

COMPFIRE

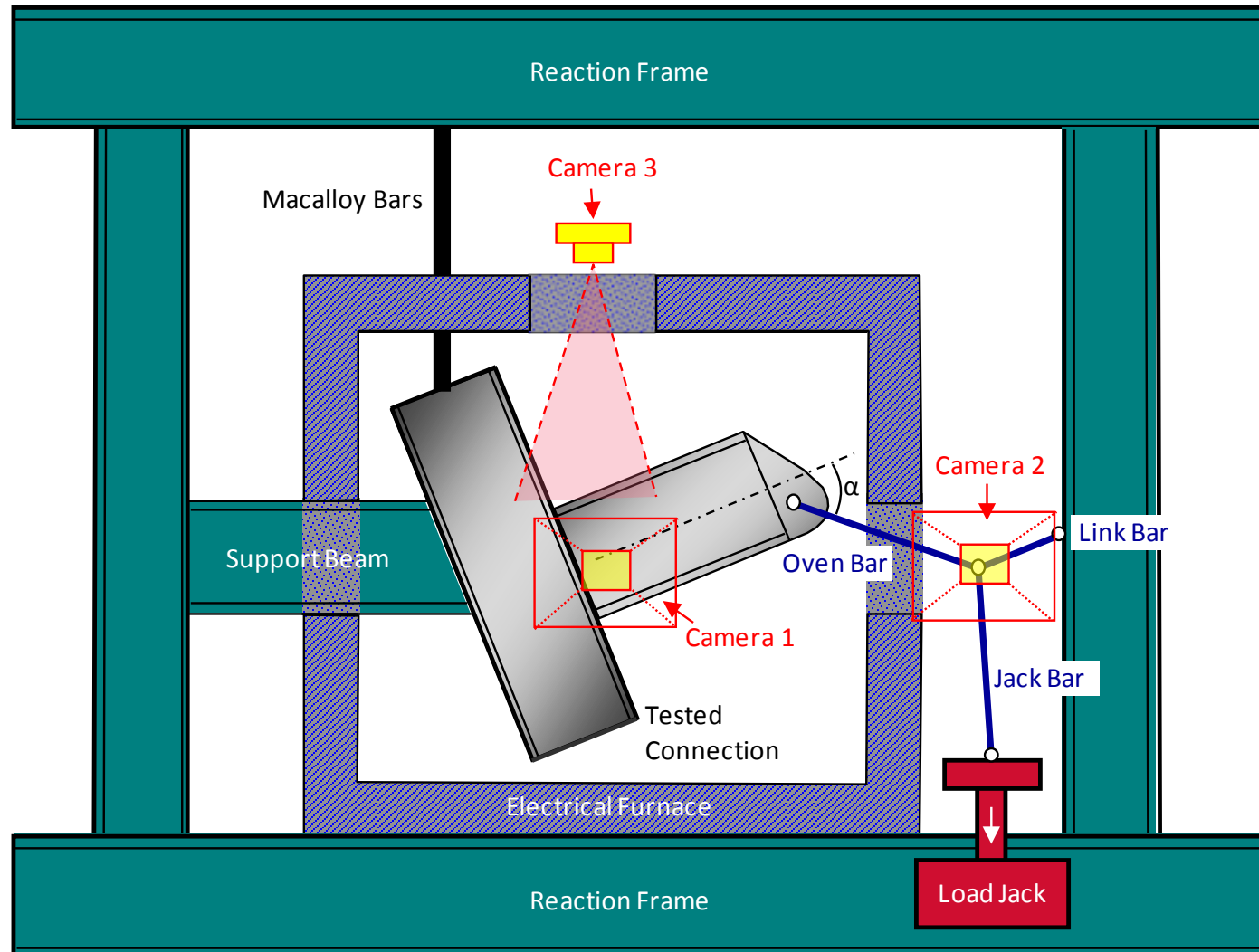
CCFT-RC200_550_55_10-01-2011

10 January 2011 Reverse Channel Connection (Cut from SHS200x6) to Circular Concrete-Filled Tube Test Result

RFSR-CT-2009-0021

Design of joints to composite columns for improved fire robustness

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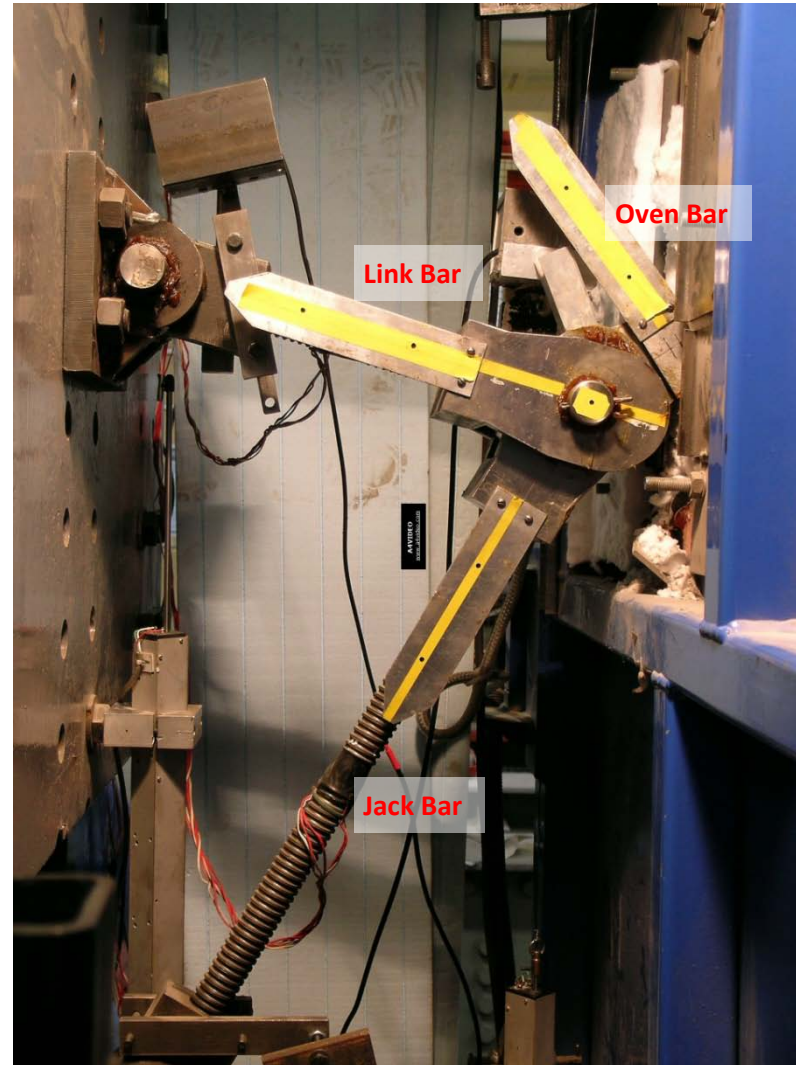
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View of Camera 1



View of Camera 3

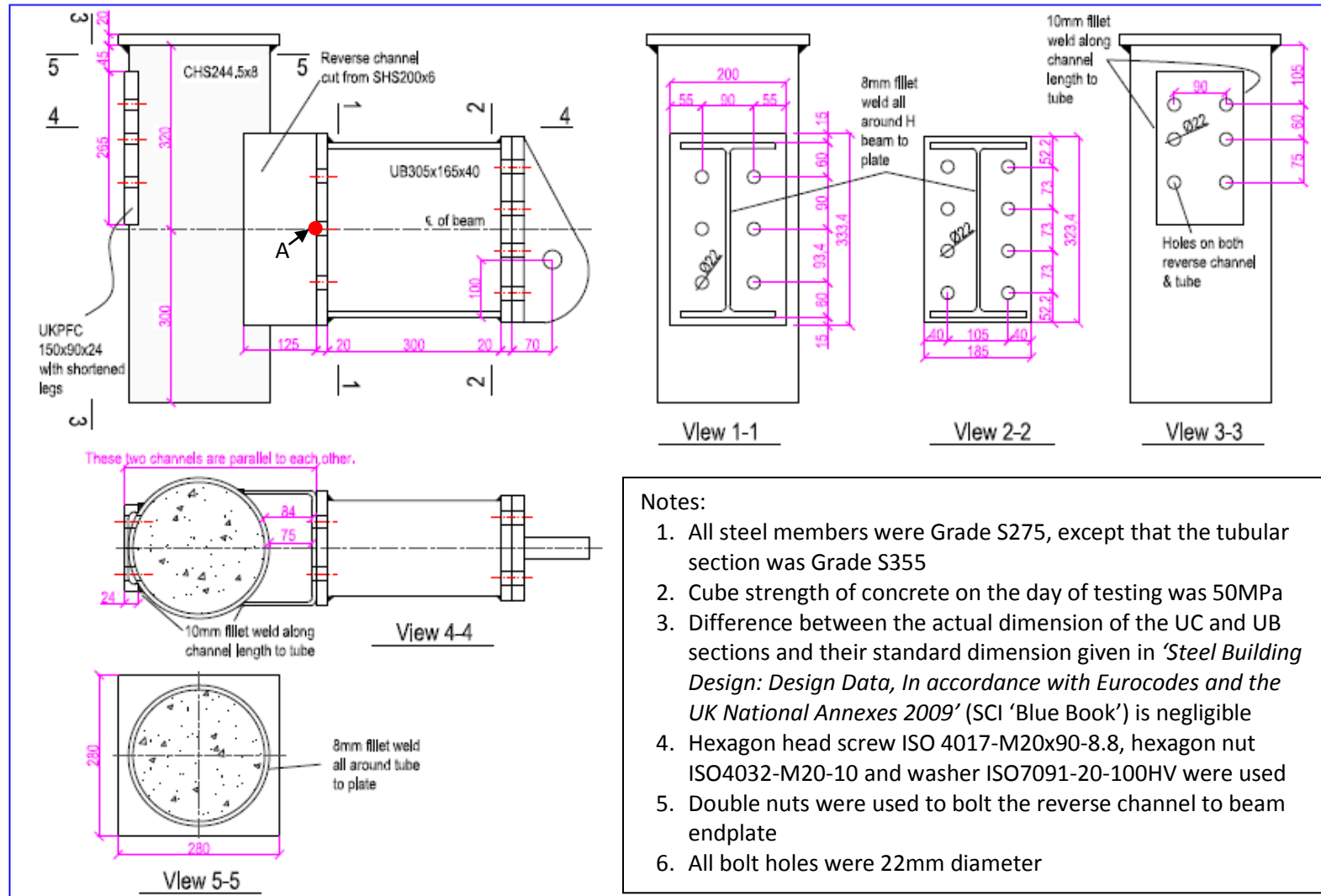


View of Camera 2

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Nominal Temperature: 550°C

Time	Temperature*	Jack Displacement	Load Angle	Beam Rotation	Column Rotation	Connection Rotation	Oven Bar Force	Tension	Shear	Moment**
(minute)	Average (°C)	(mm)	α (°)	(°)	(°)	(°)	(kN)	(kN)	(kN)	(kNm)
0	556.94	0.00	53.17	0.00	0.00	0.00	-9.41	-5.64	-7.53	-2.80
1	556.94	1.12	53.00	0.18	0.15	0.03	-5.94	-3.58	-4.75	-1.76
2	556.94	2.45	52.92	0.25	0.18	0.07	-2.97	-1.79	-2.37	-0.88
3	556.98	4.06	52.81	0.36	0.23	0.13	-0.90	-0.54	-0.71	-0.26
4	557.00	5.97	52.77	0.40	0.24	0.16	-0.78	-0.47	-0.62	-0.23
5	557.03	7.43	52.75	0.41	0.25	0.17	-0.59	-0.36	-0.47	-0.17
6	557.03	9.06	52.71	0.46	0.26	0.20	-0.05	-0.03	-0.04	-0.01
7	557.05	10.16	52.64	0.53	0.27	0.25	0.69	0.42	0.55	0.20
8	557.04	11.63	52.53	0.64	0.30	0.34	1.74	1.06	1.38	0.51
9	557.05	13.19	52.44	0.72	0.33	0.39	3.01	1.83	2.38	0.88
10	557.06	14.55	52.36	0.79	0.35	0.43	4.55	2.78	3.60	1.33
11	557.05	16.11	52.29	0.85	0.37	0.48	5.92	3.62	4.68	1.73
12	557.11	17.45	52.21	0.93	0.40	0.53	7.86	4.82	6.21	2.30
13	557.11	18.86	52.10	1.03	0.42	0.61	9.68	5.95	7.64	2.82
14	557.18	20.47	52.03	1.10	0.43	0.66	10.63	6.54	8.38	3.10
15	557.25	21.86	51.96	1.16	0.45	0.71	12.02	7.41	9.47	3.50
16	557.23	23.32	51.88	1.24	0.46	0.78	13.19	8.15	10.38	3.83
17	557.25	24.96	51.78	1.33	0.47	0.86	14.70	9.10	11.55	4.27
18	557.30	26.32	51.69	1.44	0.49	0.95	16.17	10.03	12.69	4.68
19	557.27	28.35	51.59	1.53	0.50	1.04	17.18	10.67	13.46	4.97
20	557.37	29.79	51.46	1.66	0.51	1.15	18.37	11.45	14.37	5.30
21	557.42	31.34	51.34	1.78	0.52	1.26	19.35	12.08	15.11	5.57

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22	557.45	32.86	51.22	1.90	0.53	1.37	20.22	12.66	15.76	5.81
23	557.52	34.40	51.08	2.03	0.53	1.50	21.03	13.21	16.36	6.03
24	557.56	35.90	50.94	2.16	0.55	1.62	21.81	13.74	16.94	6.23
25	557.62	37.35	50.80	2.30	0.55	1.76	22.54	14.24	17.47	6.42
26	557.64	38.85	50.67	2.44	0.55	1.89	23.21	14.71	17.95	6.60
27	557.69	40.36	50.52	2.58	0.56	2.02	23.73	15.09	18.32	6.73
28	557.72	41.89	50.38	2.72	0.57	2.15	24.35	15.53	18.75	6.89
29	557.74	43.38	50.23	2.86	0.57	2.29	24.94	15.95	19.17	7.03
30	557.83	44.88	50.07	3.02	0.59	2.42	25.43	16.32	19.50	7.15
31	557.85	46.40	49.94	3.15	0.59	2.57	25.88	16.66	19.81	7.26
32	557.90	47.93	49.78	3.31	0.59	2.72	26.40	17.05	20.15	7.38
33	557.97	49.49	49.63	3.46	0.61	2.85	26.84	17.39	20.45	7.49
34	557.97	50.80	49.49	3.60	0.61	2.99	27.44	17.82	20.86	7.63
35	558.05	52.55	49.32	3.76	0.61	3.15	27.95	18.22	21.20	7.75
36	558.07	53.99	49.16	3.91	0.63	3.28	28.36	18.55	21.46	7.84
37	558.14	55.64	49.00	4.06	0.62	3.44	28.87	18.94	21.79	7.95
38	558.16	57.14	48.85	4.22	0.64	3.58	29.29	19.28	22.06	8.05
39	558.18	58.68	48.68	4.38	0.64	3.74	29.78	19.66	22.36	8.15
40	558.24	60.16	48.52	4.54	0.65	3.89	30.41	20.14	22.78	8.30
41	558.28	61.70	48.37	4.69	0.65	4.04	30.74	20.42	22.97	8.36
42	558.31	63.06	48.22	4.83	0.66	4.18	31.29	20.85	23.33	8.49
43	558.36	64.54	48.06	4.99	0.66	4.34	31.71	21.19	23.59	8.57
44	558.37	65.97	47.91	5.15	0.67	4.48	32.17	21.57	23.87	8.67
45	558.45	67.46	47.74	5.31	0.68	4.63	32.71	21.99	24.21	8.79
46	558.50	68.97	47.59	5.46	0.68	4.78	33.28	22.44	24.57	8.91
47	558.54	70.43	47.43	5.62	0.69	4.93	33.99	23.00	25.03	9.08
48	558.60	71.81	47.25	5.80	0.70	5.10	34.42	23.36	25.28	9.16

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49	558.61	73.25	47.10	5.95	0.70	5.26	35.22	23.98	25.80	9.34
50	558.68	74.72	46.93	6.12	0.71	5.41	35.66	24.35	26.05	9.42
51	558.71	76.16	46.77	6.28	0.72	5.57	36.18	24.78	26.36	9.53
52	558.72	77.57	46.60	6.45	0.72	5.73	36.98	25.40	26.87	9.70
53	558.74	79.18	46.44	6.61	0.73	5.88	37.50	25.84	27.18	9.81
54	558.77	80.71	46.28	6.77	0.74	6.03	38.01	26.27	27.47	9.90
55	558.81	82.32	46.12	6.93	0.73	6.20	38.94	26.99	28.06	10.11
56	558.87	83.69	45.95	7.10	0.75	6.35	39.69	27.59	28.52	10.27
57	558.94	85.18	45.79	7.26	0.75	6.51	40.30	28.10	28.88	10.39
58	558.95	86.66	45.62	7.43	0.76	6.67	41.13	28.76	29.40	10.57
59	558.96	88.09	45.45	7.61	0.77	6.84	41.84	29.35	29.81	10.70
60	559.01	89.65	45.27	7.78	0.78	7.00	42.46	29.88	30.17	10.82
61	559.03	90.99	45.11	7.95	0.79	7.16	43.44	30.66	30.77	11.03
62	559.04	92.37	44.94	8.13	0.80	7.32	44.27	31.34	31.27	11.20
63	559.10	93.75	44.77	8.30	0.81	7.49	45.02	31.96	31.70	11.35
64	559.08	95.15	44.59	8.48	0.82	7.66	45.84	32.64	32.18	11.51
65	559.16	96.45	44.43	8.64	0.83	7.81	46.69	33.34	32.68	11.68
66	559.19	97.90	44.25	8.83	0.84	7.99	47.65	34.13	33.25	11.87
67	559.22	99.35	44.08	9.00	0.84	8.15	48.42	34.78	33.68	12.01
68	559.25	100.86	43.89	9.19	0.87	8.32	49.36	35.57	34.22	12.19
69	559.25	102.42	43.72	9.36	0.87	8.49	50.27	36.33	34.74	12.37
70	559.27	103.74	43.56	9.53	0.89	8.64	51.38	37.23	35.40	12.59
71	559.32	105.29	43.39	9.70	0.90	8.80	52.35	38.05	35.96	12.78
72	559.36	106.83	43.21	9.88	0.92	8.96	53.38	38.91	36.55	12.97
73	559.39	108.22	43.05	10.05	0.93	9.12	54.53	39.85	37.22	13.20
74	559.40	109.92	42.87	10.23	0.95	9.28	55.56	40.72	37.80	13.39
75	559.41	111.37	42.68	10.42	0.97	9.45	56.65	41.64	38.40	13.59

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76	559.47	112.81	42.50	10.61	0.98	9.62	57.97	42.74	39.16	13.85
77	559.48	114.33	42.34	10.77	1.00	9.77	59.17	43.73	39.86	14.08
78	559.56	115.85	42.15	10.96	1.03	9.94	60.26	44.67	40.44	14.27
79	559.55	117.34	41.96	11.16	1.04	10.12	61.43	45.68	41.07	14.48
80	559.56	118.83	41.79	11.34	1.06	10.28	62.70	46.75	41.78	14.71
81	559.49	120.42	41.62	11.51	1.10	10.41	63.98	47.83	42.49	14.95
82	559.46	121.63	41.44	11.70	1.12	10.58	65.23	48.90	43.17	15.17
83	559.60	122.90	41.26	11.88	1.14	10.74	66.44	49.95	43.81	15.38
84	559.72	124.19	41.07	12.07	1.16	10.91	67.89	51.18	44.60	15.64
85	559.78	125.52	40.90	12.25	1.20	11.05	69.19	52.30	45.30	15.87
86	559.70	126.90	40.72	12.43	1.23	11.20	70.34	53.31	45.89	16.06
87	559.70	128.26	40.54	12.62	1.26	11.35	71.83	54.59	46.68	16.32
88	559.75	129.77	40.34	12.81	1.30	11.52	72.87	55.54	47.17	16.47
89	559.75	131.21	40.17	12.99	1.32	11.67	74.55	56.97	48.09	16.77
90	559.82	132.65	39.97	13.19	1.37	11.82	75.57	57.91	48.55	16.91
91	559.86	134.19	39.79	13.38	1.42	11.96	76.83	59.04	49.18	17.11
92	559.90	135.70	39.61	13.57	1.46	12.11	78.03	60.12	49.75	17.29
93	559.91	137.10	39.42	13.76	1.51	12.24	79.39	61.33	50.41	17.50
94	559.86	138.63	39.22	13.96	1.55	12.41	80.69	62.51	51.02	17.69
95	559.89	140.19	39.04	14.15	1.59	12.56	82.17	63.83	51.75	17.92
96	559.99	141.67	38.84	14.35	1.65	12.71	83.19	64.79	52.17	18.04
97	560.09	143.33	38.64	14.56	1.69	12.86	84.45	65.96	52.73	18.21
98	560.19	144.86	38.46	14.75	1.73	13.02	85.61	67.04	53.24	18.36
99	560.19	146.38	38.27	14.95	1.77	13.18	87.20	68.47	54.01	18.60
100	560.64	147.91	38.07	15.16	1.80	13.36	88.51	69.68	54.57	18.77
101	560.66	149.49	37.87	15.36	1.85	13.52	89.97	71.02	55.23	18.97
102	560.77	151.10	37.68	15.56	1.89	13.68	91.00	72.02	55.63	19.08



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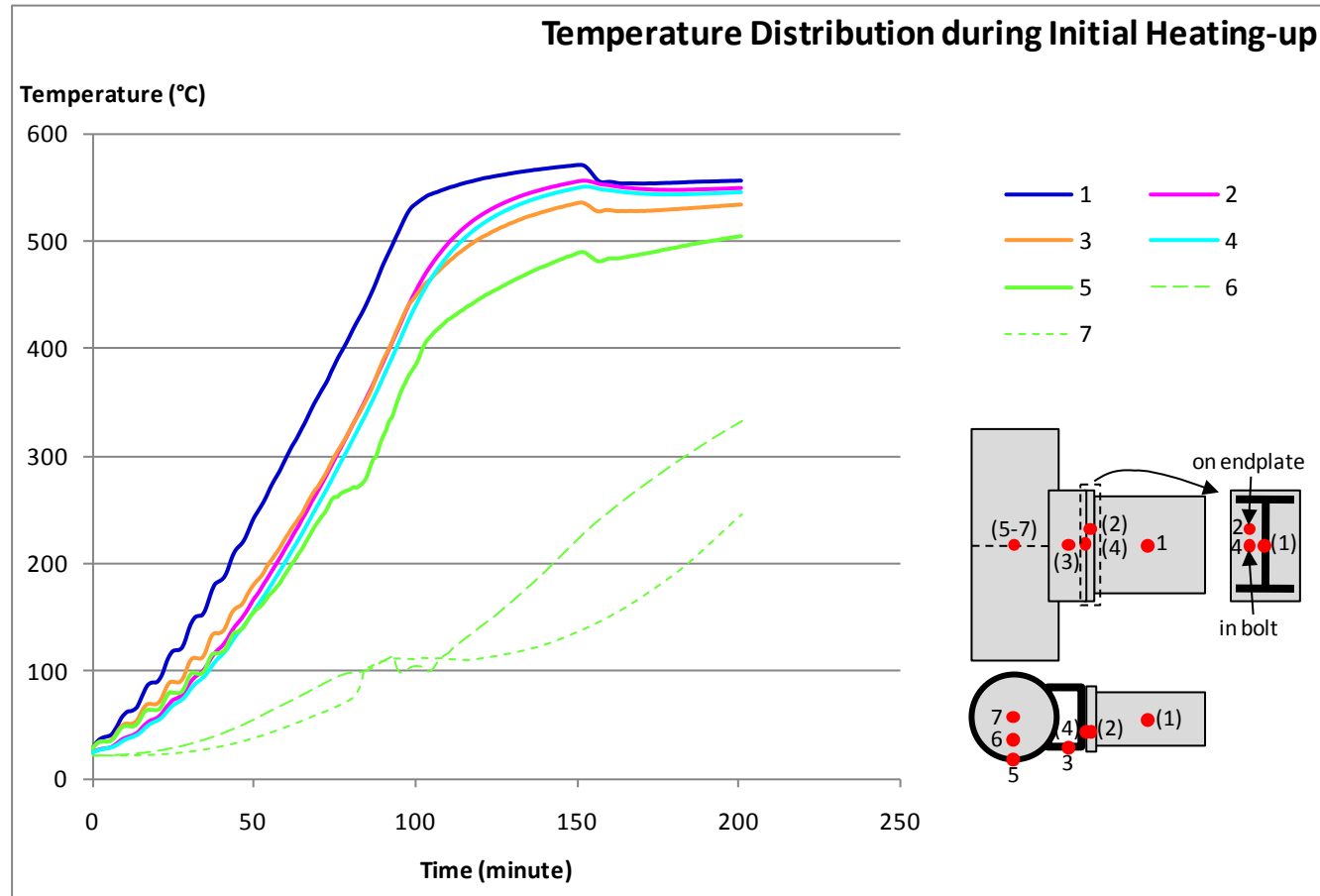
103	560.85	152.61	37.48	15.78	1.91	13.87	92.42	73.35	56.23	19.26
104	560.85	154.11	37.27	16.00	1.95	14.05	93.39	74.33	56.55	19.34
105	560.92	155.57	37.06	16.21	1.99	14.22	94.86	75.70	57.17	19.53
106	560.93	156.98	36.86	16.43	2.02	14.41	95.82	76.67	57.47	19.60
107	560.98	158.63	36.65	16.65	2.05	14.60	96.54	77.45	57.62	19.62
108	560.99	160.00	36.43	16.87	2.09	14.78	97.62	78.54	57.97	19.71
109	560.89	161.69	36.22	17.10	2.11	14.99	98.22	79.24	58.03	19.70
110	560.82	163.36	36.01	17.31	2.14	15.17	99.73	80.68	58.63	19.87
111	560.80	164.96	35.84	17.50	2.17	15.32	100.50	81.48	58.84	19.91
112	560.76	166.46	35.69	17.65	2.20	15.45	100.94	81.98	58.89	19.91
113	560.73	167.99	35.57	17.78	2.22	15.56	102.13	83.07	59.41	20.06
114	560.73	169.56	35.45	17.91	2.25	15.66	102.29	83.33	59.33	20.02

* Average temperature of the beam web, endplate, reverse channel and bolt

** Moment about Point A on the specimen drawing

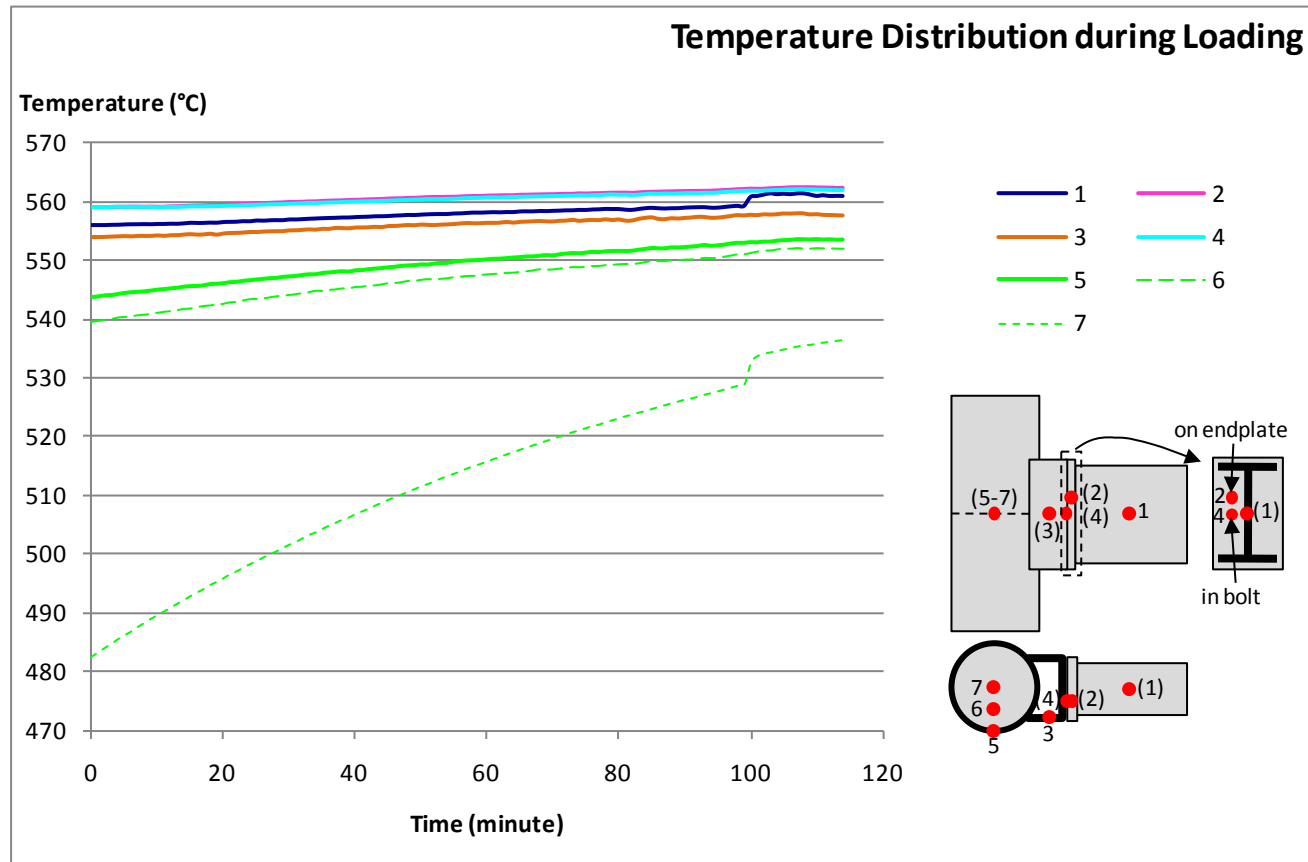
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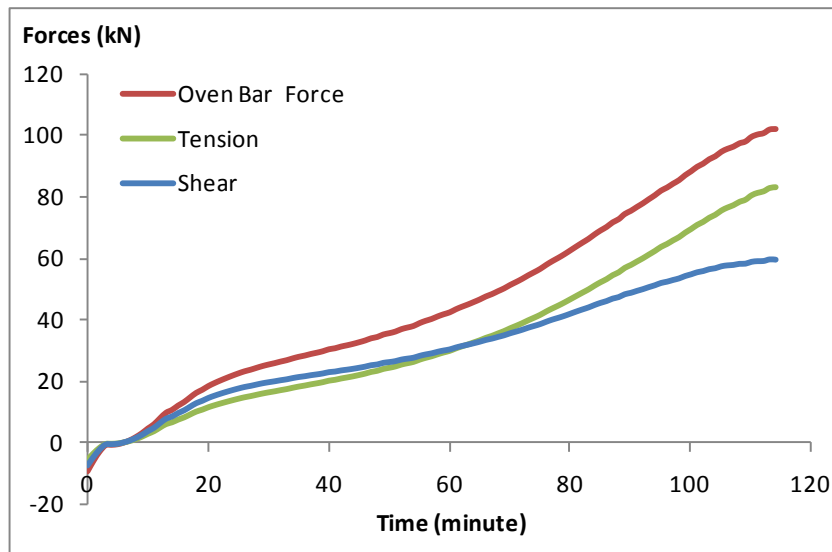
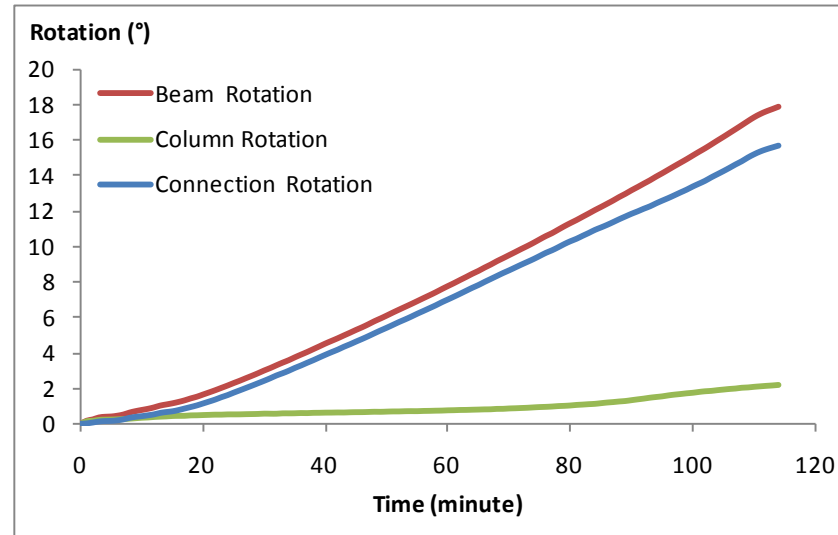
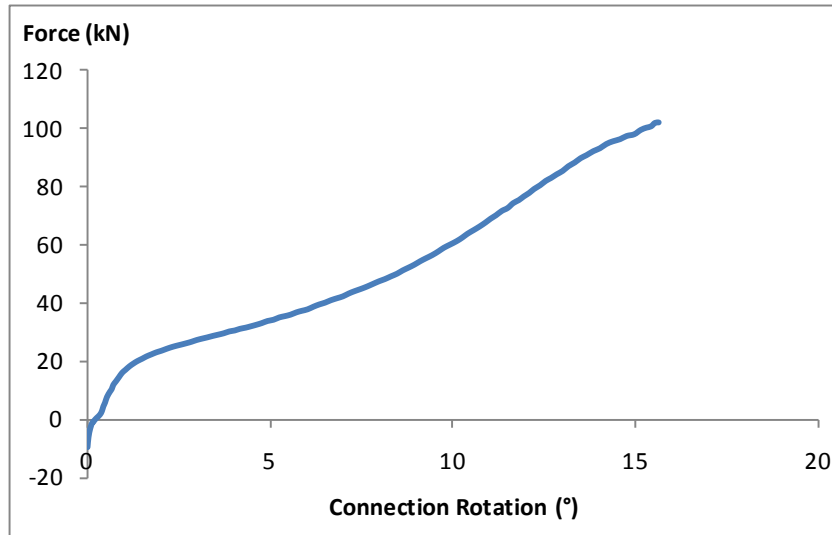
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The ultimate capacity of the specimen was not reached. The loading had to be stopped when the deformation of the specimen was so large that it exceeded the space limit of the furnace (the oven bar touched the oven wall).

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Design of joints to composite columns for improved fire robustness

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Photographs after Test



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