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Behaviour of steel end plate bolted beam-to-column joints

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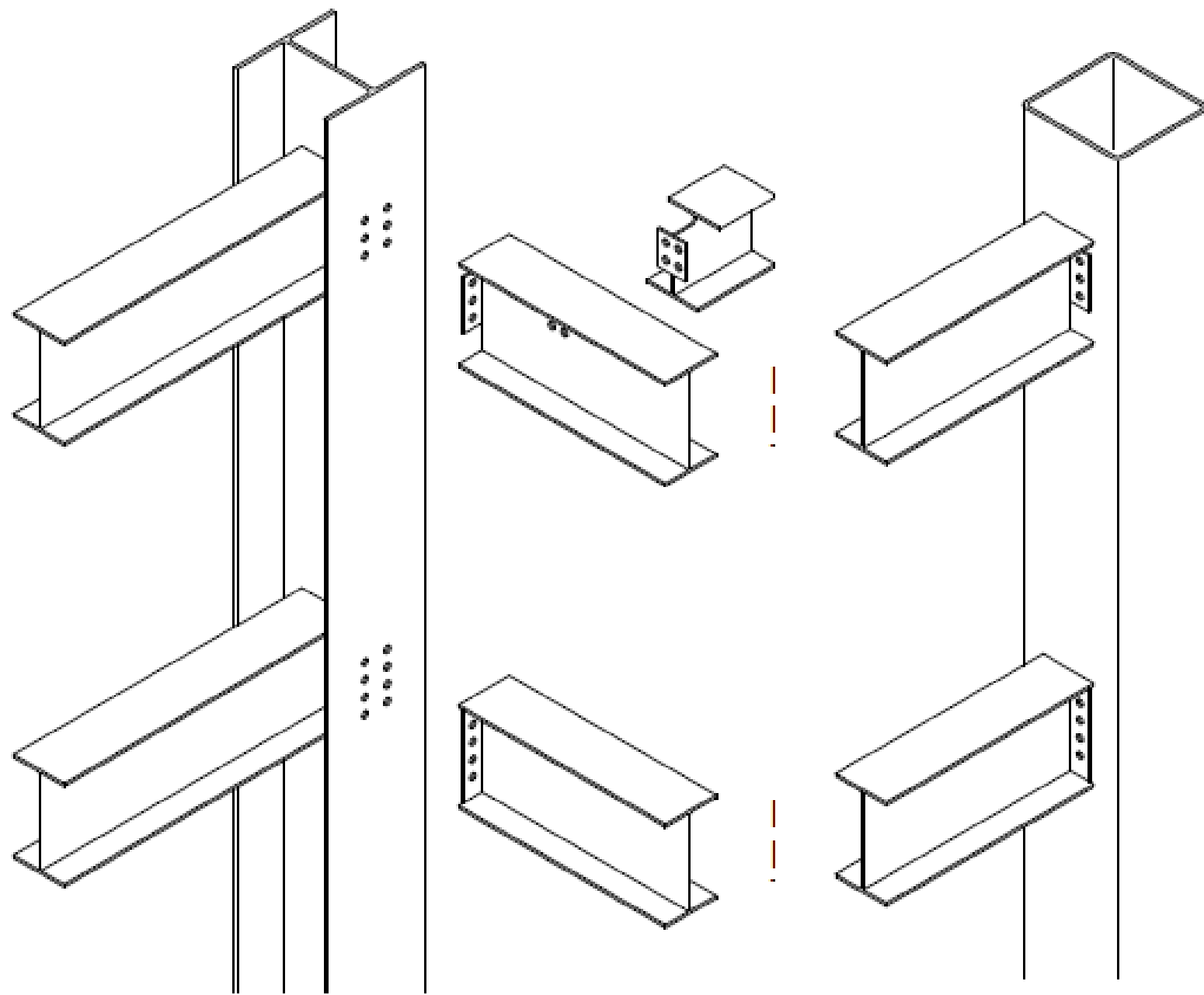
OUTLINE

- Background
- Experimental data
- Finite element model
- Parametric study
- Conclusions

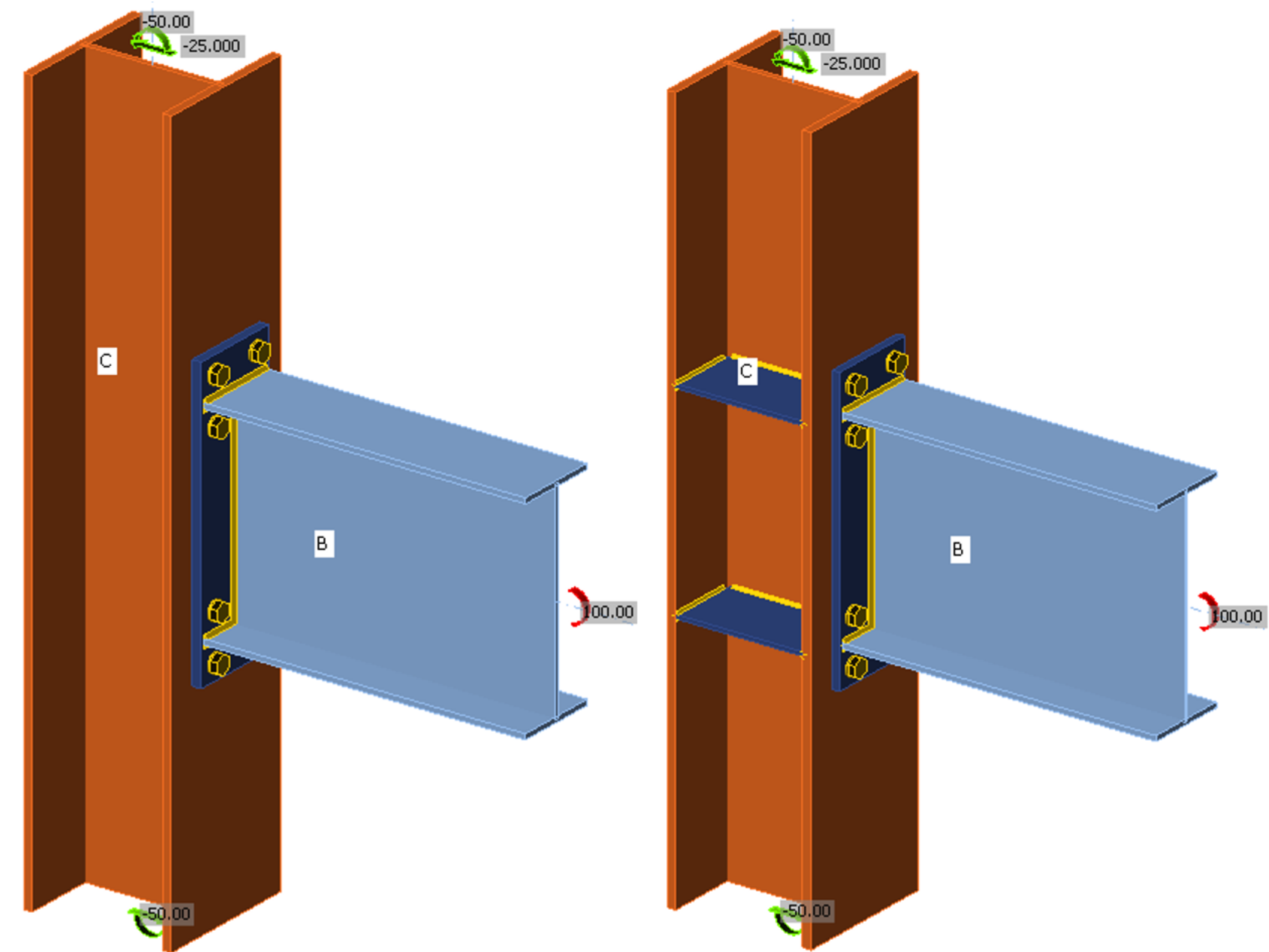


Background

Simple and moment-resisting joints



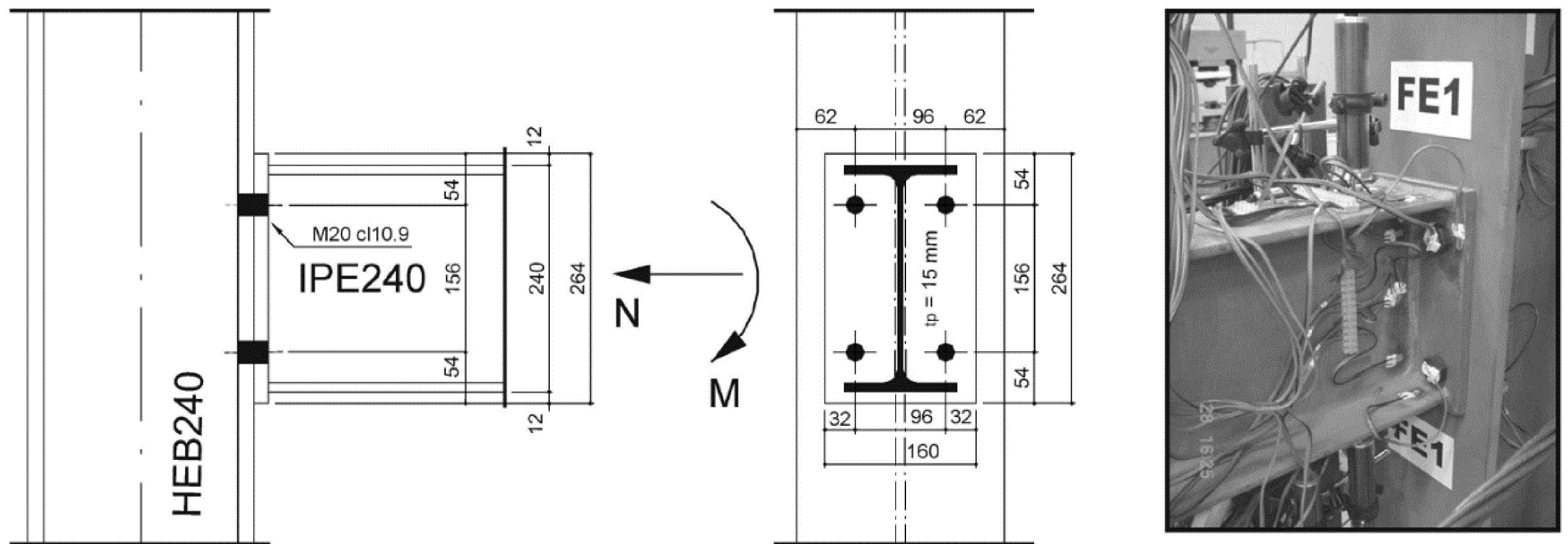
Simple joints – Partial and full depth end plate joints



Moment joints – Extended end plate joints

Experimental data

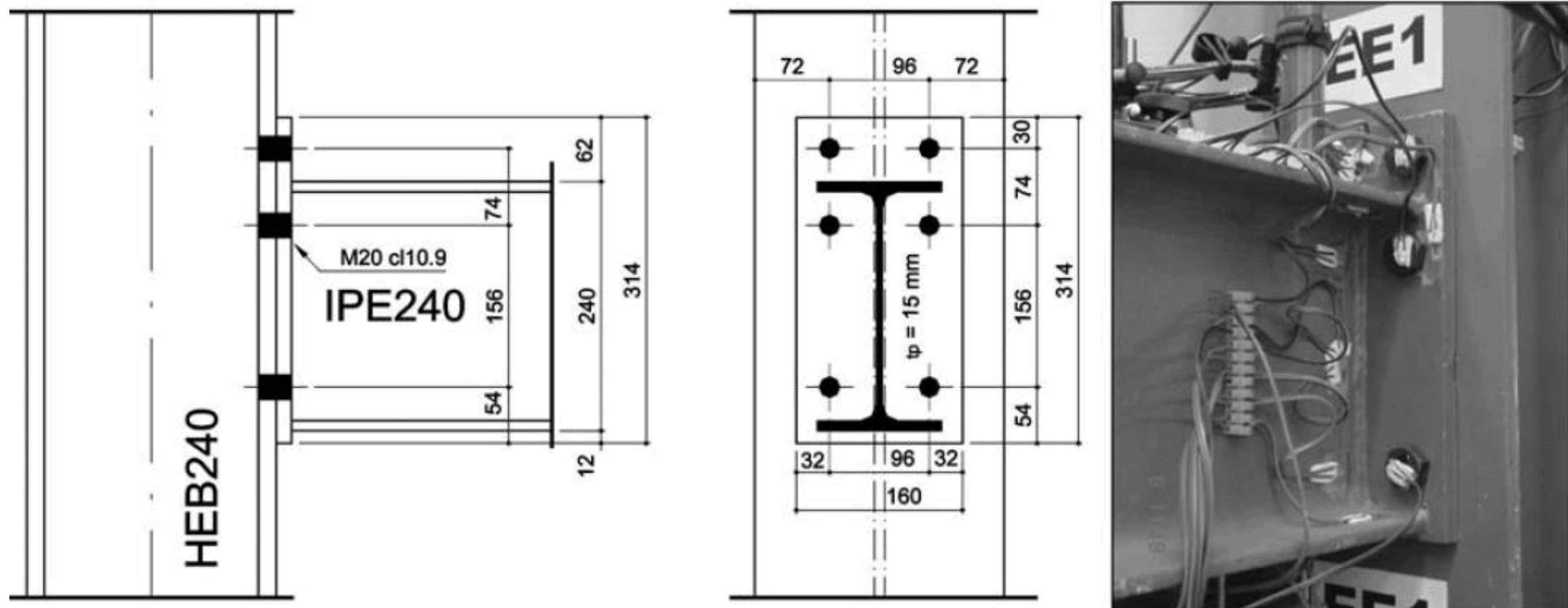
Flush end plate joint – for FE model validation



Joint detailing for flush or full depth end plate bolted joint by da Silva *et al.*

Experimental data

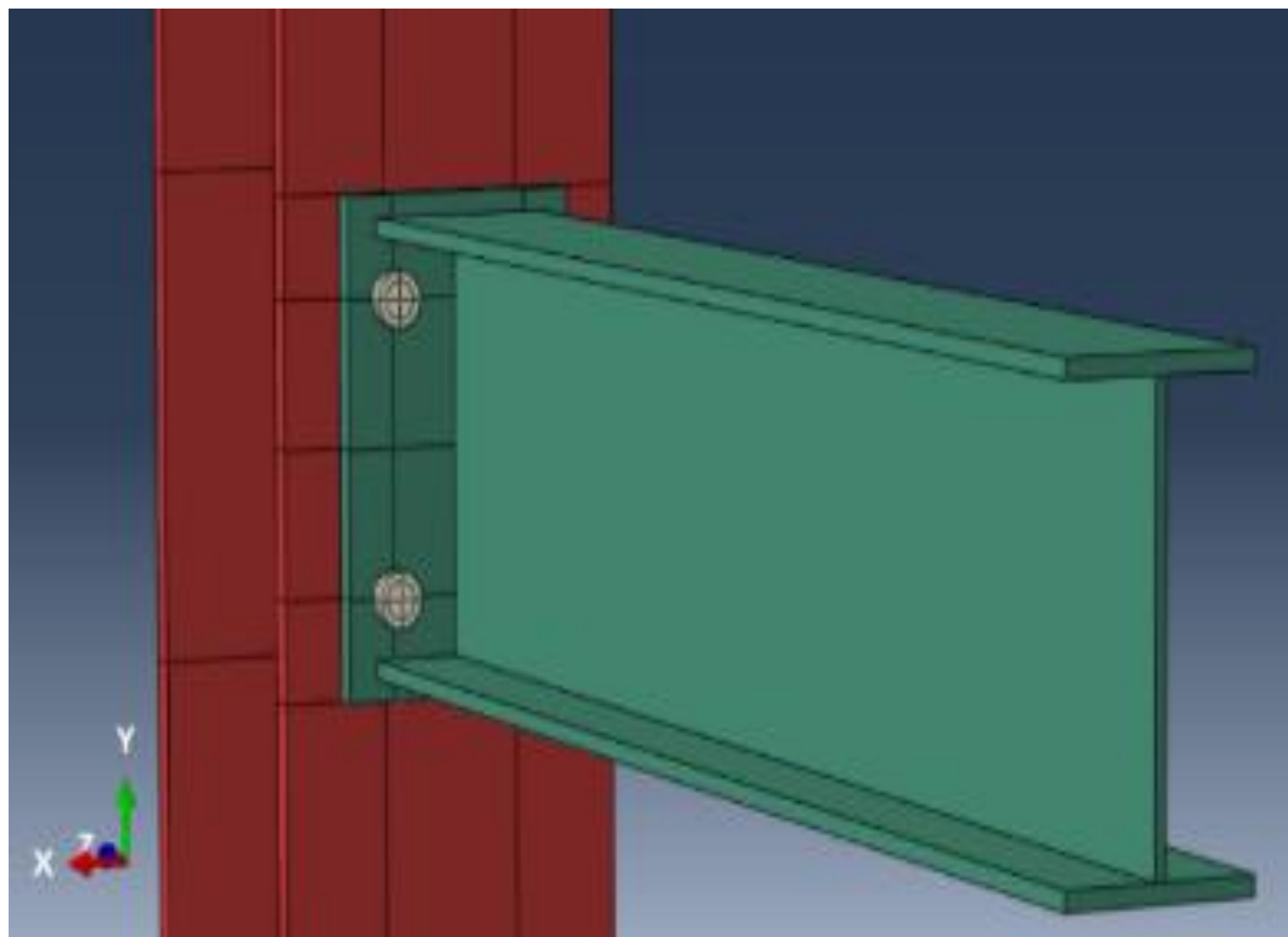
Extended end plate joint – for FE model validation



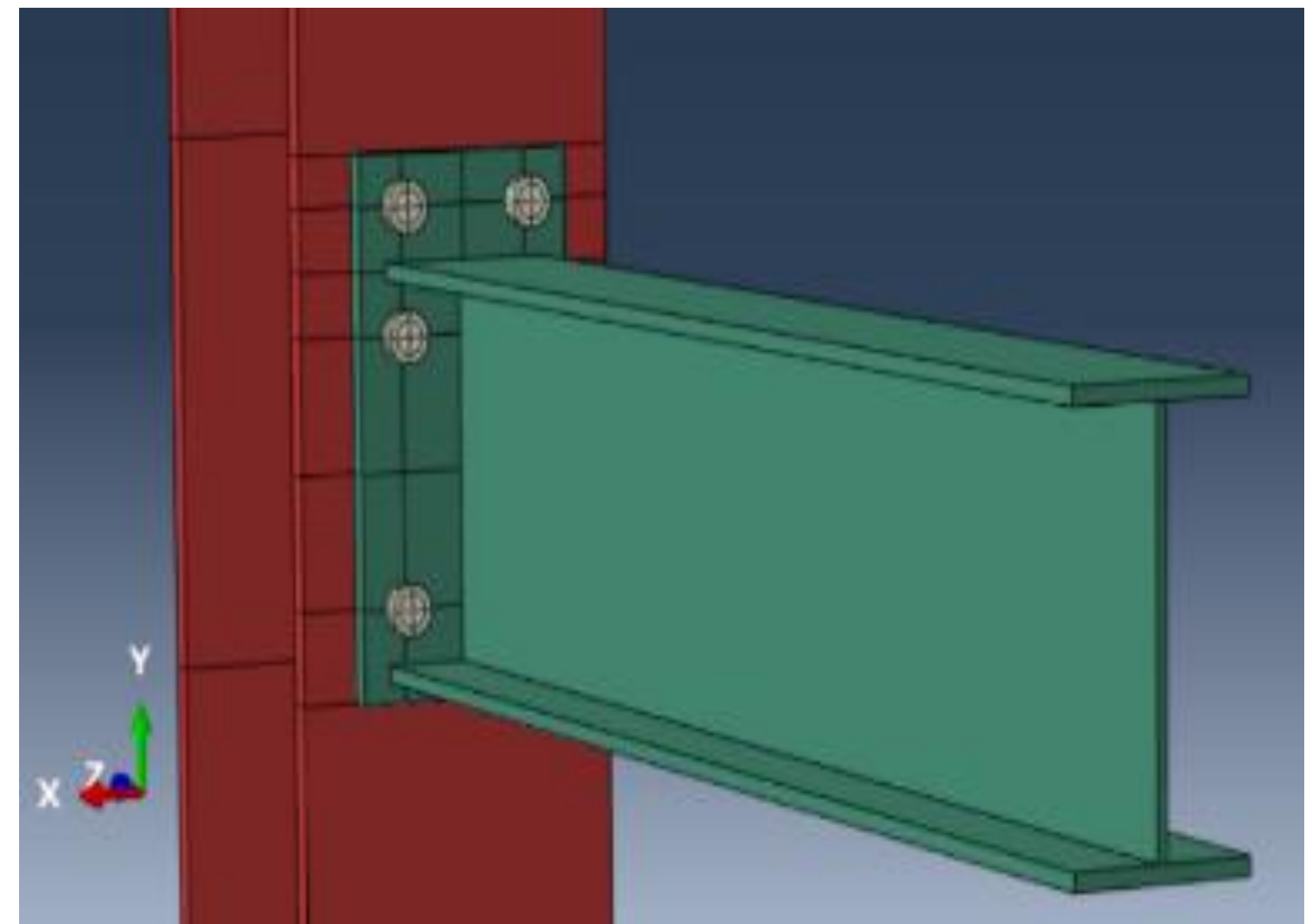
Joint detailing for extended end plate bolted joint by de Lima *et al.*

Finite element model

Validation – flush and extended end plate joints



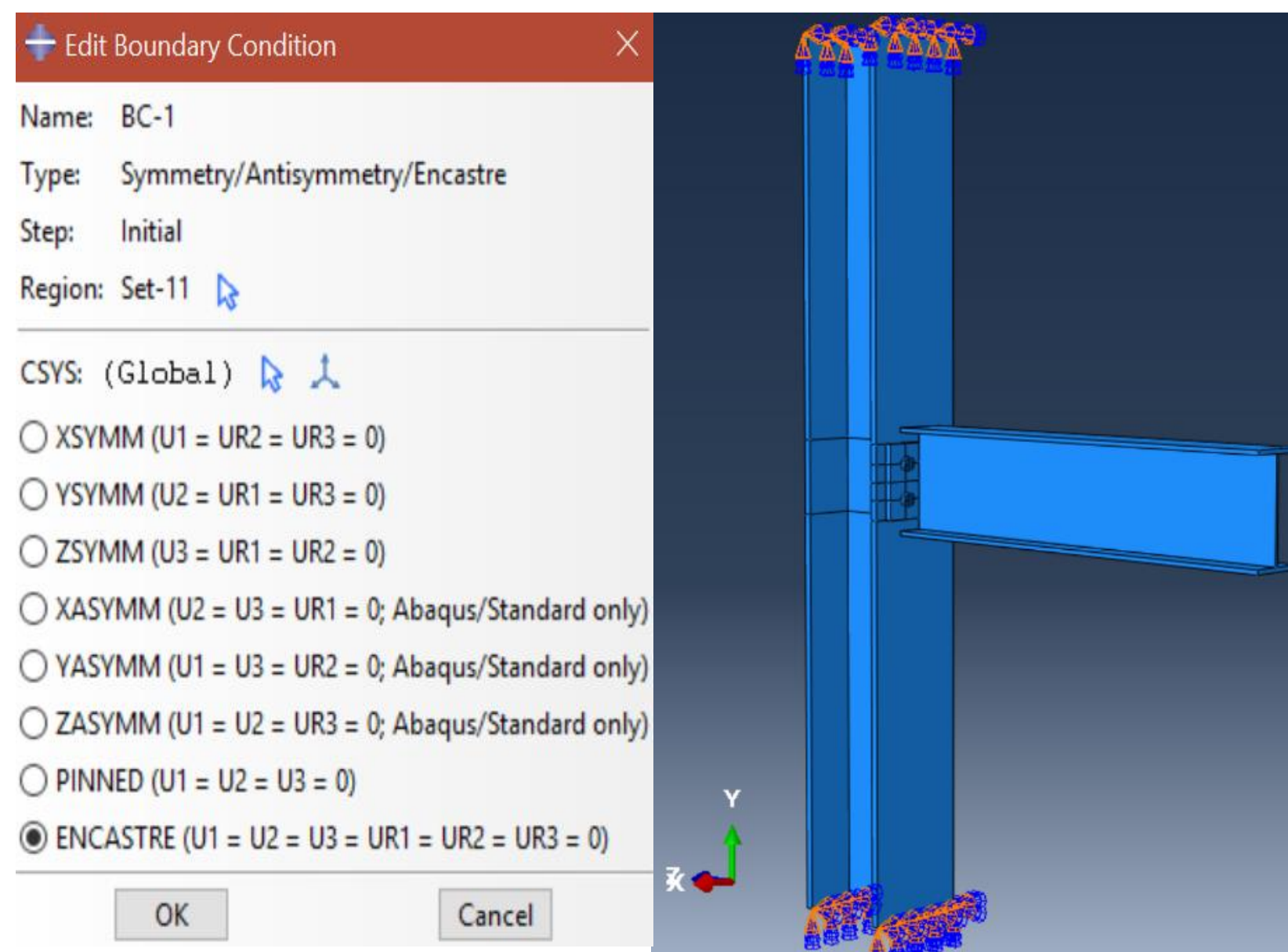
Flush end plate joint – assembled FE model



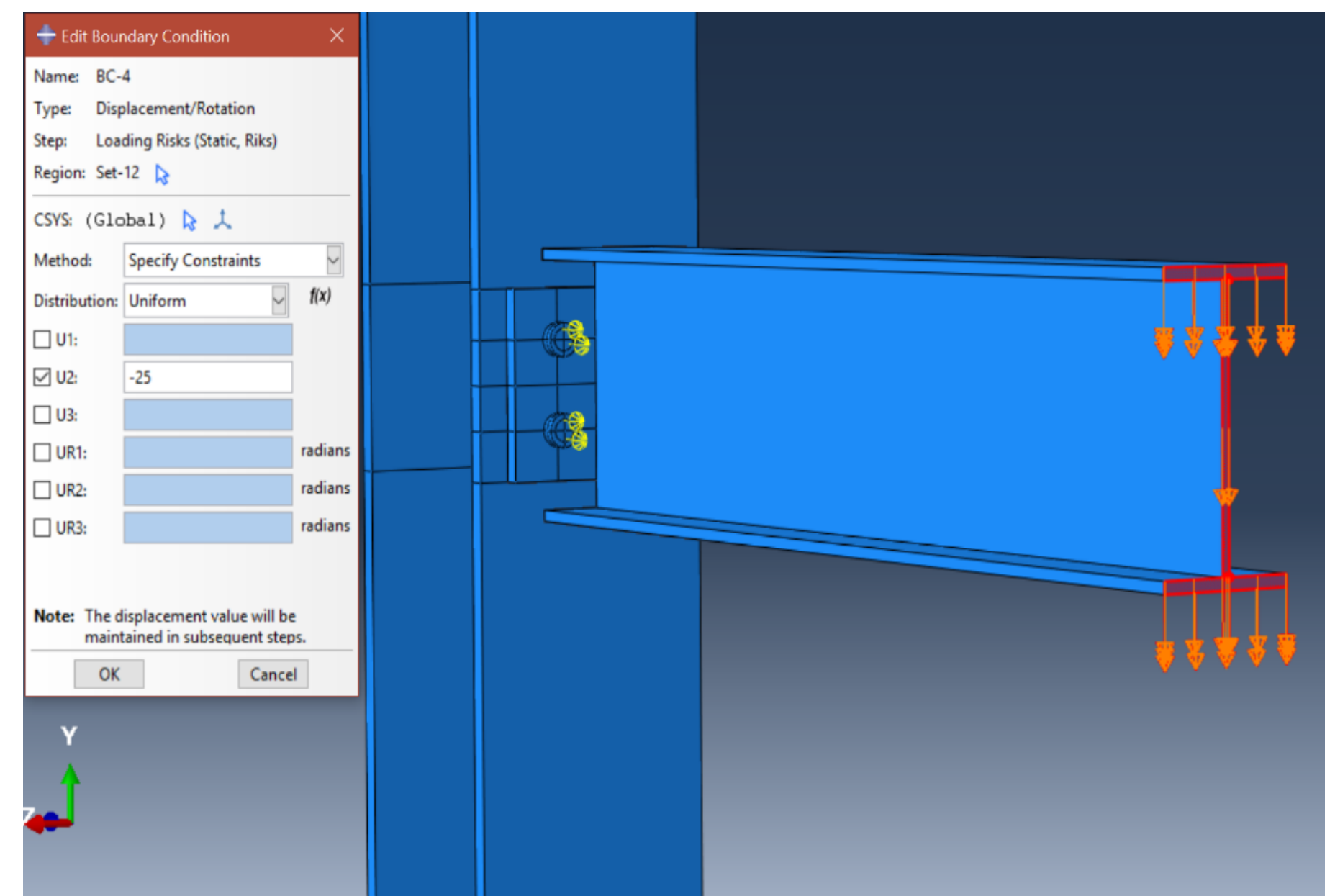
Extended end plate joint – assembled FE model

Finite element model

Validation – boundary conditions and loading



Boundary conditions



Load application

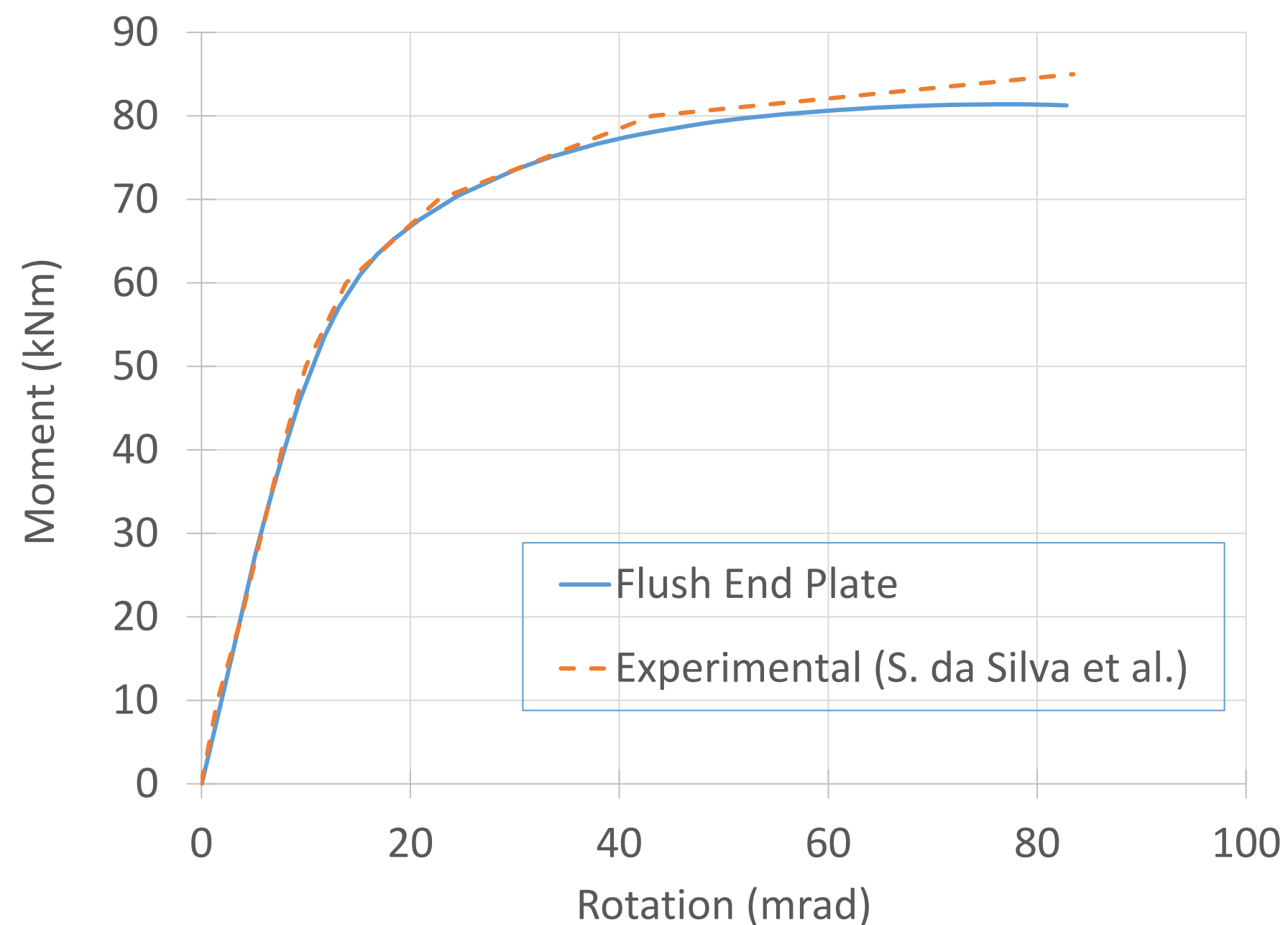
Finite element model

Validation – material properties

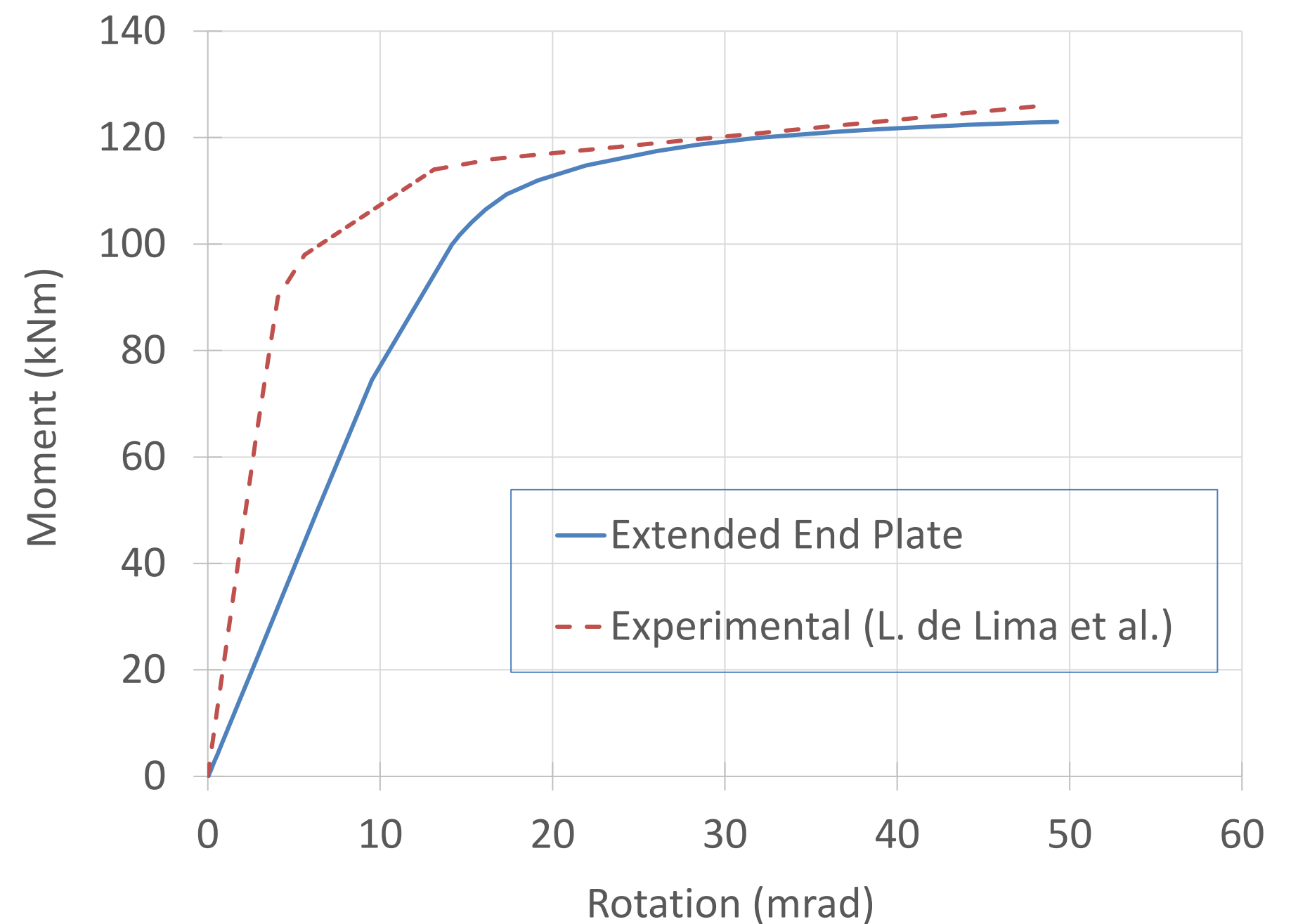
Reference	Part	Density (Tonnes/ mm ³)	Young's Modulus (E) (MPa)	Poisson's Ratio (ν)	Stress (σ)	Plastic Strain (ϵ)	Type
IPE 240 (Beam)	Flange	7.85E-09	215222	0.3	340 448	0 0.15	Yield Ultimate
	Web	7.85E-09	203713	0.3	363 454	0 0.15	Yield Ultimate
HEB 240 (Column)	Flange	7.85E-09	220792	0.3	342 448	0 0.15	Yield Ultimate
	Web	7.85E-09	206936	0.3	372 477	0 0.15	Yield Ultimate
End Plate (IPE to HEB)	N/A	7.85E-09	200248	0.3	369 503	0 0.15	Yield Ultimate
Bolt 10.9 (IPE to HEB)	N/A	7.85E-09	200000	0.3	900 1000	0 0.0875	Yield Ultimate

Finite element model

Validation – comparison of FE and experiments



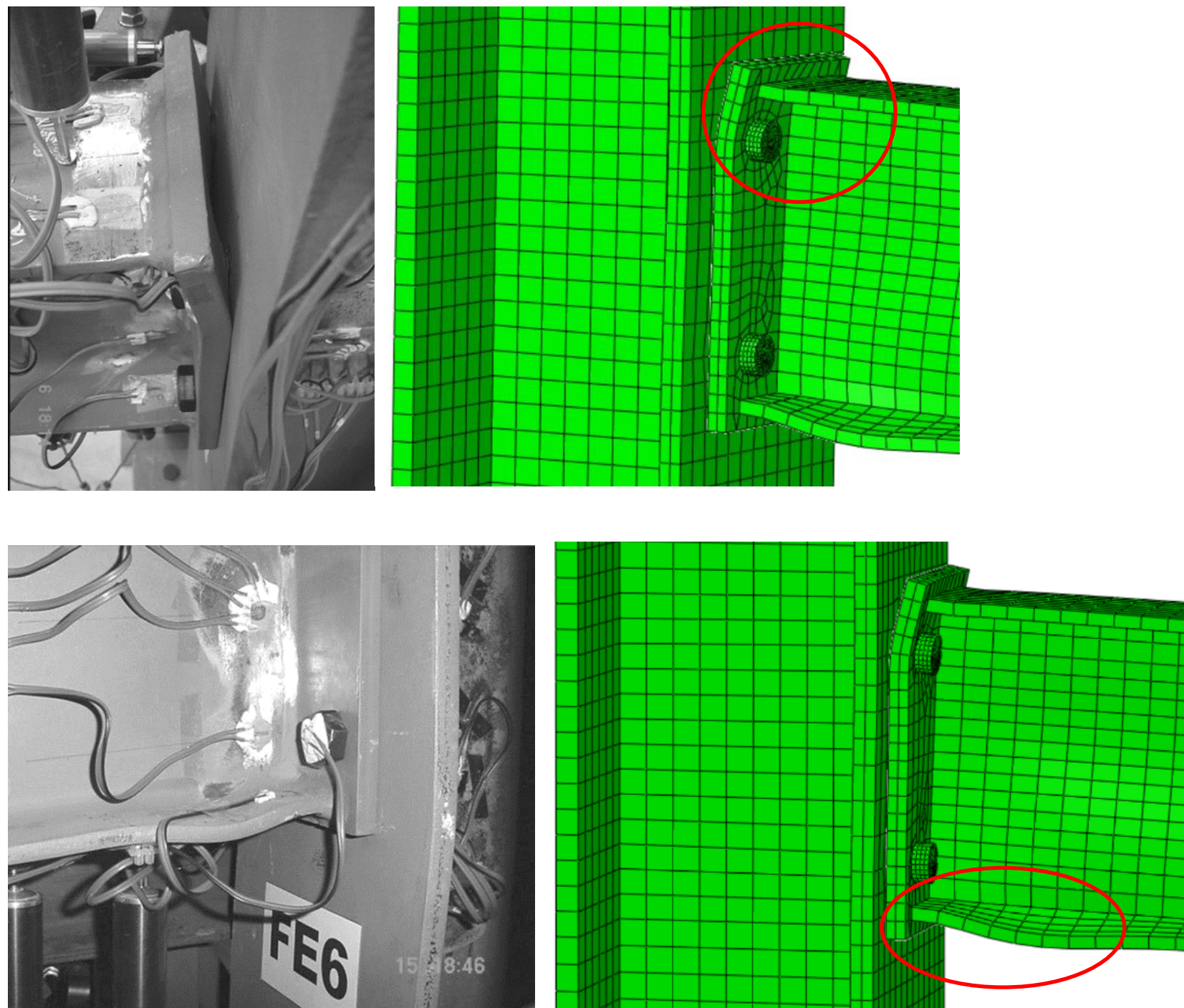
Flush end plate joint - Results



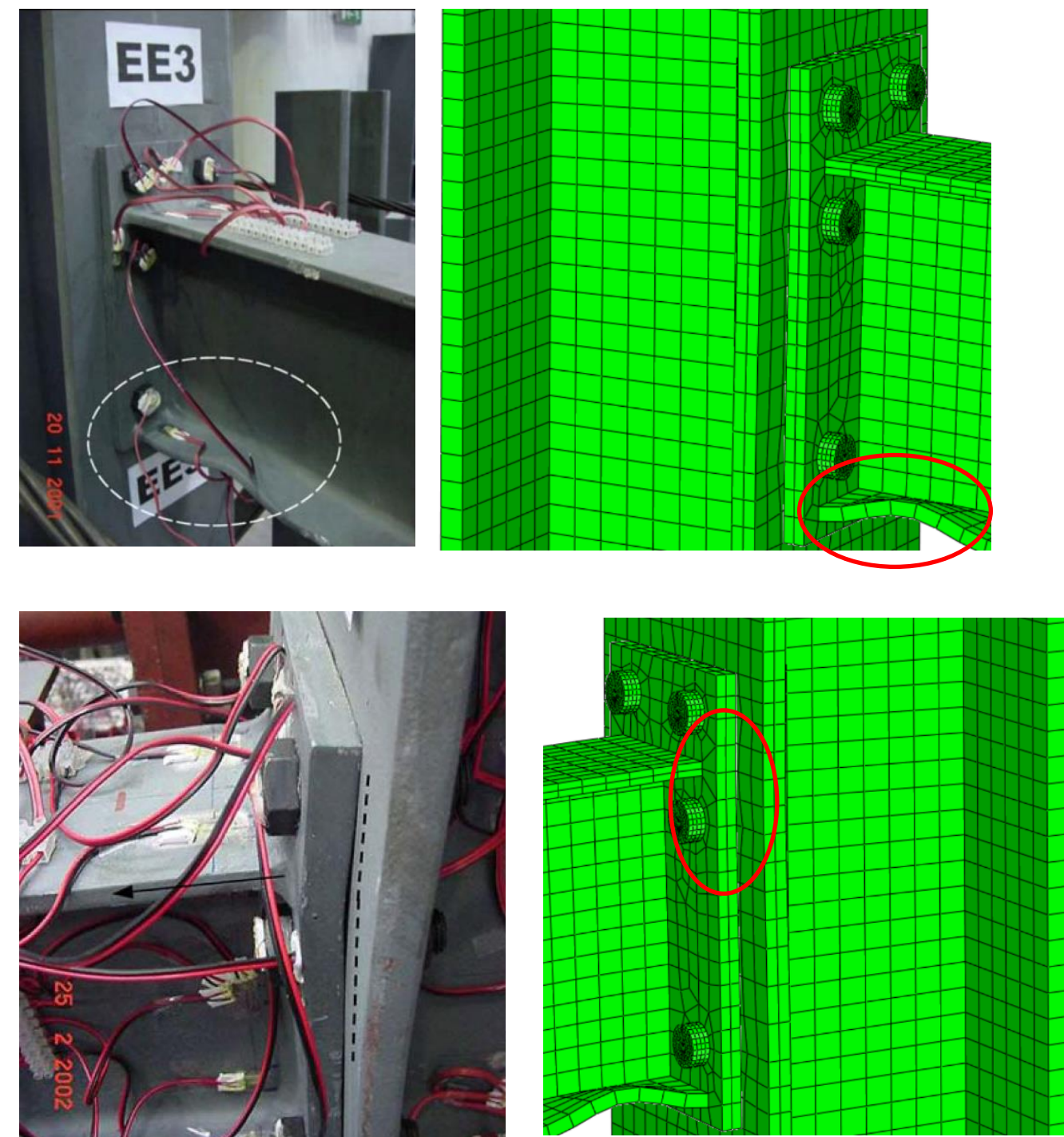
Extended end plate joint – Results

Finite element model

Validation – failure modes



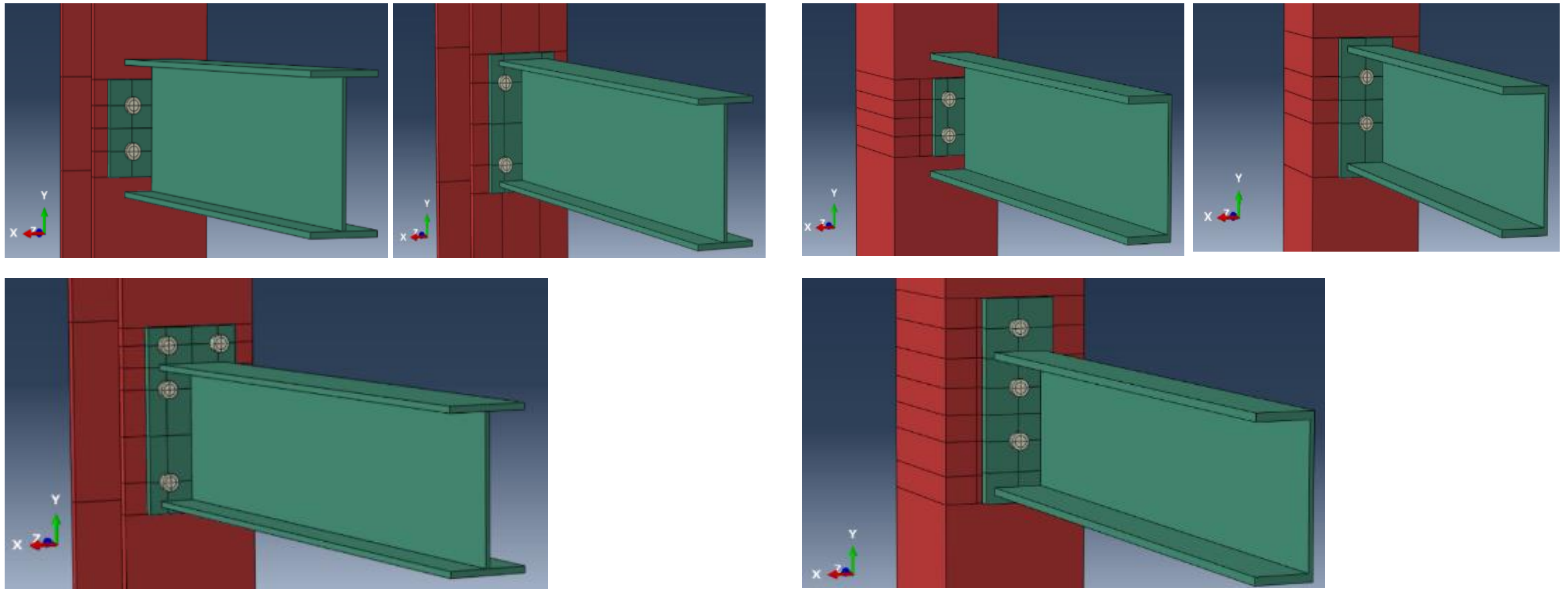
Flush end plate joint – failure modes



Extended end plate joint – failure modes

Finite element model

Parametric study – partial, full and extended depth joints

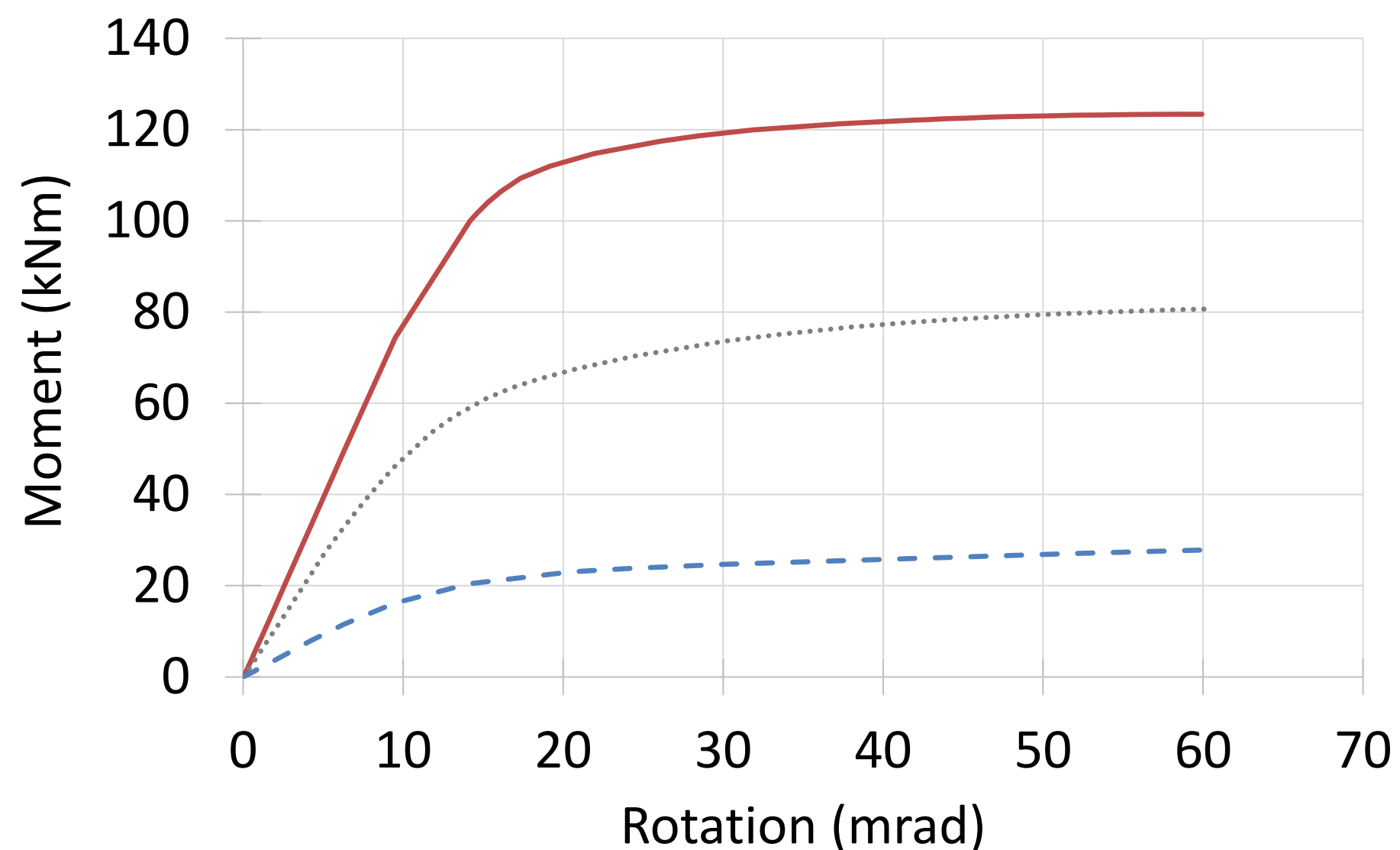


IPE Beam to HEB Column joints

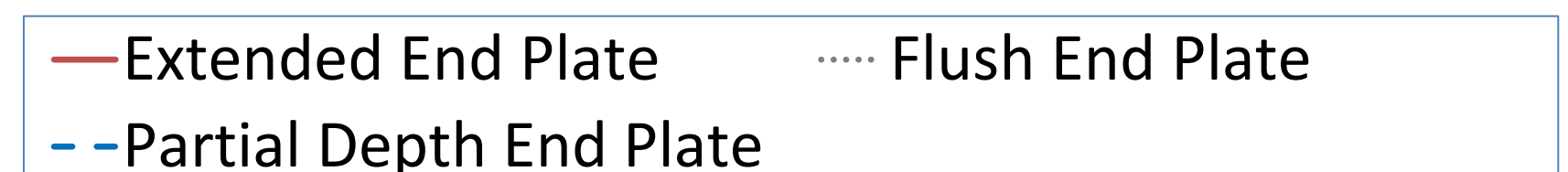
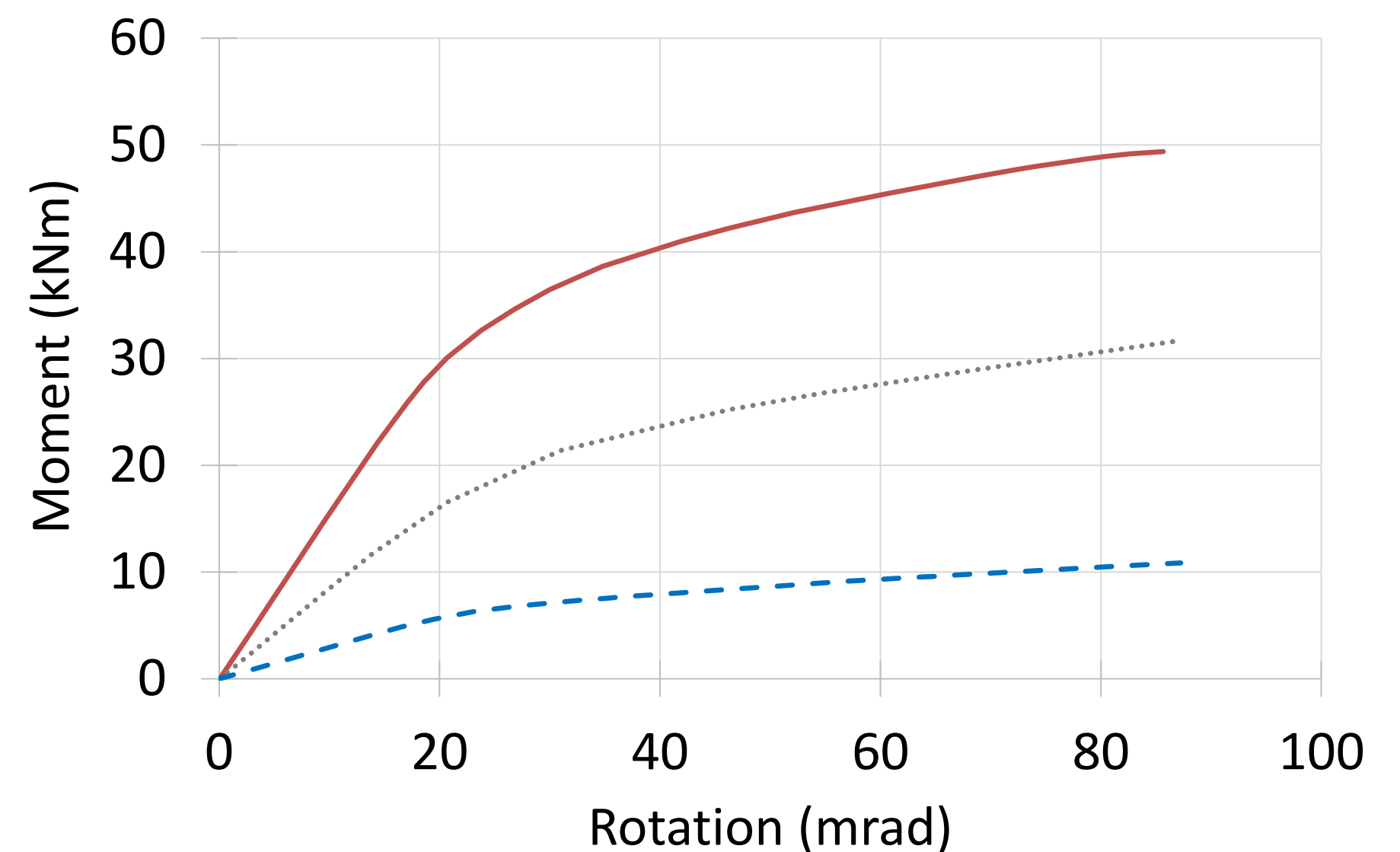
PFC Beam to SHS Column joints

Finite element model

Parametric study – moment-rotation response



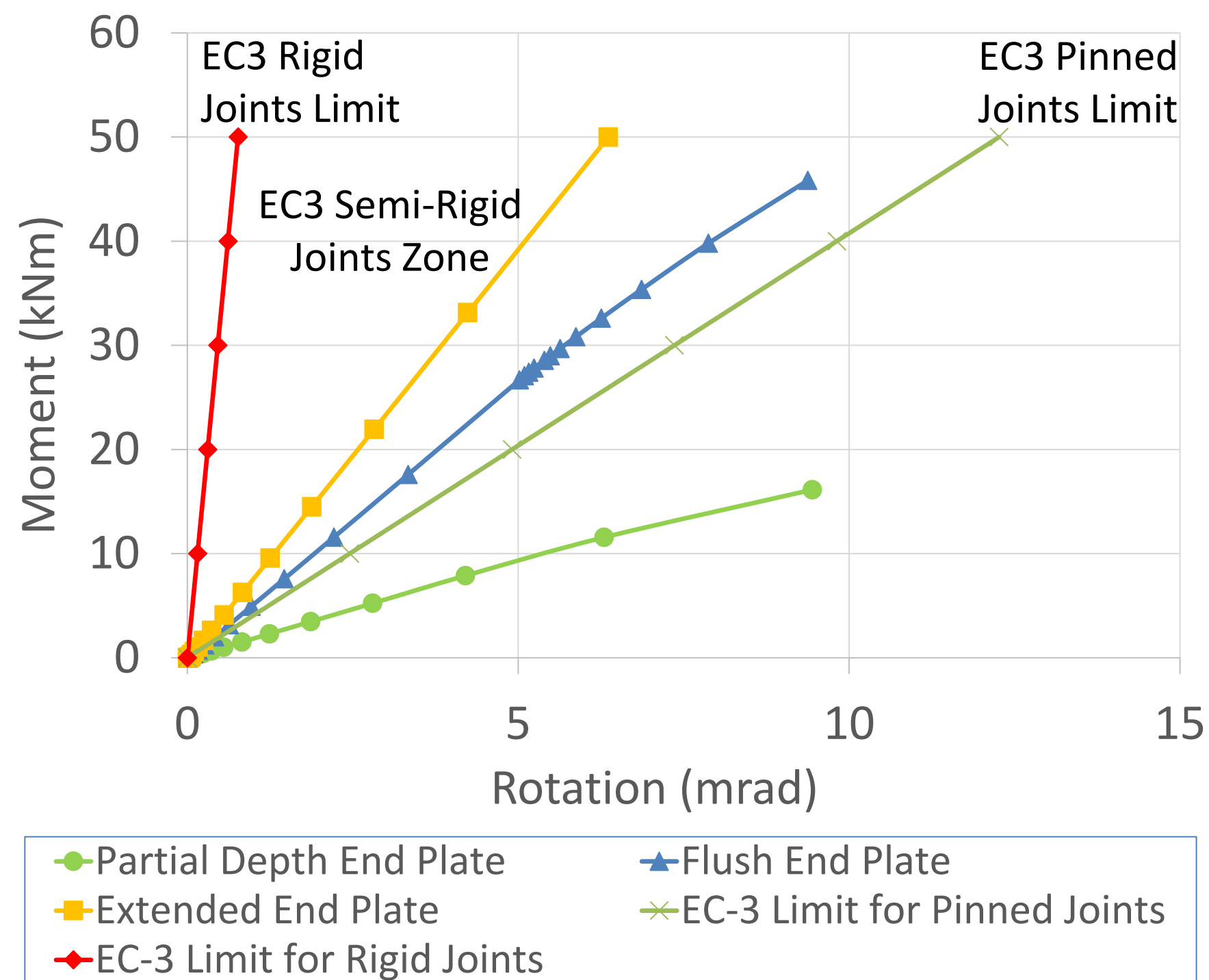
IPE-HEB beam-to-column joints



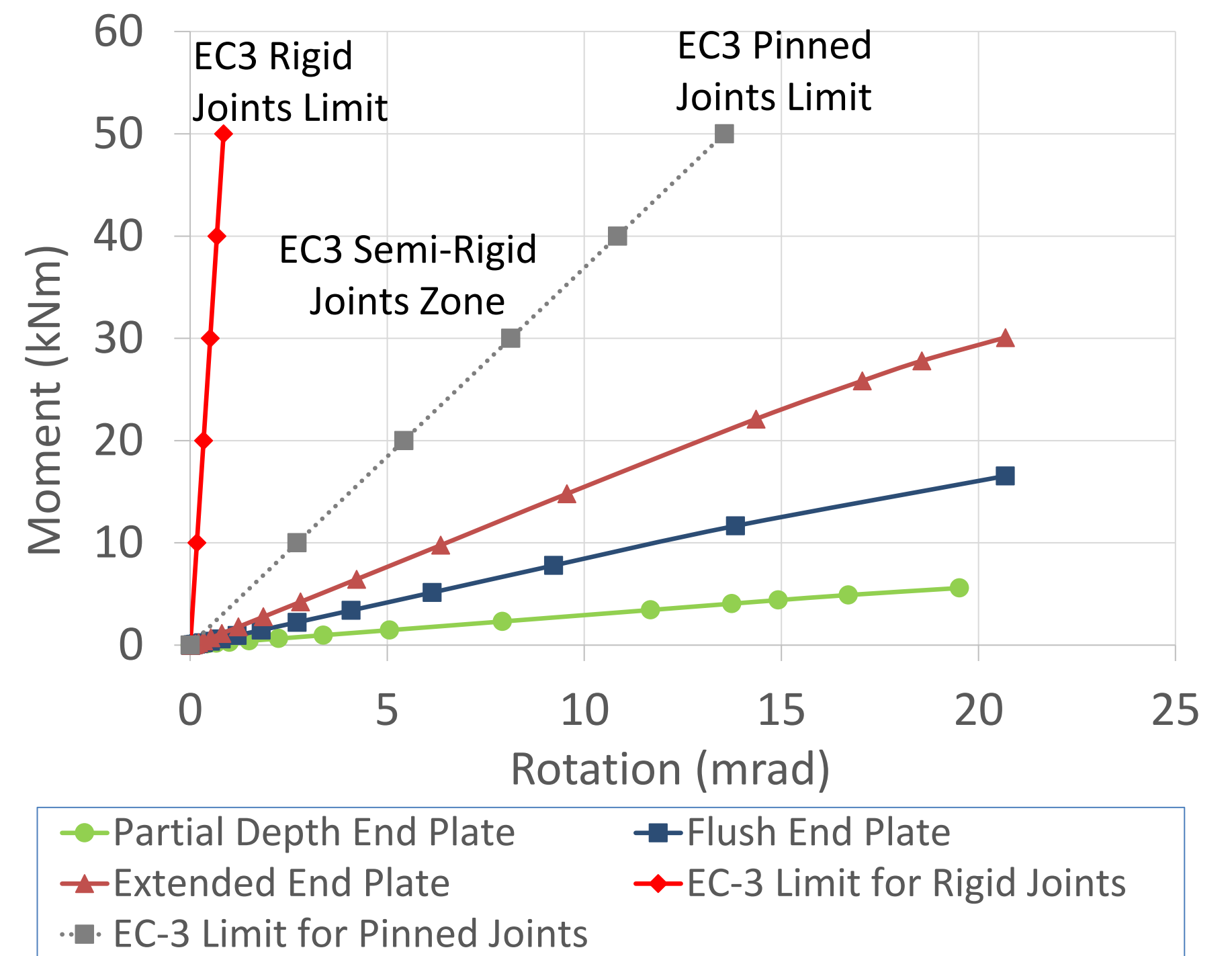
PFC-SHS beam-to-column joints

Finite element model

Parametric study – Joint classification as per EC3



IPE-HEB beam-to-column joints



PFC-SHS beam-to-column joints

Conclusions

- Finite element model matched with experiments
- Moment-rotation response and failure modes were compared
- Extended end plate joint took more moment than other joints
- IPE-HEB extended and flush joints were classed as semi-rigid
- IPE-HEB partial depth joints were classified as pinned
- All PFC-SHS joints were classified as pinned



Ongoing work – Modelling of FRP beam-to-column joints



Courtesy of Qureshi and Mottram (2015) available at <https://doi.org/10.1016/j.conbuildmat.2014.12.057>

References

Simões Da Silva L, De Lima LRO, Pedro PCG, De Andrade SAL. 2004. Behaviour of flush end-plate beam-to-column joints under bending and axial force. *Steel Compos Struct.* 4(2):77–94.

de Lima LRO, Simoes da Silva L, Vellasco PCG d. S, de Andrade SAL. 2004. Experimental evaluation of extended endplate beam-to-column joints subjected to bending and axial force. *Eng Struct.* 26(10):1333–1347.

BS EN 1993-1-8:2005. 2005. Eurocode 3: Design of steel structures - Part 1-8: Design of joints. London, UK: British Standards Institution.

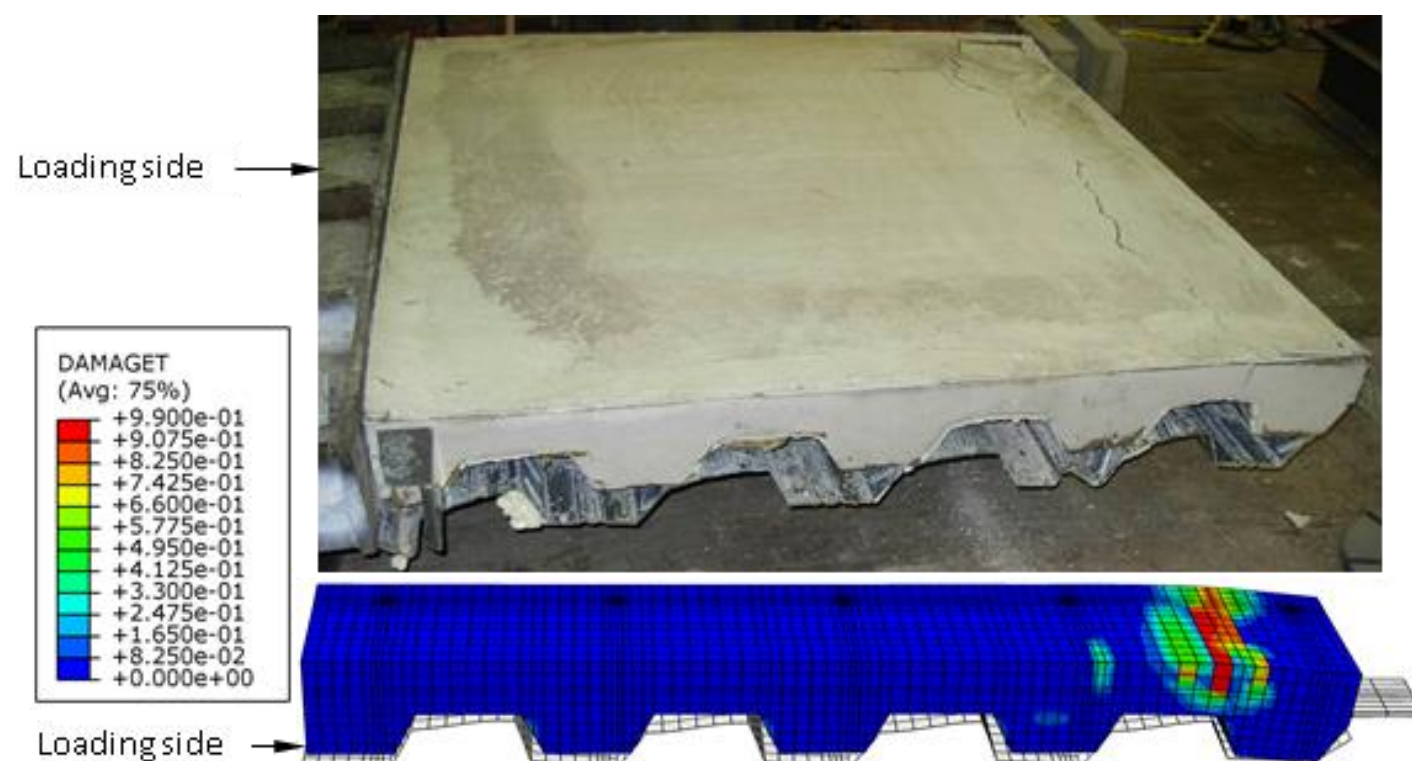
SCI P358. 2014. Joints in steel construction: Simple joints to Eurocode 3. London, UK: The British Constructional Steelwork Association Limited (BCSA).

Qureshi J, Mottram JT. 2015. Moment-rotation response of nominally pinned beam-to-column joints for frames of pultruded fibre reinforced polymer. *Constr Build Mater.* 77:396–403.

Thanks for listening.....Questions?

A recent paper on steel-concrete composite beams:

Qureshi J, Lam D. 2020. Experimental investigation of shear connector behaviour in composite beams with metal decking. Steel Compos Struct. 35(4):475–494.



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