

Thesis: NUMERICAL MODELLING AND PARAMETRIC ANALYSIS OF EXISTING STEEL FRAMES RETROFITTED WITH EXTERNAL BRBs

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SUMMARY

The need to reduce the invasiveness of the seismic retrofitting intervention by means of BRBs contributed to inspire the HITFRAMES[1] research project on which this thesis is founded. The main outcomes of the experimental campaign proved that further considerations were needed to increase the effectiveness of the intervention. De facto, the inclusion of diagonal braces, as carried out in the laboratory, allowed to increase the stiffness of the frame but not its dissipative capacity.

The above considerations inspired this dissertation. Indeed, the main objective of the study was to identify the design parameters that limited the effectiveness of the intervention and then investigate solutions that would allow design recommendations to be outlined. To this aim, the following methodological approach has been adopted. First, a non-linear FEM detailed (Abaqus) model was developed and validated against the experimental results. Thereafter, the validated model was subjected to pushover analysis aimed at identifying the key design parameters that influenced the effectiveness of the intervention and evaluating their influence on the frame behaviour. Finally, based on what was observed in the previous step, design recommendations were outlined.

The present study demonstrated that neglecting the torsional and distortional deformability of the column during the design process leads to a drastic performance reduction of the retrofitted frame. In particular, pushover analyses have shown that without torsional and distortional constraints, BRB yielding occurs at larger inter-storey drifts, thus making BRB inclusion ineffective. Therefore, to achieve similar performance between retrofit intervention through external BRBs and internal BRBs, it is required that in the former, distortional deformability of the column in the nodal zone is prevented and that an adequate torsional constraint is provided for the column. Hence, the retrofitting solution by means of external BRBs turns out to be effective in cases in which the other structural elements (e.g., orthogonal beams, slab, infills) are able to guarantee an adequate torsional restraint for the column, and at least four stiffening plates can be placed in the nodal zone. However, when torsional restraint appears to be inadequate, it is still possible to vary the strength or eccentricity of the BRB to reduce the column deformability effects.