Evaluation of Reduction Factor of Precast Concrete Moment Resisting Frames and Dual Systems with Precast Connections

Morteza Madhkhan[1], Neyram Ahooghalandary[2]
1-Department of Civil Engineering, Isfahan University of Technology, Iran
2-Department of Civil Engineering, Isfahan University of Technology, Iran
madhkhan@cc.iut.ac.ir
neron.ahoo@yahoo.com

Abstract

Reduction factor is an important factor in linear analysis that indicates inelastic operations of structures such as resistance and ductility in nonlinear stage. In seismic codes, this coefficient is just written with a constant value. Despite of many researches on this factor in monolithic constructions, complete research on this field in precast structures has not already been done. This is one of the reasons that make the necessity of research in this case indispensable. In this paper, different types of precast concrete moment resisting frames in 4, 6, and 8 stories, that each storey has 3 meters height, with 3 bays in length of 5 meters, accompany them 3 different popular connections related to beam to column precast connection, horizontal panel joint and vertical panel joint in precast industry, are studied. Nonlinear static analysis (pushover) in triangular form has been used in this study. Besides Perform 3D software is used for modeling and analysis. Results indicate while precast concrete moment frames with semi rigid connections have smaller Reduction factor than monolithic moment frames, precast dual systems could have equal or more values than equivalent monolithic dual systems.

Keywords: precast moment resisting frame, precast dual system, semi rigid connection, reduction factor, push over analysis

1. Introduction

Nowadays construction production has challenges such as production speed and cost in seismic zones [1]. Therefore precast structures are developed to expedite the casting procedure. Precasting leads to high quality, more workability, low cost, time saving and so on [2]. These structures can be constructed by moment resistant connections. However due to existence some problems, precast industry has not reached to its whole potential. Semi rigid connections in precast elements lead to these problems. Many experimental and analytical studies have been made on the beam to column connections, but few of them are about precast concrete connections performance [3]. The main problem is due to low energy damping and demand strength in precast connections. Because of low attention to their connections design, some of the precast structures have failed.

Because of limited information, it is assumed that precast concrete structures have low ductile behavior. They have more instable inelastic behavior than in-site structures. It is due to inelastic stress concentration in connection zone. Consequently, the building codes which are designed for precast concrete structures ignore the details. These codes are widely used in seismic zones as a source for seismic design, then precast structures are low progressed in these zones [3]. In addition, considering same strength level for frames in low or moderate seismic zones and frames in high seismic hazard is unappealing. Seismic behaviors of the precast frames and their connections have been studied in recent decades which were made in experimental and analytical forms. Some of these studies are described here:

Arsalan et al. (2009) studied precast moment frames with same spans. Using finite element methods and cyclic analysis, they discussed on elastic rotational stiffness (R_θ) and maximum quantity of stress. Finite