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Seismic response analysis of mega-scale buckling-restrained bracing systems in tall buildings

Mohammadreza Gholipour[a] and Moosa Mazloom[*]

Department of Civil Engineering, Shahid Rajaee Teacher Training University, Tehran, Iran

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Abstract. Tall buildings are categorized as important structures because of the large number of occupants and high construction costs. The choice of competent lateral load resisting systems in tall buildings is of crucial importance. Bracing systems have long been an economic and effective method for resisting lateral loads in steel structures. However, there are some potential adverse aspects to bracing systems such as the limitations they inflict on architectural plans, uplift forces and poor performances in compression. in order to eliminate the mentioned problems and for cost optimization, in this paper, six 20-story steel buildings and frames with different types of bracing, i.e., conventional, mega-scale and buckling-restrained bracing (BRB) were analyzed. Linear and modal push-over analyses were carried out. The results pointed out that Mega-Scale Bracing (MSB) system has significant superiority over the conventional bracing type. The MSB system is 25% more economic. Some other advantages of MSB include: up to 63% less drift ratio, up to 38% better performance in lateral displacement, up to 100% stiffer stories, and about 50% smaller uplift forces. Moreover, MSB equipped with BRB attests even a better seismic behavior in the aforementioned parameters.

Keywords: mega-scale bracing; buckling-restrained brace; tall building; seismic analysis; modal push-over analysis

1. Introduction

Design and construction of tall buildings require special expertise. Large number of occupants and high and unforeseeable construction costs make tall buildings very important structures. Studied methods should be employed to optimize costs as long as the safety of the building is assured. A main choice for building construction is definitely the steel structural system, and in these buildings, braces are the favorite to be employed as the lateral load resisting system due to simplicity in erecting, affordability and inexpensiveness, and also high strength and stiffness. But major disadvantages are also associated with bracing systems, namely the uplift forces in columns, low ductility and being impedimental to the architectural plan (Smith and Coull 1991). Concentric bracing, eccentric bracing and special bracing systems constitute the three different bracing types, each one offering specific characteristics and also requiring different design approaches (Mazzolani *et al*. 2009). Opting for the most appropriate type of bracing has a substantial effect on

∗Corresponding author, Associate Professor, E-mail: mazloom@srttu.edu
[a] Ph.D. Student, E-mail: mrgholipour91@gmail.com

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