

COMPFIRE

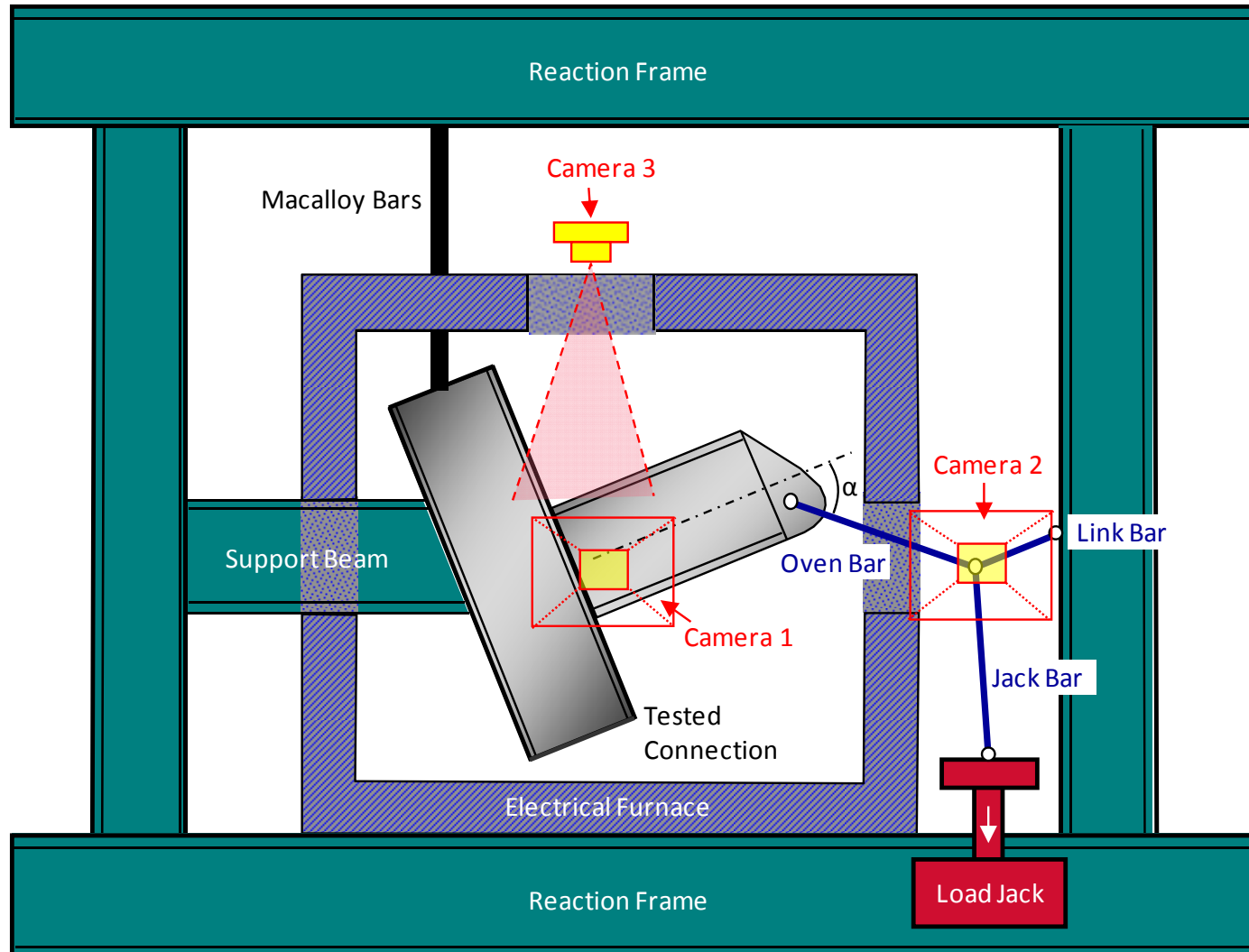
PE-EP_550_55_16-06-2010

16 June 2010 Flush Endplate Connection to Partially-Encased Column Test Result

RFSR-CT-2009-0021

Design of joints to composite columns for improved fire robustness

[ftp://openspace.dec.uc.pt/](http://openspace.dec.uc.pt/)



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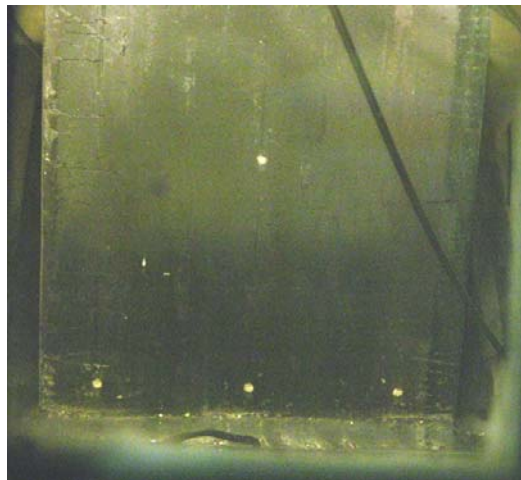
RFSR-CT-2009-0021

Design of joints to composite columns for improved fire robustness

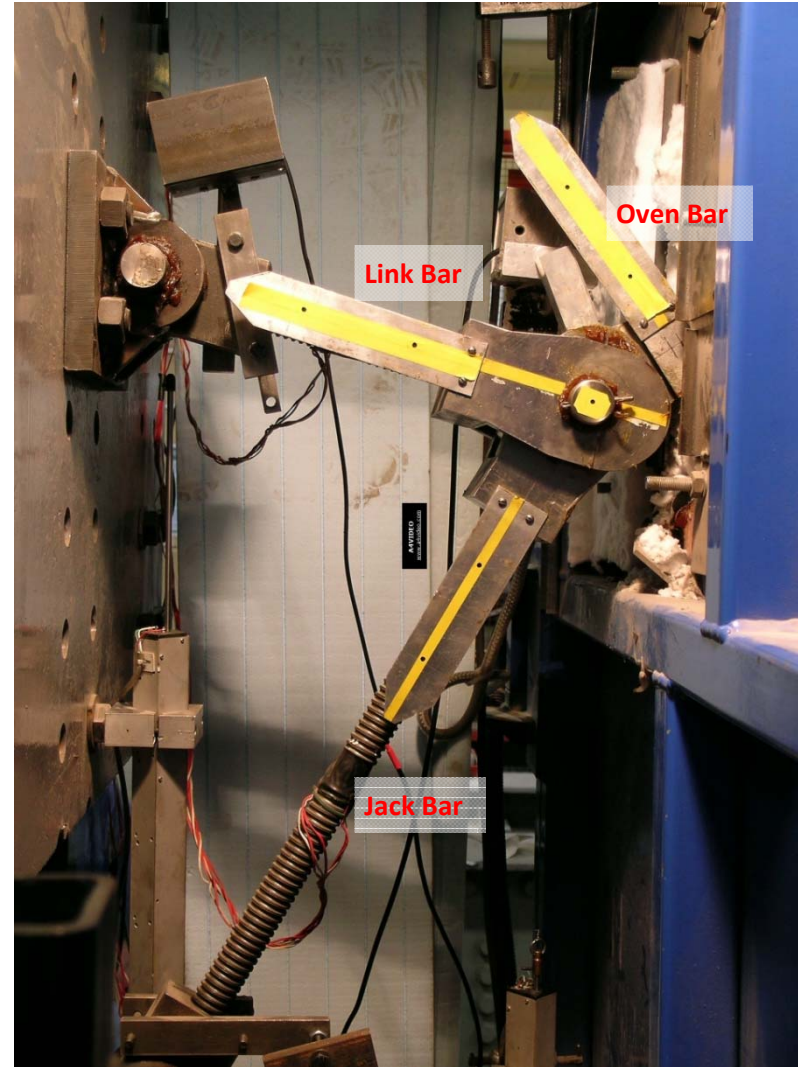
<ftp://openspace.dec.uc.pt/>



View of Camera 1



View of Camera 3

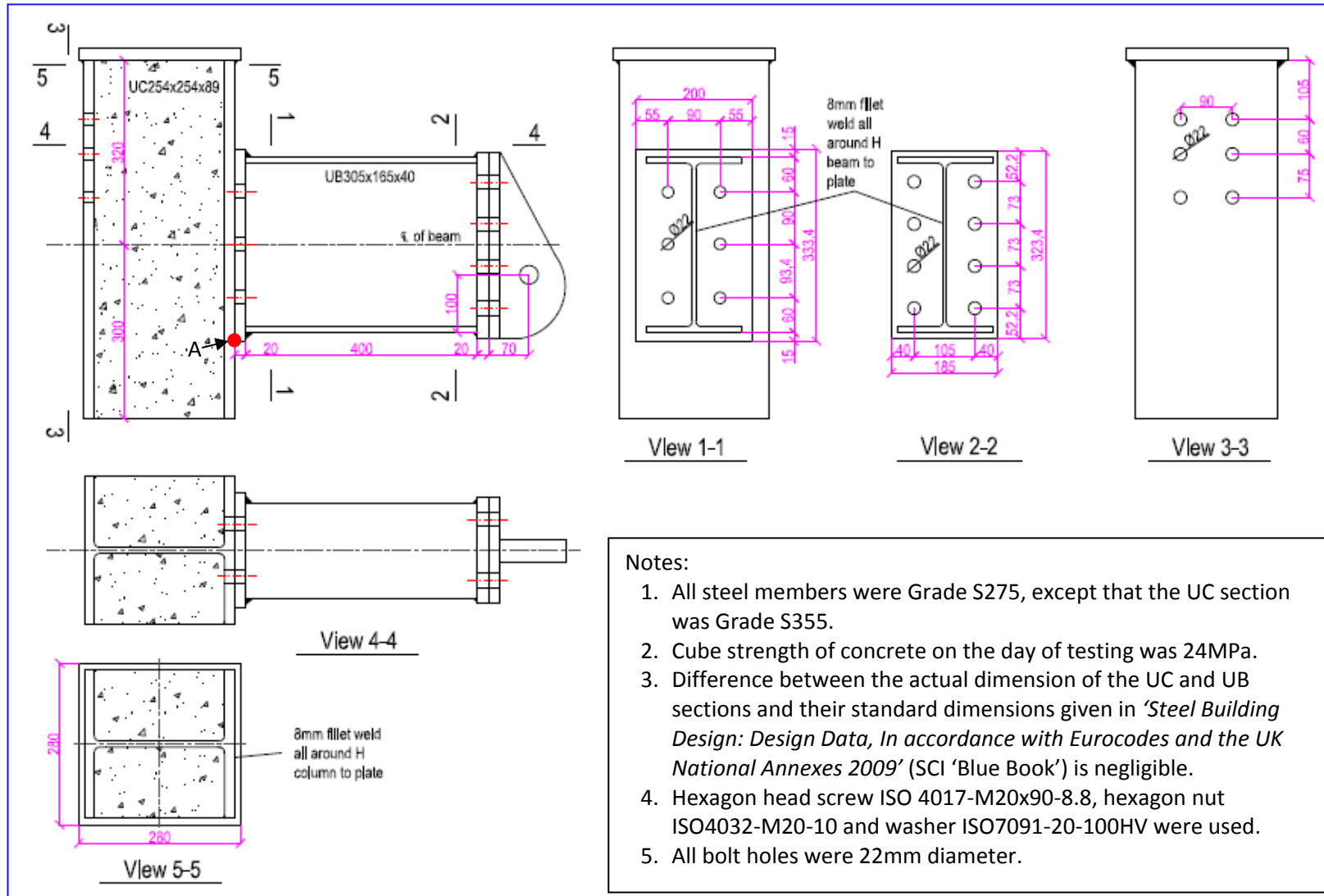


View of Camera 2

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16 June 2010 Flush Endplate Connection to Partially-Encased Column Test Result

Nominal Temperature: 550°C

Time	Temperature*	Jack Displacement	Load Angle	Beam Rotation	Column Rotation	Connection Rotation	Oven Bar Force	Tension	Shear	Moment**
(minute)	(°C)	(mm)	α (°)	(°)	(°)	(°)	(kN)	(kN)	(kN)	(kNm)
0	542.12	-0.04	59.65	0.00	0.00	0.00	-10.48	-5.29	-9.04	-5.22
1	542.08	1.33	59.65	0.12	0.13	-0.01	-7.69	-3.89	-6.63	-3.83
2	542.03	2.86	59.58	0.20	0.22	-0.02	-5.21	-2.64	-4.49	-2.59
3	542.05	4.63	59.43	0.26	0.26	0.00	-3.00	-1.53	-2.58	-1.49
4	542.06	6.26	59.40	0.30	0.29	0.01	-1.70	-0.87	-1.46	-0.85
5	542.00	7.93	59.24	0.33	0.33	-0.01	-1.08	-0.55	-0.92	-0.53
6	542.01	9.23	59.07	0.35	0.35	0.00	-0.45	-0.23	-0.39	-0.22
7	541.97	10.52	58.74	0.40	0.40	0.00	0.34	0.18	0.29	0.17
8	542.04	12.14	58.68	0.44	0.45	0.00	1.64	0.85	1.40	0.81
9	541.98	13.71	58.59	0.51	0.49	0.01	2.81	1.46	2.40	1.39
10	542.03	15.44	58.53	0.56	0.56	0.00	3.94	2.05	3.36	1.95
11	542.05	16.93	58.48	0.63	0.61	0.02	5.23	2.73	4.46	2.59
12	542.04	18.56	58.44	0.70	0.67	0.03	6.64	3.47	5.66	3.28
13	542.13	19.95	58.30	0.76	0.70	0.05	8.03	4.22	6.83	3.97
14	542.19	21.39	58.37	0.82	0.75	0.06	8.75	4.59	7.45	4.33
15	542.23	22.85	58.31	0.85	0.81	0.04	10.00	5.25	8.51	4.94
16	542.32	24.14	58.15	0.89	0.83	0.06	11.12	5.87	9.44	5.49
17	542.35	25.62	58.11	0.95	0.86	0.08	13.24	7.00	11.24	6.54
18	542.41	26.96	58.09	1.01	0.90	0.11	16.04	8.48	13.61	7.92
19	542.45	28.41	58.03	1.07	0.98	0.09	19.10	10.11	16.20	9.42
20	542.54	30.46	57.93	1.13	1.03	0.10	22.27	11.83	18.87	10.99
21	542.56	31.90	57.90	1.20	1.10	0.10	25.85	13.73	21.90	12.75



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22	542.61	33.35	57.91	1.27	1.17	0.10	29.69	15.78	25.15	14.64
23	542.65	34.75	57.78	1.33	1.22	0.11	33.86	18.05	28.65	16.68
24	542.75	36.41	57.68	1.39	1.27	0.12	38.09	20.36	32.18	18.76
25	542.83	37.99	57.70	1.46	1.34	0.12	42.44	22.68	35.87	20.90
26	542.85	39.73	57.64	1.53	1.36	0.17	46.95	25.13	39.66	23.12
27	542.90	41.43	57.54	1.59	1.39	0.20	51.47	27.62	43.43	25.33
28	542.97	42.93	57.56	1.66	1.42	0.24	56.10	30.09	47.35	27.61
29	543.09	44.54	57.45	1.73	1.49	0.25	60.68	32.65	51.15	29.84
30	543.13	46.10	57.47	1.80	1.55	0.25	65.11	35.02	54.90	32.02
31	543.25	46.40	57.40	1.88	1.58	0.30	69.37	37.38	58.44	34.10
32	543.31	48.00	57.40	1.96	1.60	0.36	73.45	39.58	61.88	36.11
33	543.41	49.55	57.28	2.05	1.66	0.39	77.18	41.71	64.94	37.91
34	543.49	51.15	57.23	2.14	1.69	0.45	80.87	43.77	68.00	39.71
35	543.53	52.78	57.20	2.24	1.74	0.50	84.09	45.55	70.69	41.29
36	543.68	54.38	57.12	2.32	1.76	0.56	86.98	47.21	73.05	42.69
37	543.79	56.01	57.06	2.42	1.84	0.57	89.69	48.77	75.28	44.00
38	543.93	57.53	56.99	2.51	1.85	0.66	92.16	50.21	77.28	45.19
39	544.01	59.21	56.89	2.62	1.90	0.72	94.33	51.53	79.01	46.22
40	544.08	60.78	56.91	2.73	1.90	0.83	96.18	52.51	80.58	47.13
41	544.20	62.40	56.80	2.83	1.94	0.90	97.87	53.58	81.89	47.93
42	544.31	64.02	56.72	2.95	1.98	0.97	99.17	54.42	82.91	48.54
43	544.44	65.72	56.63	3.07	2.00	1.07	100.32	55.18	83.78	49.07
44	544.53	67.45	56.55	3.19	2.05	1.14	99.97	55.10	83.41	48.88
45	544.60	68.96	56.48	3.32	2.06	1.26	100.11	55.28	83.46	48.92
46	544.72	70.61	56.34	3.46	2.07	1.38	97.91	54.27	81.49	47.80
47	544.82	72.19	56.17	3.60	2.06	1.55	96.06	53.48	79.80	46.85
48	544.98	73.89	55.96	3.76	2.05	1.70	93.54	52.36	77.52	45.55

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49	545.08	75.59	55.85	3.92	2.01	1.91	90.53	50.82	74.92	44.05
50	545.19	77.36	55.59	4.11	1.96	2.15	83.40	47.13	68.81	40.51
51	545.31	78.93	55.48	4.26	2.01	2.25	83.15	47.12	68.51	40.36
52	545.35	80.52	55.27	4.39	1.99	2.40	83.23	47.42	68.41	40.34
53	545.45	82.09	55.17	4.56	1.97	2.59	80.50	45.98	66.08	38.99
54	545.58	83.85	54.94	4.75	1.93	2.82	73.51	42.23	60.17	35.54
55	545.65	85.46	54.75	4.92	1.93	2.99	73.62	42.49	60.12	35.55
56	545.82	87.15	54.55	5.06	1.90	3.16	74.55	43.24	60.73	35.94
57	545.96	88.81	54.37	5.24	1.91	3.33	70.36	40.99	57.19	33.88
58	546.01	90.52	54.04	5.44	1.89	3.55	63.79	37.46	51.64	30.64
59	546.14	92.09	53.90	5.61	1.85	3.76	62.36	36.75	50.39	29.92
60	546.25	93.73	53.71	5.80	1.80	4.00	57.26	33.89	46.15	27.44
61	546.45	95.29	53.47	5.97	1.80	4.17	55.75	33.19	44.80	26.66
62	546.50	96.70	53.28	6.11	1.78	4.33	58.44	34.94	46.84	27.91
63	546.52	98.23	53.16	6.28	1.78	4.49	57.16	34.27	45.75	27.27
64	546.58	99.79	52.86	6.49	1.74	4.75	50.57	30.53	40.31	24.07
65	546.64	101.50	52.74	6.66	1.73	4.93	49.62	30.04	39.49	23.59
66	546.73	103.03	52.49	6.84	1.72	5.12	47.17	28.72	37.42	22.39
67	546.86	104.62	52.29	7.01	1.72	5.29	46.09	28.19	36.46	21.84
68	546.98	106.17	52.12	7.18	1.71	5.48	45.22	27.77	35.69	21.40
69	547.06	107.83	51.86	7.38	1.69	5.69	41.05	25.36	32.29	19.38
70	547.11	109.43	51.67	7.57	1.67	5.90	38.56	23.92	30.25	18.18
71	547.18	111.02	51.49	7.74	1.67	6.07	36.29	22.60	28.40	17.08
72	547.23	112.58	51.35	7.90	1.64	6.26	37.18	23.22	29.03	17.48
73	547.35	114.08	51.22	8.05	1.65	6.40	38.71	24.25	30.18	18.18
74	547.49	115.86	51.02	8.24	1.64	6.60	36.37	22.88	28.27	17.05
75	547.44	117.54	50.71	8.44	1.60	6.85	31.73	20.09	24.56	14.84



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76	547.55	119.24	50.57	8.64	1.57	7.08	29.02	18.43	22.41	13.55
77	547.55	120.91	50.44	8.80	1.60	7.20	30.40	19.36	23.44	14.18
78	547.64	122.49	50.29	8.96	1.59	7.38	31.70	20.25	24.39	14.77
79	547.68	124.03	50.12	9.14	1.60	7.54	29.99	19.23	23.01	13.95
80	547.80	125.81	49.89	9.35	1.59	7.77	25.21	16.25	19.28	11.70
81	547.87	127.56	49.60	9.56	1.55	8.01	21.56	13.97	16.42	9.98
82	548.01	129.09	49.53	9.73	1.58	8.15	22.69	14.73	17.26	10.50
83	548.01	130.65	49.43	9.89	1.59	8.29	24.12	15.69	18.32	11.15
84	548.17	132.24	49.31	10.07	1.58	8.49	24.37	15.89	18.48	11.25
85	548.14	133.88	49.13	10.27	1.54	8.73	21.30	13.94	16.11	9.82
86	548.22	135.59	48.89	10.49	1.50	9.00	17.63	11.59	13.28	8.11
87	548.28	137.19	48.74	10.68	1.50	9.19	18.23	12.02	13.70	8.37
88	548.40	138.84	48.63	10.85	1.50	9.36	18.58	12.28	13.95	8.52
89	548.48	140.49	48.45	11.07	1.49	9.57	16.61	11.02	12.43	7.61
90	548.49	142.09	48.26	11.28	1.46	9.83	14.00	9.32	10.45	6.40
91	548.58	143.62	48.14	11.47	1.44	10.03	14.58	9.73	10.86	6.66
92	548.60	145.25	48.07	11.65	1.43	10.21	15.53	10.37	11.55	7.08
93	548.65	146.76	47.92	11.85	1.42	10.43	14.40	9.65	10.69	6.56
94	548.67	148.57	47.74	12.08	1.41	10.67	12.08	8.12	8.94	5.49
95	548.88	150.06	47.60	12.28	1.39	10.89	11.75	7.92	8.68	5.34
96	548.99	151.92	47.56	12.47	1.40	11.08	12.12	8.18	8.94	5.50
97	549.04	153.52	47.39	12.68	1.40	11.29	11.67	7.90	8.59	5.29
98	549.03	155.32	47.25	12.91	1.40	11.50	11.08	7.52	8.13	5.01
99	549.12	157.07	47.13	13.13	1.40	11.72	10.93	7.43	8.01	4.94
100	549.13	158.67	46.98	13.35	1.40	11.94	10.90	7.44	7.97	4.92
101	549.22	160.19	46.85	13.57	1.40	12.17	10.82	7.40	7.89	4.88
102	549.23	161.83	46.77	13.79	1.38	12.41	10.28	7.04	7.49	4.63

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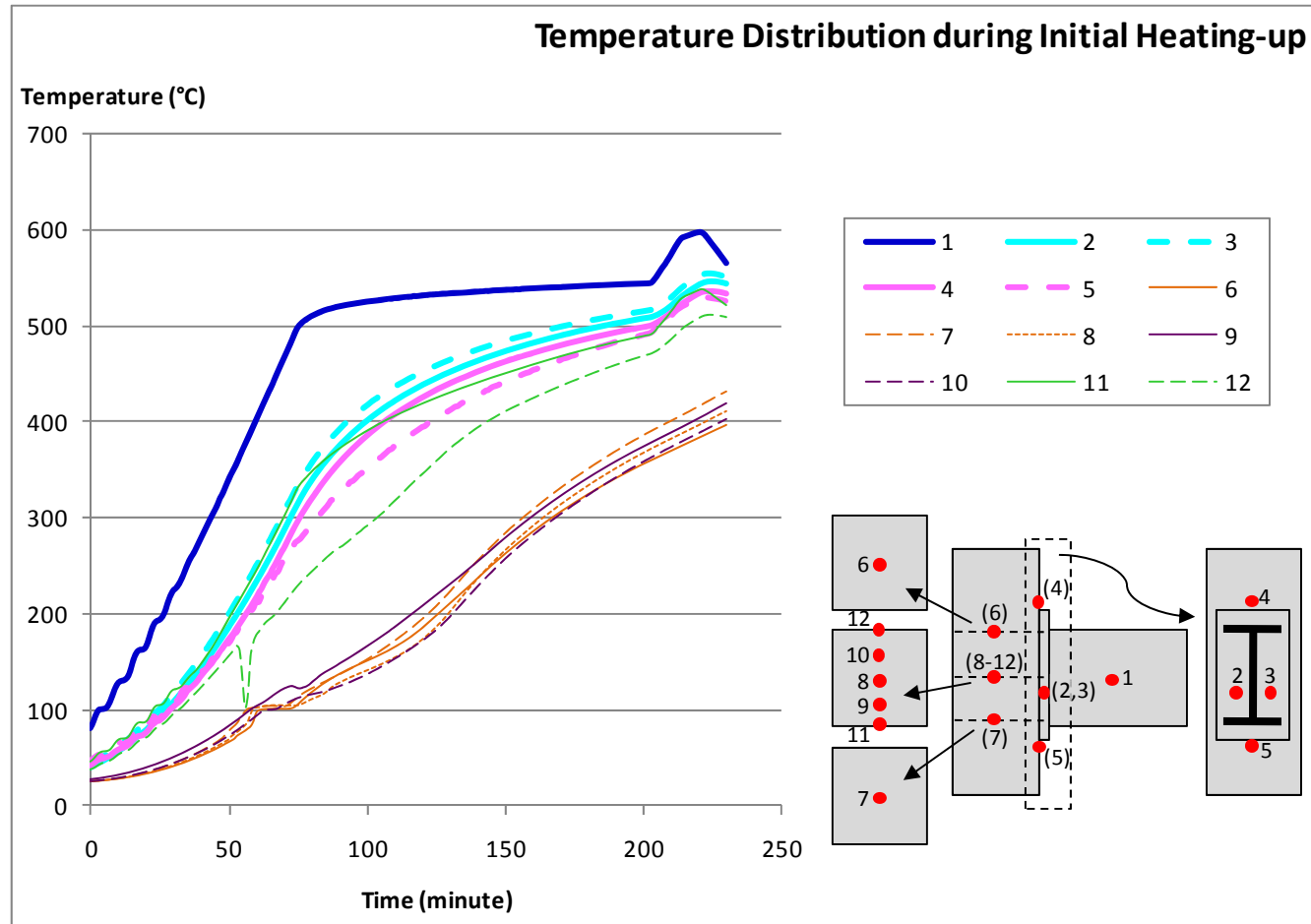
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103	549.31	163.47	46.63	14.02	1.39	12.63	9.89	6.79	7.19	4.45
104	549.40	165.15	46.51	14.26	1.39	12.87	9.60	6.61	6.96	4.31
105	549.44	166.78	46.38	14.49	1.41	13.09	9.42	6.50	6.82	4.22
106	549.50	168.57	46.26	14.73	1.41	13.31	9.30	6.43	6.72	4.16
107	549.53	170.31	46.15	14.96	1.39	13.57	9.27	6.42	6.68	4.15
108	549.60	171.93	46.02	15.20	1.40	13.80	9.58	6.65	6.89	4.28
109	549.67	173.55	45.91	15.44	1.41	14.03	10.02	6.97	7.20	4.47
110	549.76	175.11	45.87	15.64	1.43	14.21	10.44	7.27	7.49	4.66
111	549.80	176.80	45.81	15.86	1.43	14.43	10.54	7.35	7.56	4.70
112	549.88	178.35	45.84	15.98	1.40	14.58	10.51	7.32	7.54	4.69
113	549.95	179.97	45.87	16.08	1.45	14.63	10.20	7.10	7.32	4.55
114	549.99	181.87	45.98	16.10	1.42	14.68	9.71	6.75	6.98	4.34
115	550.05	183.61	46.04	16.13	1.42	14.71	9.29	6.45	6.69	4.15

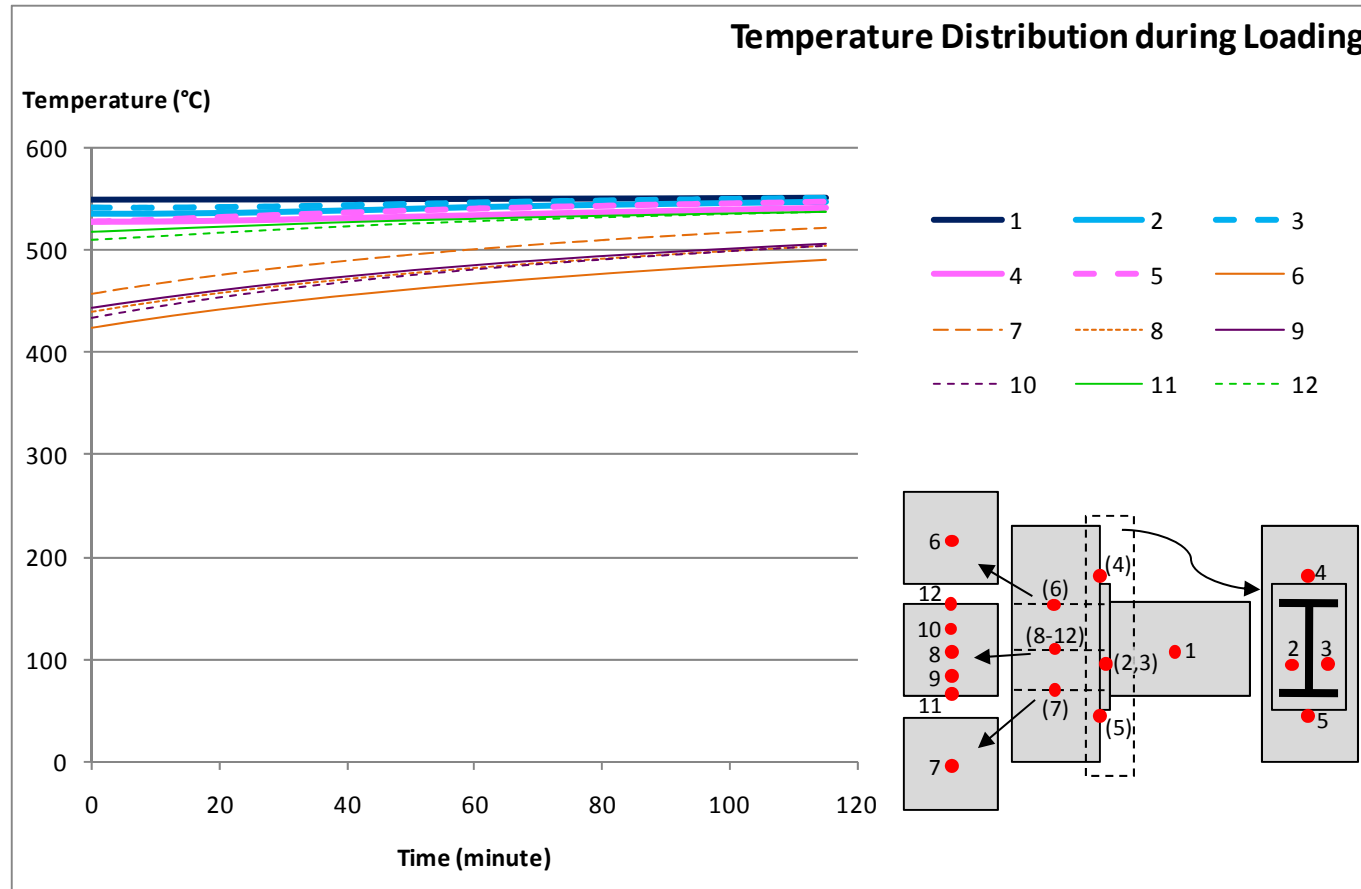
* Average temperature of the beam web and endplate

** Moment about Point A on the specimen drawing



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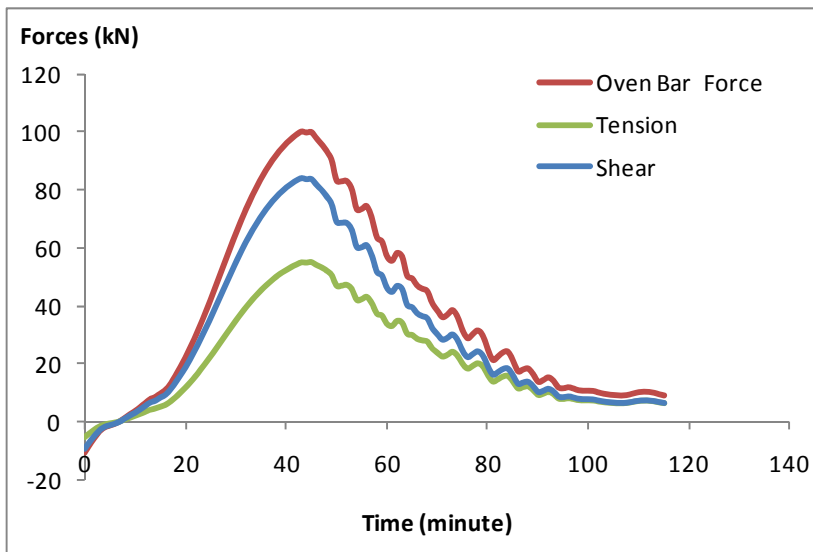
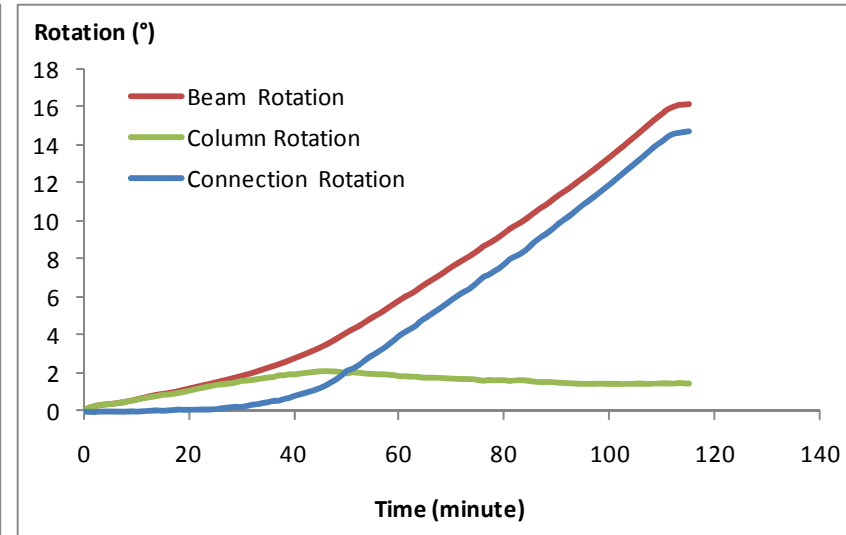
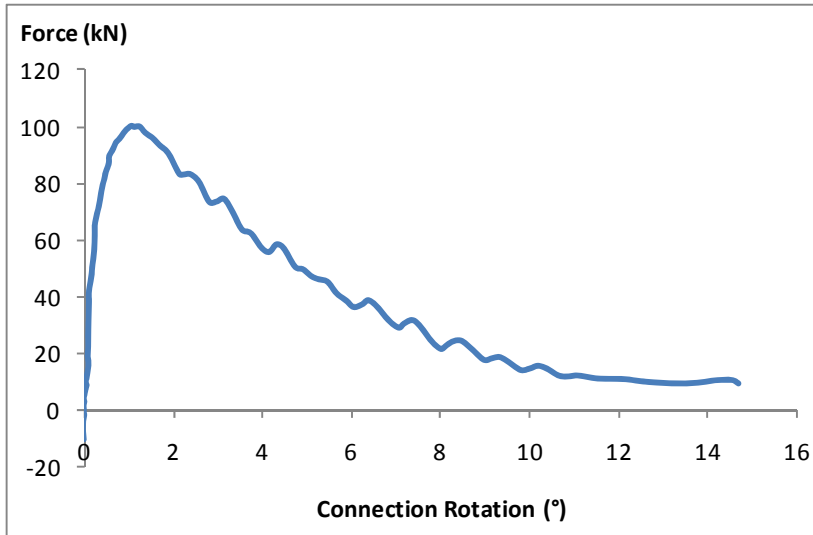
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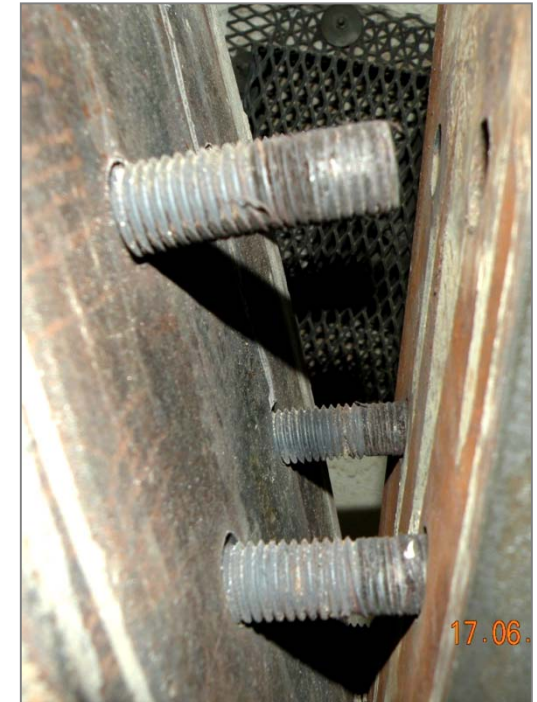
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RFSR-CT-2009-0021

Design of joints to composite columns for improved fire robustness

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Photographs after Test



Failure mode: nut stripping of all bolts