Paper Code. 4150

Seismic Assessment of Buckling Restrained Braced Frame Dual System with Special Moment Resisting Frame

Alireza Mehdipanah[1], S. Rasoul Mirghaderi [2], S. Ali Razavi [3]

1- Graduate student of structural engineering, University of Tehran
2- Assistant professor of structural engineering, University of Tehran
3- PhD candidate of structural engineering, University of Tehran
mehdipanah.a@ut.ac.ir
rmirghaderi@ut.ac.ir
arazavi@ut.ac.ir

ABSTRACT

Buckling-Restrained Braced Frames (BRBFs) have shown to have appropriate energy–dissipating characteristics, however, low post-yield stiffness of the non-buckling braces cause vulnerability of the structure and seismic defects such as large residual drifts. To mitigate these shortcomings, the Steel Special Moment Resisting Frames (SMRFs) are introduced to BRBFs in a dual system configuration.

This paper presents results of a parametric study conducted to investigate the potential benefits of using BRBFs and SMRFs in a dual system. 3 structures have been modeled for comparing the different stiffness proportions of the BRBF and SMRF in dual systems. A bare BRBF and 2 different proportions of stiffness in dual systems have been considered. The 2 dual systems are: 75%-25% structure which the proportions of stiffness in BRBF and SMRF are 75% and 25% respectively. The other structure is 60%-40% model which the proportions of stiffness in BRBF and SMRF are 60% and 40% respectively.

The performances of the structures are analyzed by conducting pushover analyses using PERFORM-3D. Analyses demonstrate that adding the Moment Resisting Frames to the BRBF system changes the natural period slightly. Therefore the design base shear will be constant. Also the results of this study show that the 60%-40% model has a better seismic behavior in mid-rise buildings. All the BRBs remain in LS performance level and the secondary system will be mobilized at higher level which may be concerning for bare BRBF system.

Keywords: **BRBFs, MRFs, Low Post Yield Stiffness, Dual System, PERFORM-3D.**

1 INTRODUCTION

Buckling-Restrained Braced Frame (BRBF) systems have shown predictable performance and robust energy dissipation capacity when subjected to seismic loading. However, the low post-yield stiffness of Buckling-Restrained Braces (BRB) may cause BRBFs to exhibit large maximum and residual drifts. To mitigate this potential shortcoming, Steel Special Moment Resisting Frames (SMRFs) can be used with BRBFs in a dual system configuration.[1]

Architecturally, the use of SMRFs is advantageous due to the large open spaces they allow, whereas BRBs may be hidden in walls adjacent to lift shafts and stair walls with relative ease.[2] While BRBFs exhibit very favorable energy-dissipating characteristics, low post-yield stiffness of the braces leave this system vulnerable to unfavorable behavioral characteristics such as maximum story drift and residual story drift. This can pose a problem for building owners who want to minimize repair costs following a significant seismic event.[3] BRBFs can provide significant elastic stiffness and cause small elastic drifts, while SMRFs have small lateral stiffness to the extent that limiting lateral drifts in SMRF is the governing design criteria. By combining these two systems a dual system with advantages of the two systems can be provided and the disadvantages of the two systems can be prevented as well. The flexible SMRF remains elastic after the BRBF have yielded and provide additional stiffness and prevent large drifts leading in less residual drifts for the