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NUMERICAL STUDIES ON SEISMIC RESPONSE OF STEEL AND COMPOSITE ECCENTRICALLY BRACED FRAMES

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ABSTRACT

Eccentrically braced frames (EBF) are frequently used for the structures in seismic areas as an alternative to the concentrically braced frames (CBF) and moment resisting frames (MRF). When are designed to dissipate the seismic induced energy, the potential plastic zones (dissipative elements) must have a predictable behaviour. The other structural elements are non-dissipative and must be designed to remain essentially in elastic stage under seismic action. The strength, stiffness, and ductility of EBF is directly related to the configuration of the links. While short links are preferred for their larger stiffness and deformation capacity, long or intermediate links may be also required, especially due to architectural or space usage constraints. This paper presents the result of numerical studies with the objective to investigate and compare the behaviour of steel and composite eccentrically braced frames under seismic loading with different link configurations. Numerical models were calibrated against test data.

Keywords: plastic deformation, steel frame, eccentrically braced frame, seismic response.

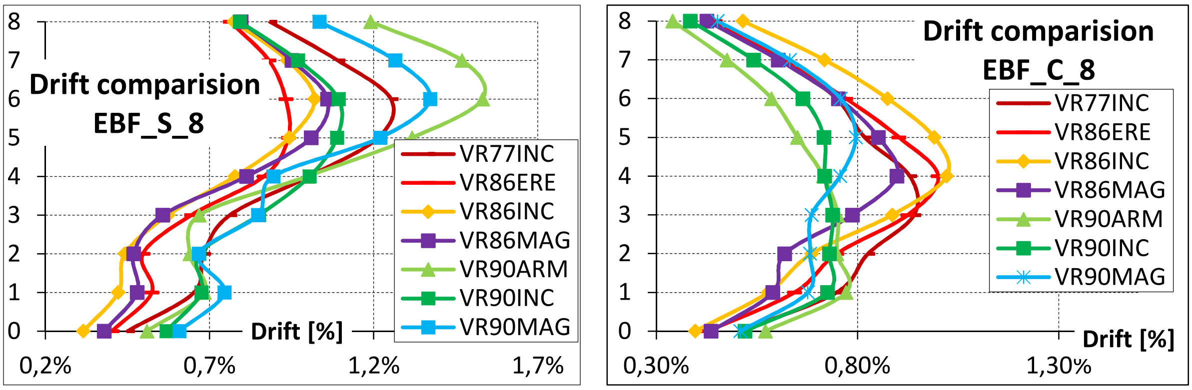
INTRODUCTION

Steel and composite eccentrically braced frames (EBFs) are efficient lateral load resisting systems and are widely used for structures located in seismic areas. The EBFs combine the advantages of MRFs and CBFs, i.e. good ductility associated with an adequate lateral stiffness. In case of EBFs with composite beams, the current practice recommends a complete detachment between steel beam and concrete slab in the dissipative zones (link). The interaction between the concrete slab and the steel frame in the link region has an important influence on development of plastic hinges and deformation capacity (Ciutina *et al*., 2013; Ioan *et al*., 2016; Senila *et al*., 2016).

For a comparative analysis between the behavior of eccentrically braced frames with steel beam links with and without considering the concrete slab, a series of nonlinear time-history analysis were carried out for both types of structures. Frames with different number of stories were analyzed using SAP2000 program.

RESULTS AND CONCLUSIONS

The following set of results shows the maximum recorded values (envelopes) for interstory drifts, for seven ground motion records (stiff ground type, a_g=0.4 g), Figure 1. When comparing the response of the two structures, i.e. with and without concrete slab, at the design ground acceleration corresponding to Ultimate Limit State ULS conditions (acceleration multiplier λ equal to 1.0), the difference between the two cases can be seen. The presence of the concrete slab leads to a stiffer response of the structure and less deformation demands. The contribution of the concrete slab is significant in regards to the global behavior of structure, even in the situation when shear connectors are not present in the dissipative link beam.



(a) (b)

Fig. 1 - Inter-story drift comparison at ULS for frames with 8 stories: (a) without concrete slab EBF-S-8; (b) with concrete slab EBF-C-8

REFERENCES

[1] A. Ciutina, G. Danku, D. Dubina. Influence of steel-concrete interaction in dissipative zones of frames: I - Experimental study. Steel and Composite Structures, Vol. 15, No. 3 (2013), ISSN 1229, 2013.

[2] A. Ioan, A. Stratan, D. Dubina, M. Poljanšek, F. J. Molina, F. Taucer, P. Pegon, G. Sabau, Experimental validation of re-centring capability of eccentrically bracedframes with removable links, Engineering Structures 113 (2016), pp. 335-346.

[3] M. Senila, A. Sigauan, I. Petran. Comparison between behaviour of steel and composite Eccentrically Braced Frames with long links, 13th International Conference on Metal Structures ICMS, Zielona Góra, Poland, 15-17 June, 2016.