THE COMPARISON OF SEISMIC PERFORMANCE OF THE BRACES EQUIPPED WITH BRB AND RBS

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Seismic retrofitting and rehabilitation of structures is one of the most important issues in earthquake engineering. One of the common methods of retrofitting steel structures is to use bracing system for increased stiffness and lateral resistance.

Conventional steel bracing elements show asymmetrical behavior under cyclic loading: high ductility in tension due to the ductile yielding material characteristics and buckling under compression. This stability problem influences the overall cyclic response of the element, reflected by the cyclic degradation. By removing the buckling phenomenon, BRBs offer balanced, extremely ductile and dissipative cyclic behaviour.

Buckling Restrained Braces (BRBs) are a structural component useful when providing bracing for seismic or other loads. BRBs have a large ductility capacity and are designed to yield under loads without buckling. They offer robust cyclic performance and significant cost savings, compared to conventional bracing systems (Deulkar et al., 2010).

Buckling restrained braces (BRBs) are composed of a slender steel core continuously supported by a concrete casing in order to prevent buckling under axial compression. The core and the casing are decoupled to prevent interaction between them.

By the achieved ductility and stable, repeatable hysteresis loops, BRB can absorb significant amount of energy during cyclic loadings, such as an earthquake event.

Hysteresis loops for conventional brace system (CBS) and BRB shown in Figure 1.

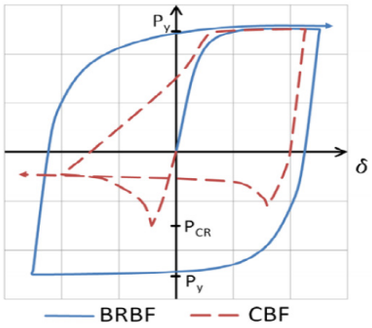

Figure 1. Hysteresis loops for CBS and BRB (Deulkar et al., 2010)

The new high performance bracing system as shown in Figure 2, developed by Golafshani et al. (2006) that can be installed in the braces as a supplemental part, is capable of removing the permanent drift of stories at the end of excitation

and concentrating structural damage in braces. The RBS device which is assembled in a desired location of the brace member, Figure 3, is made of high strength steel. In comparison with conventional brace system (CBS), ribbed bracing system (RBS) can absorbed seismic energy without causing large permanent drift in structure. In the conventional bracing systems it is assumed that the braces buckle under little compressive forces; but in this new presented completely tensile-ribbed bracing system (RBS), buckling of compressive member is prevented by using of a ribbed shape cylinder. The brace equipped with this system loses its length under pressure effect; in contrast with conventional braces, this brace can receive tensile force at any point during its return. Therefore, brace equipped with this system can apply a continuously variable stiffness to structure during earthquakes. RBS has no need to any actuator and power supply, therefore, as a passive control of structures is known.

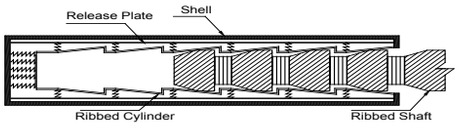

Figure 2. Supplemental part developed by Golafshani et al., (2006)

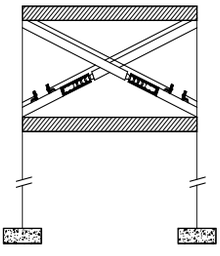

Figure 3. Structure equipped with RBS (Golafshani et al., 2006)

Hysteresis loops for ribbed bracing system (RBS) shown in Figure 4.

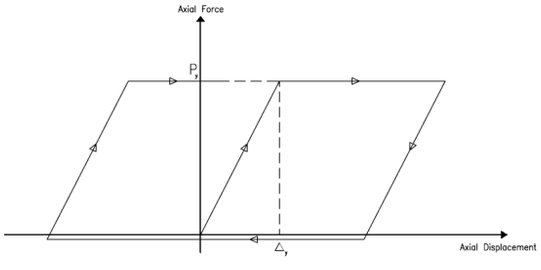

Figure 4. Hysteresis loops for CBS and RBS (Tabeshpour et al., 2006)

In this paper, performance of BRB and RBS in steel structures with modeling in OpenSees software has been investigated under earthquake load. To do this study, the nonlinear dynamic analysis under various earthquake records have been investigated on the 2D steel frames with conventional braces and equipped with BRB and RBS. The results show that these systems have suitable performance compared with conventional braces.

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