CHAPTER I

INTRODUCTION

1.1. Background

Irregular shaped Reinforced Concrete Special Moment Frame (RC-SMF) is widely used as an earthquake-resisting structure in many parts of south and south-east Asia. The RC-SMF components like beam, column, joints etc. are designed using special seismic provision of ACI and ASCE to resist heavy ground motion. However, the economic losses due to structural and non-structural component damage, full structure or soft story collapse etc. in time of resisting heavy earthquake shaking have shown that seismic provision are not providing satisfactory performance for all RC-SMF. Hence, the seismic design methodologies and procedures of current building codes should include the target performance level of RC-SMF under severe ground motion while designing the components.

A proper seismic design is needed to achieve the target performance level of earthquake-resisting structure which will consider the controlled story drift and yield mechanism, inelastic behavior of overall structure, calculation of appropriate design base shear and later force distribution. However, the present seismic design provision is basically force based design method, which is mainly account the components strength and indirectly the displacements, and is not consider the performance level under various hazard levels. Therefore, a new displacement-based method is applied to design irregular type RC-SMF

which consider the collapse prevention as well as control the property damage in this study.

The proposed displacement based method has been developed with a series of research works which is conducted in some universities of USA. A performance based design of steel moment frame is proposed using target drift and yield mechanism by Lee et. al 2001. After that, a comprehensive research work carried out on different type of steel structure like Eccentrically Braced Frame (EBF), Concentrically Braced Frame (CBF), and Special Moment Truss Frames (STMF) by using the target drift and yield mechanism concept and a modified performance based seismic design method (Chao and Goel 2005; Chao and Goel 2006a; Chao and Goel 2006b; and Chao and Goel 2006c). Furthermore, performance based method have been applied on reinforced concrete structure to validate this methodology on RC structure (Goal et. al 2009; Liao et. al 2010a; and Liao et. al 2010b). However, research works have only been performed on Reinforced Concrete Special Moment Frame (RC-SMF). Therefore, some researches are needed using this methodology for another type of RC structure like RC-SMF with irregularity in shape, RC moment frame with shear wall, Reinforced Concrete Ordinary Moment Frame (RC-OMF), Reinforced Concrete Intermediate Moment Frame (RC-IMF) etc. In this study, the RC-SMF with irregularity in shape is taken for designing and analyzing using the proposed seismic design method.

1.2. Formulation of Problem

In this study, the main research problems to design the irregular type of RC-SMF using displacement-based method are given below:

1. How to design the irregular type of RC-SMF structure using displacement-based
   design method?
2. How the inelastic state lateral force distribution works for the irregular type of RC-SMF?
3. Is the maximum interstory drift and story shear distribution of the designed RC-SMF using the proposed method passed the performance level under nonlinear time history analysiss?

1.3. Objective of The Study

The followings are the objectives of this research:

1. To develop and validate the displacement-based seismic design for irregular type of RC-SMF
2. To validate the lateral force distribution based on inelastic state (Chao et. al 2007) for the irregular type of RC-SMF
3. To validate the proposed method by performing nonlinear time history analysis using OpenSees (Open System for Earthquake Engineering Simulation)

1.4. Benefit

The benefits of this study is listed below:

1. Structural designer will get a new method to design the irregular type RC-SMF structure
2. Validation of lateral force distribution based on inelastic state (Chao et. al 2007) will be encouraged the designer to use this method
3. Designer can choose the best methodology for designing a structure under heavy ground motion

1.5. Limitation

The limitation of this research is describe below:

1. The maximum 8 story irregular type RC-SMF is consider for designing and analyzing purpose in this study
2. Design base shear is based on work-energy concept and lateral force distribution is based on inelastic state
3. Only one kind of soil condition is taken in this study which is soft soil (E type Tanah Lunak)
4. The mid portal of structure is taken to model in OpenSees for performing nonlinear time history analysis to get the performance level of the structure

1.6. Authenticity of Research

There are several research work is done using displacement-based seismic design. Some list are given below:

1. Lee, S.-S., and Goel, S. C., "Performance-Based Design of Steel Moment Frames Using Target Drift and Yield Mechanism" 2001.
2. Chao, S.-H., and Goel, S. C., "Performance-Based Seismic Design of EBF Using Target Drift and Yield Mechanism as Performance Criteria", 2005.
3. Priestley, M. J. N., Calvi, G. M., and Kowalsky, M. J., "Displacement-Based Seismic Design of Structure", 2007.
4. Chao, S.-H., Goel, S. C., and Lee, S.-S., "A Seismic Design Lateral Force Distribution Based on Inelastic State of Structures", 2007.
5. Goel, S. C., Liao, W.-C., Mohammad, R. B and Chao, S.-H, "Performance-based plastic design (PBPD) method for earthquake-resistant structures: an overview", 2009
6. Liao, W.-C. and Goel S. C., "Performance-Based Plastic Design (PBPD) of Reinforced Concrete Special Moment Frame Structures", 2010