

Fig. 1. Cruciform test configuration and loading arrangement (all dimensions are in mm).

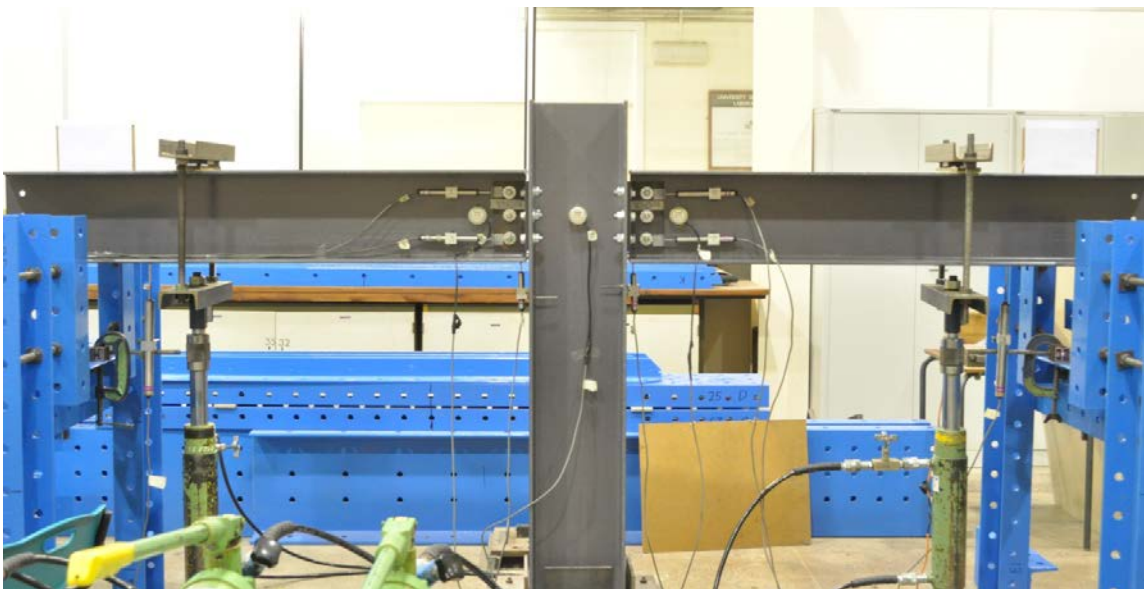


Fig. 2. General test arrangement for major-axis beam-to-column joint Wmj254_3M16_ST1-2.

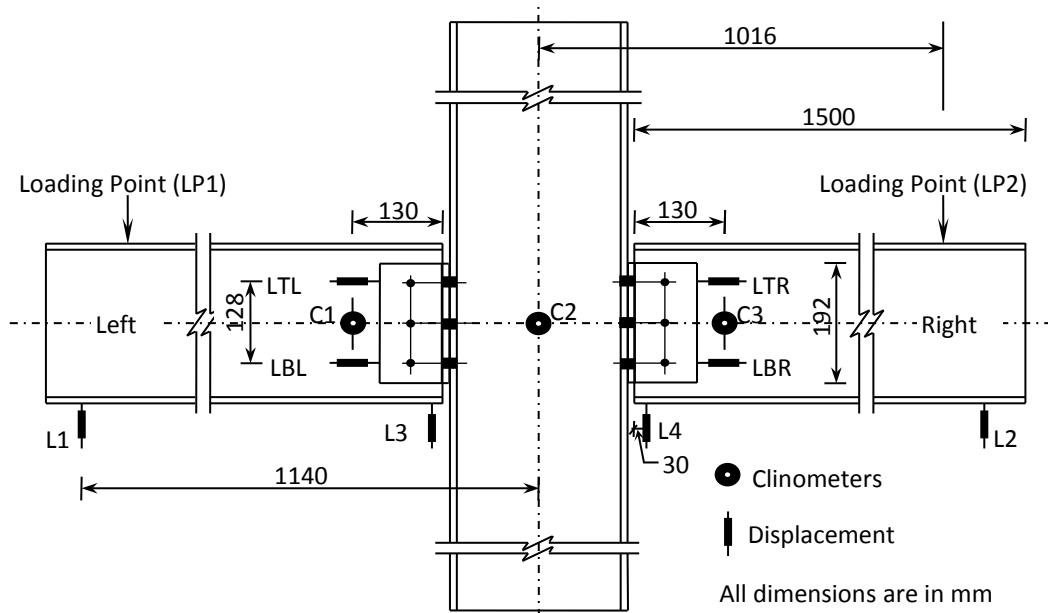


Fig. 3. Location of instrumentation in nominally pinned beam-to-column joint tests (all dimensions are in mm).

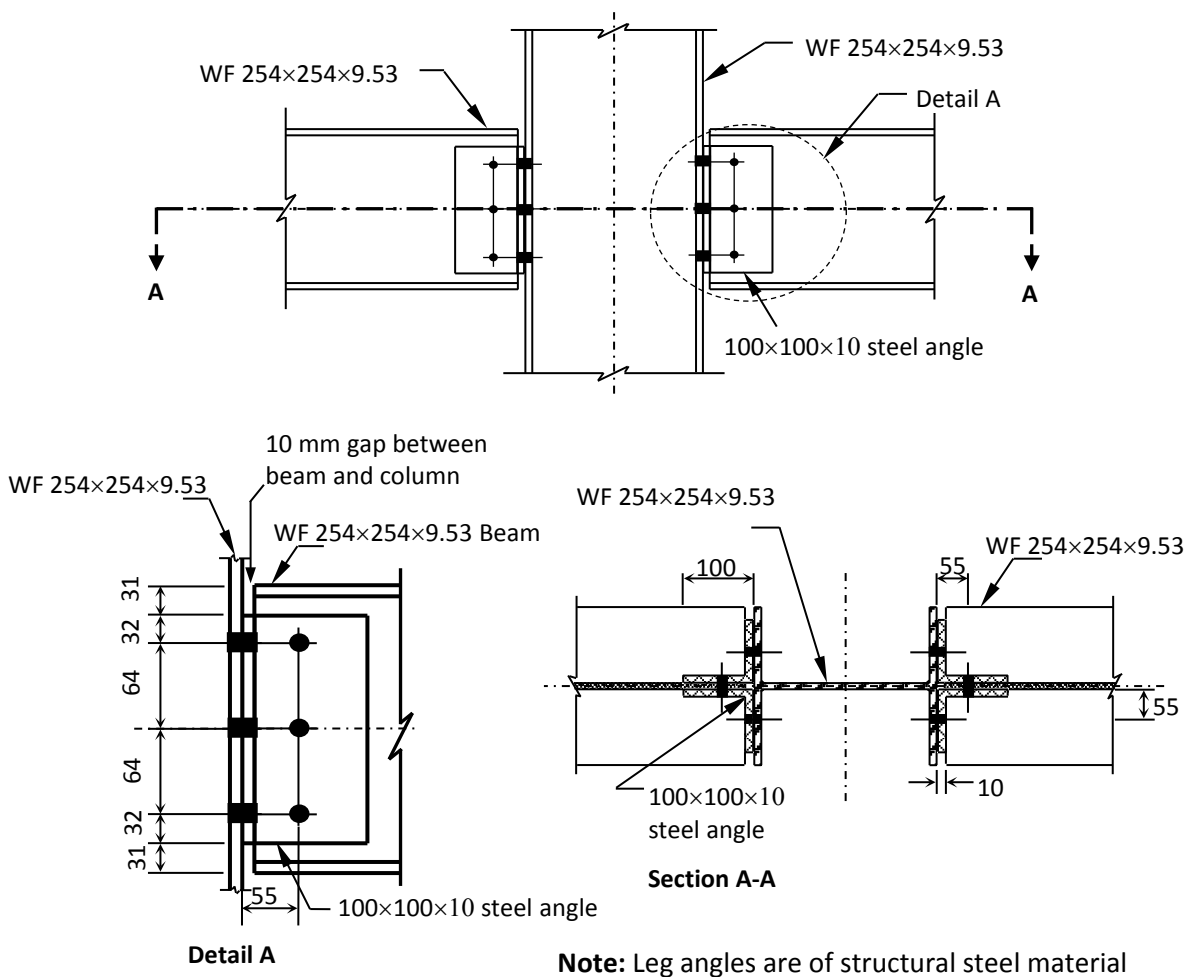


Fig. 4. Connection details for beam-to-column joint tests with structural steel cleats (All dimensions are in mm), adapted from [Fig. 1].



Fig. 5. Details of nominally pinned beam-to-column joint test Wmj254_3M16_ST1-2.

Test Ref: Wmj254_3M16_ST1-2

Test date: 1st December 2011

Moment arm = 1.016 m

Load Incr	LEFT SIDE										
	Centre rotation, C2 (CH18)	Load Point, LP1 (CH 21)	Rotation, C1 (CH 17)	Moment =LP1 x moment arm	Joint rotation, (4)-(2)	Slip compensa ted joint rotation, (6)-(12)	End beam deflecti on L1, (CH11)	Slip top, LTL (CH1)	Slip bot, LBL (CH3)	Beam deflecti on near column end, L3 (CH13)	Rotation due to horizontal slip, arctan ((LBL-LTL)/L)
	mrad	kN	mrad	kN.m	mrad	mrad	mm	mm	mm	mm	mrad
1	2	3	4	5	6	7	8	9	10	11	12
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-0.38	0.25	-0.66	0.26	0.27	0.25	0.68	-0.04	-0.04	0.00	0.02
	-0.89	0.77	-2.08	0.79	1.19	1.14	2.05	-0.04	-0.03	0.03	0.05
	-0.96	0.78	-2.22	0.80	1.27	1.23	2.17	-0.04	-0.04	0.03	0.04
	-1.20	1.08	-3.39	1.09	2.19	2.06	3.26	-0.04	-0.03	0.05	0.12
	-1.21	1.07	-3.48	1.08	2.27	2.11	3.33	-0.06	-0.04	0.05	0.16
	-1.46	1.23	-4.27	1.25	2.81	2.63	4.06	-0.06	-0.04	0.06	0.18
	-1.45	1.21	-4.34	1.23	2.88	2.69	4.12	-0.07	-0.05	0.06	0.20
	-1.01	1.48	-4.91	1.51	3.89	3.59	4.62	-0.08	-0.04	0.08	0.30
	-0.93	1.43	-4.94	1.45	4.01	3.68	4.63	-0.09	-0.04	0.09	0.33
	-0.92	1.36	-4.97	1.39	4.05	3.73	4.62	-0.12	-0.08	0.08	0.32
	0.11	1.75	-5.45	1.78	5.56	5.16	5.00	-0.12	-0.07	0.11	0.40
	0.11	1.71	-5.56	1.74	5.67	5.21	5.10	-0.14	-0.08	0.11	0.46
	-0.03	2.01	-7.05	2.04	7.01	6.44	6.39	-0.15	-0.08	0.14	0.57
	0.28	1.89	-7.24	1.92	7.52	6.98	6.50	-0.15	-0.08	0.15	0.54
	-0.08	2.22	-9.34	2.26	9.26	8.58	8.29	-0.17	-0.08	0.19	0.68
	-0.05	2.15	-9.48	2.18	9.43	8.74	8.40	-0.17	-0.08	0.19	0.70
	0.12	2.49	-11.69	2.53	11.81	10.96	10.25	-0.18	-0.08	0.24	0.85
	0.12	2.41	-11.86	2.44	11.98	11.13	10.38	-0.19	-0.08	0.24	0.84
	0.17	2.74	-13.93	2.79	14.10	13.09	12.12	-0.21	-0.08	0.28	1.02
	0.19	2.63	-14.18	2.67	14.37	13.34	12.32	-0.22	-0.08	0.29	1.03
	-0.30	2.91	-17.90	2.96	17.61	16.42	15.57	-0.23	-0.08	0.35	1.19
	-0.32	3.03	-19.16	3.07	18.84	17.59	16.65	-0.23	-0.07	0.38	1.25
	-0.65	2.78	-19.56	2.82	18.91	17.63	16.98	-0.24	-0.07	0.38	1.28
	8.00	0.15	2.49	0.15	5.51	4.86	0.00	-0.22	-0.13	0.06	0.65
	0.39	2.57	-17.03	2.62	17.42	16.29	14.73	-0.23	-0.09	0.35	1.12
	-0.67	2.97	-21.35	3.02	20.68	19.41	18.48	-0.24	-0.08	0.42	1.27
	-1.05	2.73	-21.58	2.78	20.52	19.27	18.66	-0.24	-0.08	0.42	1.26
	-0.14	2.98	-23.19	3.03	23.05	21.76	19.94	-0.25	-0.08	0.48	1.29
	-1.50	0.10	-7.56	0.10	6.07	5.45	6.47	-0.22	-0.15	0.08	0.62
	-0.11	2.38	-20.11	2.42	20.00	18.97	17.31	-0.24	-0.11	0.41	1.02
	-0.15	3.05	-26.17	3.09	26.02	24.76	22.42	-0.25	-0.09	0.55	1.26
	0.06	2.80	-26.55	2.85	26.61	25.31	22.65	-0.26	-0.09	0.56	1.30
	0.89	3.19	-31.85	3.24	32.74	31.34	26.94	-0.26	-0.09	0.71	1.40

	1.49	2.92	-32.32	2.96	33.82	32.41	27.25	-0.27	-0.09	0.73	1.41
	0.96	3.23	-49.04	3.28	50.00	48.51	40.99	-0.28	-0.09	1.13	1.49
	-1.50	3.23	-52.27	3.28	50.77	49.26	43.88	-0.28	-0.08	1.15	1.51
	-2.94	3.38	-55.88	3.43	52.94	51.39	46.98	-0.28	-0.08	1.21	1.55
	-3.64	3.10	-56.26	3.15	52.62	51.14	47.31	-0.27	-0.08	1.20	1.48
	-3.86	2.85	-56.58	2.90	52.71	51.24	47.46	-0.30	-0.11	1.20	1.47
	-3.87	2.84	-56.59	2.89	52.72	51.30	47.45	-0.31	-0.13	1.20	1.41
	-24.89	0.84	-55.30	0.85	30.41	29.43	47.23	-0.29	-0.16	0.66	0.98
	-13.80	0.13	-31.88	0.14	18.08	17.38	27.36	-0.28	-0.19	0.36	0.70
	-14.01	0.17	-31.36	0.17	17.35	16.64	26.99	-0.28	-0.19	0.34	0.71
	-27.02	0.06	-39.93	0.06	12.91	12.28	34.74	-0.28	-0.20	0.24	0.63

Note: L is vertical separation between two horizontal displacement transducers on the web cleat = 128 mm

Green: indicates linear elastic joint properties

Red: shows joint properties at damage onset*

Blue: indicates joint properties at maximum moment

***Damage Onset** is defined in following two ways:

1. When audible loud cracking noise is first heard.
2. When width of column near centreline of top bolt increases by 1% of its width before loading.

Test Ref: Wmj254_3M16_ST1-2

Test date: 1st December 2011

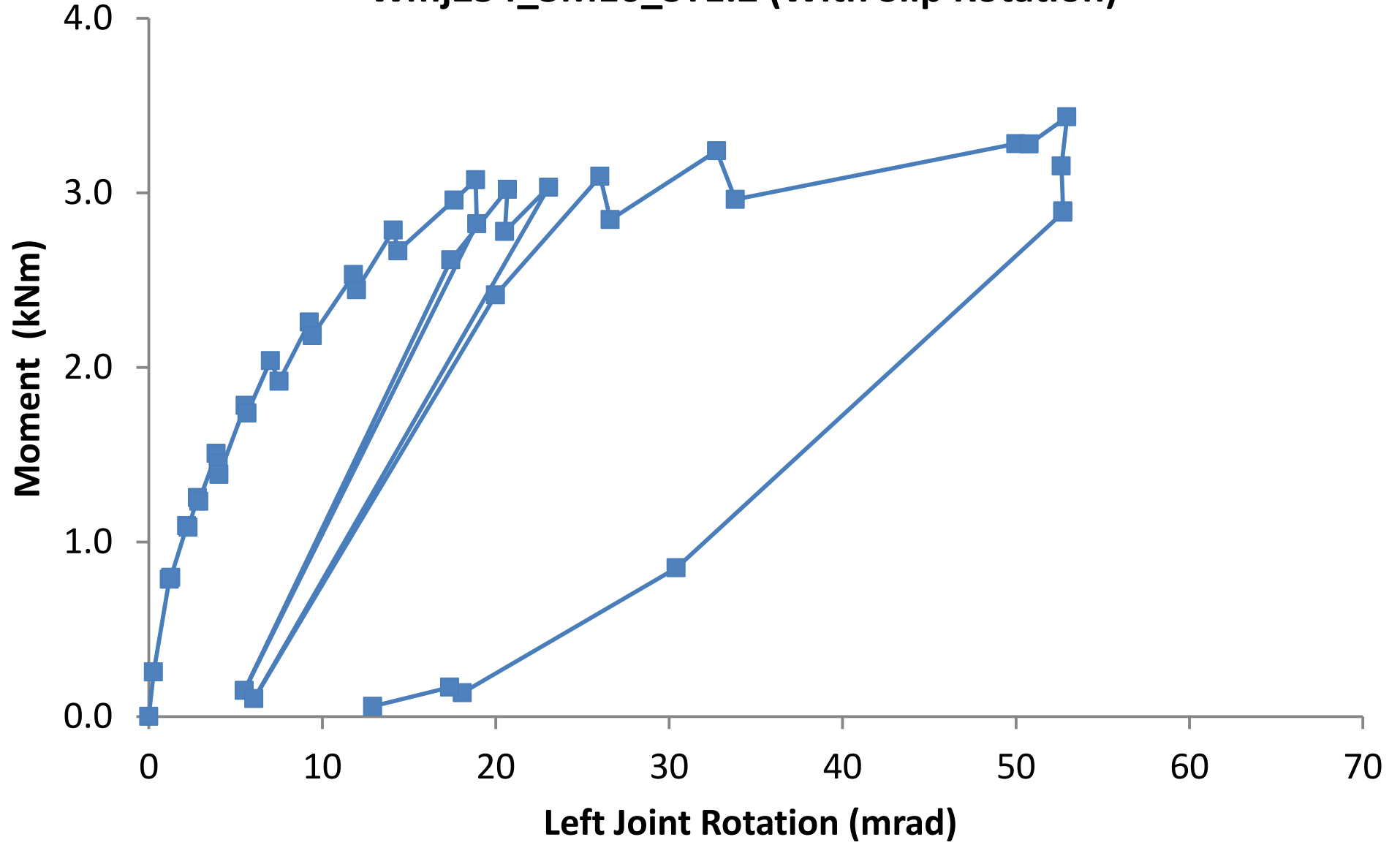
Moment arm =

1.016 m

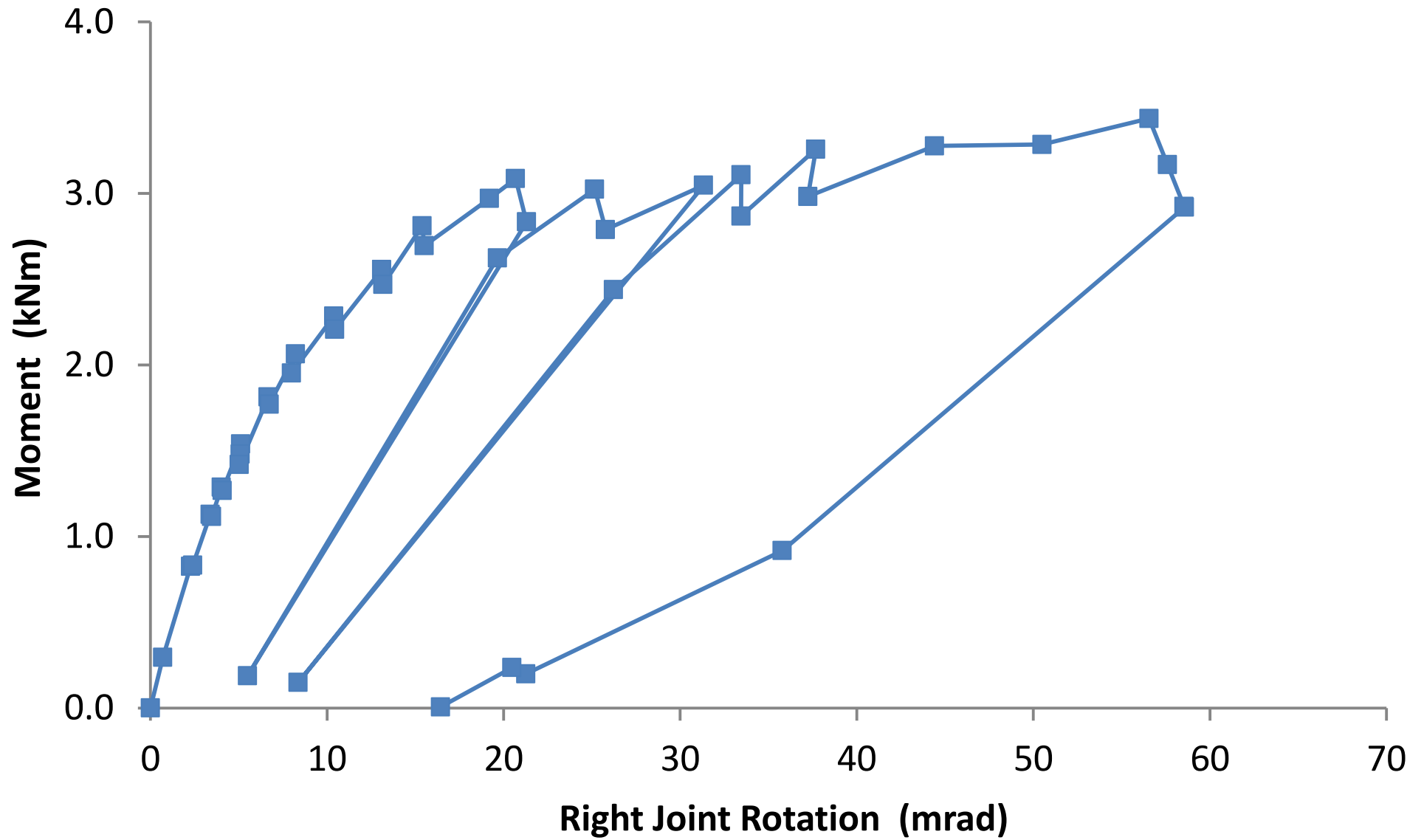
RIGHT SIDE									
Load Point, LP2 (CH 22)	Rotation C3 (CH 19)	Moment =LP2 x moment arm	Joint rotation, (14)-(2)	Slip compensated joint rotation, (16)-(22)	End beam deflection L2, (CH9)	Slip top, LTR (CH5)	Slip bot, LBR (CH7)	Beam deflection near column end, L4 (CH15)	Rotation due to horizontal slip, arctan ((LBL-LTL)/L)
kN	mrad	kN.m	mrad	mrad	mm	mm	mm	mm	mrad
13	14	15	16	17	18	19	20	21	22
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.29	0.32	0.30	0.70	0.65	0.38	-0.06	-0.05	0.01	0.05
0.81	1.38	0.83	2.27	2.07	1.30	-0.07	-0.04	0.03	0.20
0.82	1.44	0.83	2.40	2.15	1.35	-0.07	-0.04	0.04	0.24
1.11	2.19	1.13	3.39	3.14	2.10	-0.07	-0.04	0.05	0.25
1.10	2.25	1.12	3.46	3.19	2.15	-0.09	-0.05	0.05	0.27
1.27	2.56	1.29	4.02	3.69	2.45	-0.10	-0.05	0.06	0.33
1.25	2.62	1.27	4.07	3.74	2.46	-0.11	-0.07	0.06	0.33
1.52	4.10	1.54	5.12	4.74	3.82	-0.11	-0.06	0.08	0.37
1.46	4.16	1.48	5.09	4.65	3.86	-0.13	-0.07	0.08	0.44
1.40	4.12	1.42	5.04	4.65	3.77	-0.16	-0.11	0.08	0.39
1.78	6.78	1.81	6.67	6.19	6.15	-0.17	-0.11	0.10	0.48
1.74	6.84	1.77	6.73	6.29	6.18	-0.18	-0.12	0.10	0.44
2.03	8.18	2.06	8.21	7.71	7.37	-0.19	-0.13	0.13	0.50
1.92	8.26	1.95	7.99	7.43	7.42	-0.20	-0.13	0.12	0.56
2.25	10.31	2.28	10.39	9.84	9.15	-0.21	-0.14	0.17	0.55
2.17	10.39	2.21	10.44	9.84	9.21	-0.22	-0.14	0.17	0.60
2.52	13.22	2.56	13.10	12.36	11.69	-0.23	-0.14	0.21	0.74
2.43	13.29	2.47	13.17	12.47	11.74	-0.24	-0.15	0.21	0.70
2.77	15.57	2.81	15.40	14.61	13.75	-0.26	-0.16	0.25	0.78
2.65	15.70	2.69	15.51	14.73	13.82	-0.26	-0.16	0.25	0.78
2.92	18.90	2.97	19.20	18.36	16.58	-0.27	-0.16	0.31	0.84
3.04	20.36	3.09	20.68	19.80	17.83	-0.27	-0.15	0.34	0.88
2.79	20.65	2.83	21.30	20.43	17.99	-0.27	-0.16	0.35	0.87
0.18	13.49	0.19	5.50	5.08	11.92	-0.24	-0.19	0.10	0.41
2.58	20.04	2.62	19.65	18.86	17.43	-0.27	-0.17	0.33	0.79
2.98	24.49	3.02	25.16	24.28	21.18	-0.28	-0.16	0.43	0.87
2.75	24.72	2.79	25.78	24.95	21.30	-0.28	-0.17	0.44	0.83
3.00	31.19	3.05	31.33	30.45	26.56	-0.28	-0.17	0.55	0.87
0.15	6.87	0.15	8.37	7.97	5.68	-0.25	-0.20	0.14	0.40
2.40	26.12	2.44	26.23	25.50	22.36	-0.28	-0.18	0.45	0.73
3.06	33.31	3.11	33.46	32.54	28.27	-0.29	-0.17	0.59	0.92
2.82	33.51	2.87	33.45	32.52	28.42	-0.30	-0.18	0.60	0.93
3.21	38.57	3.26	37.68	36.67	32.69	-0.30	-0.17	0.68	1.02

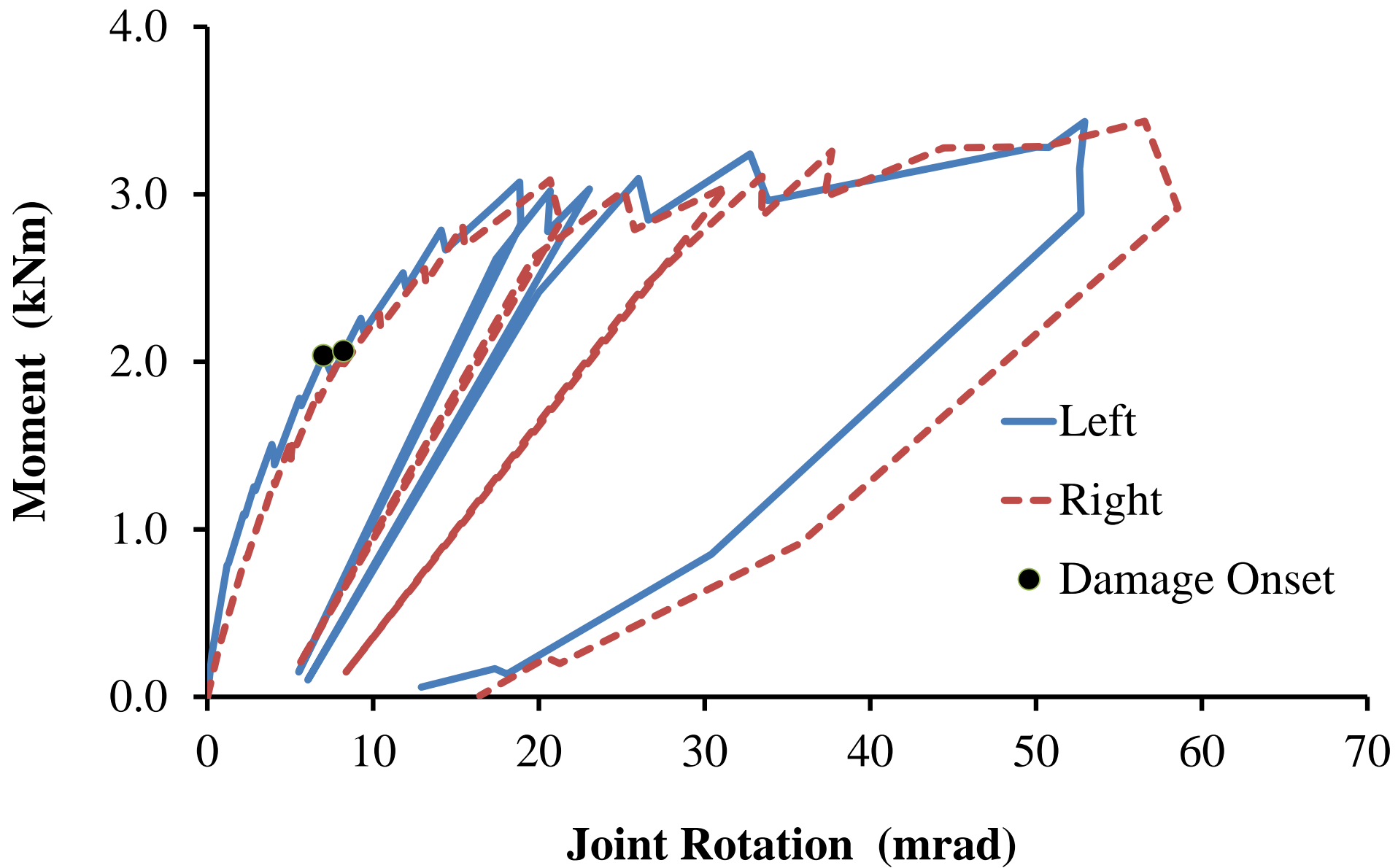
2.94	38.73	2.98	37.24	36.26	32.79	-0.31	-0.18	0.67	0.98
3.23	45.37	3.28	44.41	43.34	38.15	-0.31	-0.17	0.82	1.07
3.23	48.99	3.28	50.50	49.39	41.06	-0.31	-0.17	0.94	1.11
3.38	53.62	3.44	56.56	55.39	44.83	-0.31	-0.16	1.07	1.16
3.12	53.96	3.17	57.60	56.52	45.04	-0.30	-0.16	1.09	1.08
2.88	54.68	2.92	58.54	57.45	45.50	-0.35	-0.21	1.11	1.09
2.87	54.69	2.92	58.56	57.44	45.50	-0.36	-0.21	1.10	1.12
0.90	10.90	0.92	35.79	35.18	7.47	-0.33	-0.25	0.65	0.61
0.20	7.46	0.20	21.27	20.77	5.13	-0.32	-0.25	0.37	0.50
0.23	6.47	0.24	20.48	20.03	4.35	-0.32	-0.26	0.36	0.45
0.01	-10.59	0.01	16.43	16.06	-0.07	-0.32	-0.27	0.27	0.37

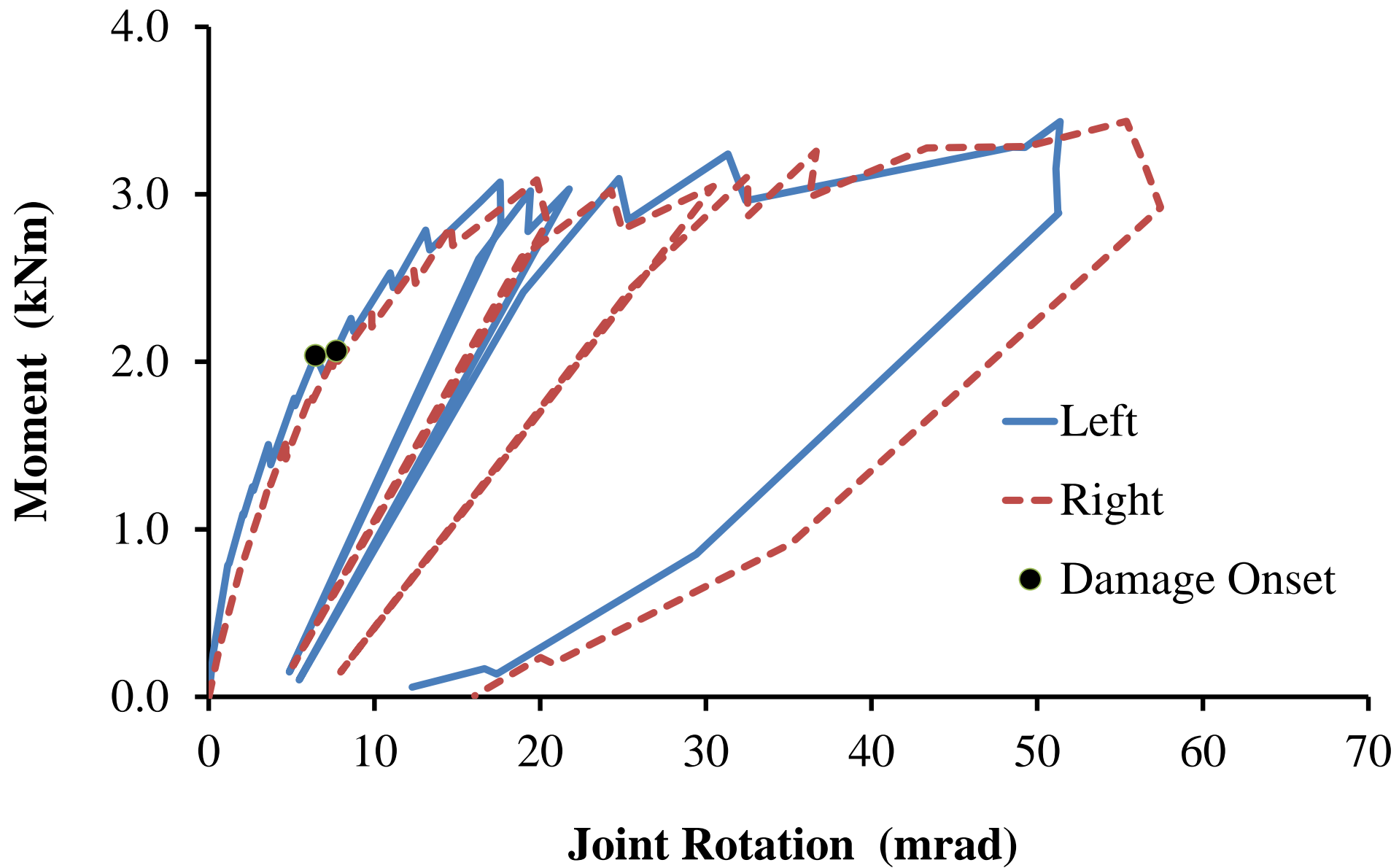
Wmj254_3M16_ST1.2 (With Slip Rotation)



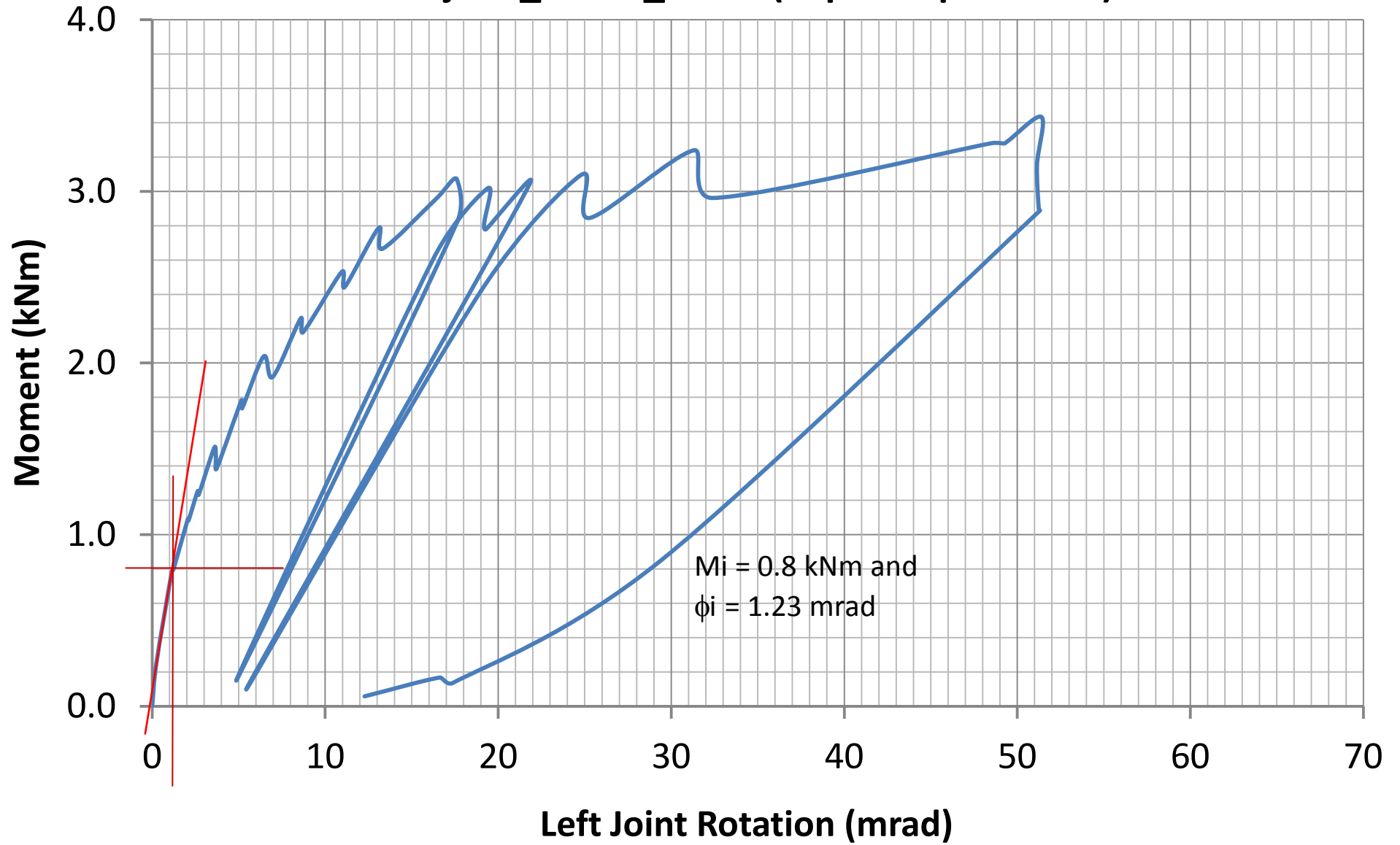
Wmj254_3M16_ST1.2 (With Slip Rotation)



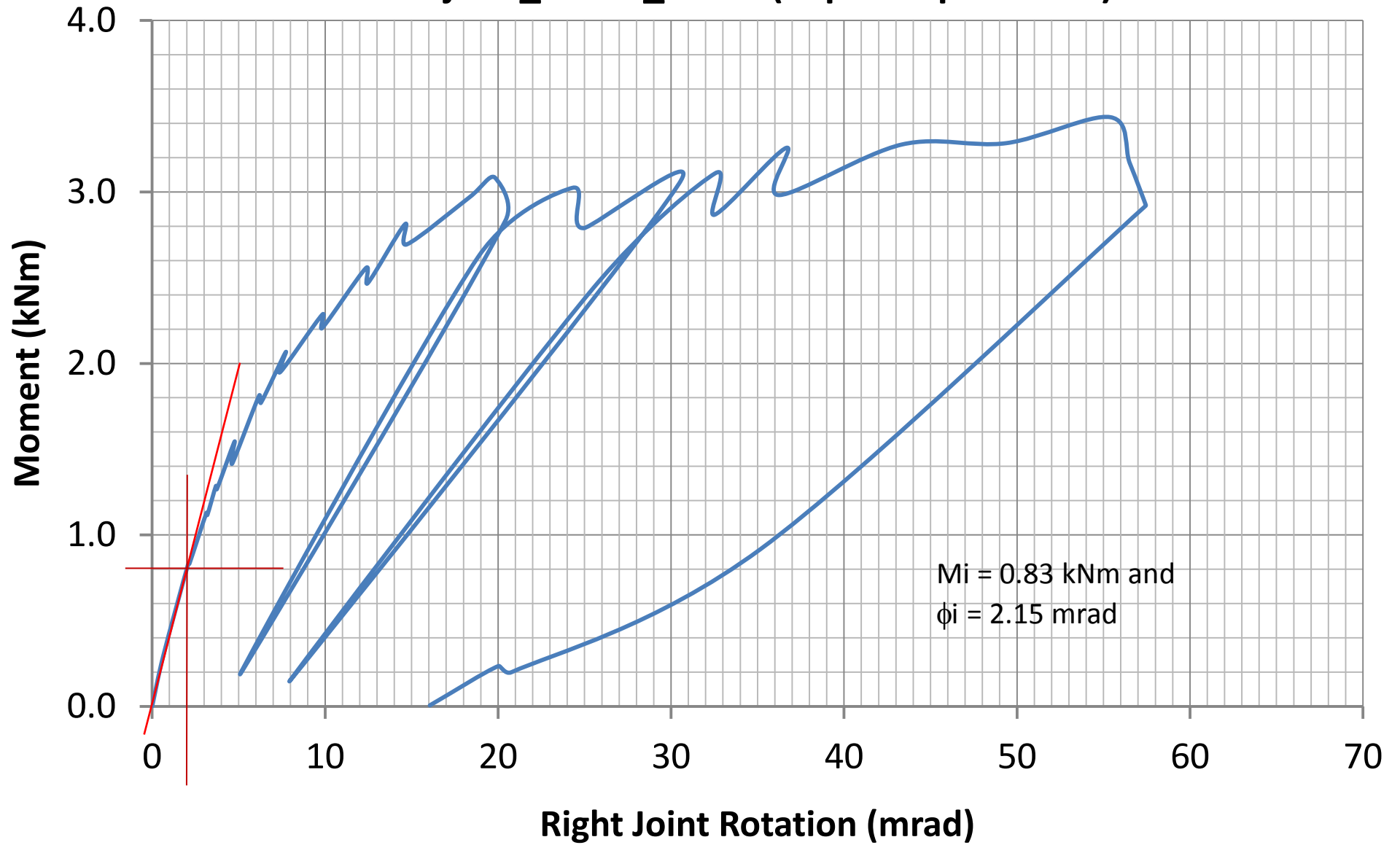




Wmj254_3M16_ST1.2 (Slip Compensated)



Wmj254_3M16_ST1.2 (Slip Compensated)



Moment = Applied Load × Moment Arm

Moment Arm = 1.016 m

Width of the column at TOP web cleat = TOP

Width of the column at BOTTOM web cleat = BOT

Load (kN)	Moment (kNm)	TOP (mm)	BOT (mm)	% increase TOP	% increase BOT	
Before of start of test	0.00	0.00	255.6	254.7	0.0%	0.0%
	0.80	0.81	256.0	254.4	0.2%	0.1%
	1.10	1.12	256.3	254.4	0.3%	0.1%
	1.25	1.27	256.6	254.4	0.4%	0.1%
	1.50	1.52	256.8	254.3	0.5%	0.2%
	1.75	1.78	257.5	254.3	0.7%	0.2%
	2.00	2.03	258.0	254.3	0.9%	0.2%
	2.25	2.29	258.9	254.3	1.3%	0.2%
	2.50	2.54	259.8	254.3	1.6%	0.2%
	2.75	2.79	260.6	254.3	2.0%	0.2%
	3.00	3.05	262.4	254.7	2.7%	0.0%
	3.20	3.25	267.9	254.9	4.8%	0.1%
	3.30	3.35	274.9	255.0	7.6%	0.1%
After unloading	0.00	0.00	261.7	255.3	2.4%	0.2%

