Influence of the Type of Bracing System on Dynamic Response of Steel Frames

Sh. Eghtesadi[1], K. Behfarnia[2]

1- **Graduated Student, Department of Civil Engineering, Isfahan University of Technology, Isfahan, Iran**
2- **Assistant Professor, Department of Civil Engineering, Isfahan University of Technology, Isfahan, Iran**

kia@cc.iut.ac.ir

Abstract

This paper presents an overview of comparing the dynamic response of steel braced frames subjected to seismic loadings. To perform this study, four types of bracing systems including X-bracing, Diagonal bracing, chevron-inverted V and chevron-inverted V type EBF, with 3, 6, 9 and 12- story frames are modeled and designed in accordance with AISC-ASD 89 code. To compare the dynamic characteristics of considered structural systems, nonlinear static analysis was conducted. The parameters which are evaluated and compared in these models are consisted of economical viewpoint with evaluating the weight of the structures based on steel used, the maximum roof displacement, behavior factor, ductility and the energy absorption. Results indicate that response modification factors (*R*) have different values depending on the brace configuration type and the building height. However, EBFs possess the highest amount of *R* factors, it seems in order to obtain the light weight structure, as well as the high energy absorption capacity, the best solution among compared bracing systems, is to apply the Inverted-chevron V bracing systems in steel frames. Obtained results are presented in relative diagrams and tables.

Keywords: braced frames, push over analysis, ductility, energy absorption capacity.

1. INTRODUCTION

Steel braced frames are wildly used in buildings as an important lateral load resisting system in order to provide required stiffness and ductility during severe earthquake excitations, so investigating the seismic performance of different types of bracing is of crucial importance. Elastic design of structures without considering its substantial energy dissipation capacity and inelastic behavior, may require large member sizes and leads to uneconomical design; therefore, many seismic codes permit a reduction in design loads, taking advantage of the fact that the structures possess significant reserve strength (overstrength) and capacity to dissipate energy (ductility). The overstrength and the ductility are incorporated in structural design through a force reduction factor or a response modification factor [1]. While response modification factor (*R*) is affected by many parameters, building codes and standards specified the same value for all types of one resisting system with different height levels (period) and different geometry of bracings.

Response modification factor of concentric (CBF) and eccentric (EBF) bracings have been the subjects of investigations by several researchers. According to Maheri, Kousari and Razazan [2] indicated the effective use of steel bracing including X and knee braced in reinforced concrete frames. By obtaining the experimental force-displacement curve, they showed that retrofitting of the existing RC frames may be successfully achieved using direct internal bracing without the need for an elaborate and expensive indirect internal bracing system. Also maheri and Akbari [3] evaluated the behavior factor for steel braced RC buildings they came to the point that in short dual systems, knee bracing provides higher ductility and *R* value when compared with X bracing. The over strength, ductility, and the response modification factors of special concentric braced frames (SCBFs) and ordinary concentric braced frames (OCBFs) of chevron type, were evaluated by Kim and Chio [1]. Daneshjoo and Badarloo [4] studied displacement, base shear and ductility demand of eccentric braced steel frames under 4 pairs of near and far-fault records of earthquake. It was concluded that to resist lateral forces of near-fault excitations high ductile structure is required. Sasikumar and Mitra [5] determine the effects of variation in eccentricity on the dynamic response of chevron type EBF. Mahmoudi and Zaree [6] evaluated the response modification factor of chevron V, chevron- inverted V and X bracing with both single and double bracing bays, they realized that the height of buildings and the number of bracing bays had great effect on *R* factor.