural Pty Ltd, will not be held liable for any such changes and variations.

REPORT LIMITATIONS

1. This report has been created on good faith, based on the information and data provided by ResCom panel sponsor, Centurion Framing Systems P/L.
2. The conclusions reached in this report are strictly based on the fire test carried out on ResCom panel by Ignis Solutions (Chartered Professional Fire Safety Engineers).
3. This assessment is valid under the existing Australian Standard Codes and NCC-2016(BCA), SECTION C, Fire Resistance and will expire in March 2019.
4. Atech Civil & Structural will not be held liable for loss or damage resulting from any defect of the building or materials and non-compliance with the Fire services or equipment with any legislative or operational requirements.
5. This report is entirely based on the prototype test specimens testing conditions and procedures adopted by IGNIS and test samples provided by ResCom Boards provided by Centurion Framing Systems P/L. Any defects in the test samples which may lead to structural failure of the supporting members are outside the scope of this report.
6. Full structural analysis of the test specimens is not within the scope of this report. For steel studs and battens design, the manufacturer's safe load tables must be utilised for various design load conditions.

Written and Authorised by

A handwritten signature in blue ink, appearing to read 'K. Nemat', with a long horizontal stroke extending to the right.

Kevin Nemat (BE Civil, Master Eng, NER, MIE Aust, EC-1363)
Director

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REFERENCES:

2. Steel Structures Code AS 4100-1998
3. Steel Structures Code AS 4600-2018 Cold formed Steel Structures
4. NCC(BCA), SECTION C, Fire Resistance
5. IGNIS SOLUTIONS (Chartered Professional Fire Safety Engineers)- Report IGNS-6259 I01 R00, Revised on 13.12.2018.
6. AS 1530.4:2014
7. ResCom Installation manual
8. Distortional Buckling Behaviour of Cold Formed Steel Compression Members at Elevated Temperatures (Queensland University of Technology)
9. Fire resistance of cold-formed steel columns (University of Coimbra)
10. ResCom Test Report # IGNS-6259
11. Pilot Fire-Resistance test by SGS conducted on 25 Sept 2018.