A Paper on "SEISMIC RESPONSE CONTROL OF BUILDING USING STEEL BRACING"

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1. Introduction

A seismic design is based upon combination of strength and ductility. For small, frequent seismic disturbances, the structure is expected to remain in the elastic range with all stress well below the yield level. However, it is not reasonable to expect that the traditional structure will respond elastically when subjected to major earthquake. Instead the design engineer relies upon the inherent ductility of the building structure to prevent catastrophic failure while accepting certain level of structural and nonstructural damage. This philosophy has led to the development of a seismic design codes featuring lateral force methods and more recently, inelastic methods. Ultimately, with these approaches, the structure is designed to resist an equivalent static load and results have been reasonably successful. Even an approximate accounting for lateral effects will almost certainly improve building survivability. However, by considering the actual dynamic nature of environmental disturbances, more improvements were made in the design procedures. As a result, from the dynamical point of view, new and innovative concepts of structural protection system advanced and are at various stages of development.

The modern structural protective system is categorized into three major categories: Seismic Isolation System, Passive Energy Dissipation Devices and Semi Active and Active Energy Dissipation Devices. These energy dissipation devices When gets installed inside any structure curtails response due to the seismicity of earthquake ground motion. All these devices have their advantages and disadvantages but prove to be effective in improving response of structure.

Besides these devices different type of bracing system could be thought upon to dissipate the seismic energy through the structure functioning unlike the metallic damper. These bracings are essentially made of mild steel. These bracings also dissipate energy through their inelastic yielding capabilities. There are mainly two type of bracing system that exist they are concentric type and eccentric type of bracing system. Different type of bracing system that attained the focus of the structural designers includes X bracing system, V bracing system, Inverted V bracing system and K bracing system which are a part of concentric bracing system. Some of the eccentric brace frame (EBF) configuration are D brace EBF, Split K braced EBF and V braced EBF. Buckling Restrained braces are also another type of bracing system that provides energy dissipation through its ductile behavior.

2. Modelling and Analysis

Present work contains seven models. Model I is bare frame model. Model II, III and IV include X, V and inverted V (IV) configuration of concentric bracing system. This system of bracing is used because eccentric bracing system consist of a link element that undergoes inelastic deformation for energy dissipation. This link is possibly beam element of frame structure which is more suitable for steel structures and not for reinforced concrete structures. 3-D elevation view seven models created are depicted in Figure 1.

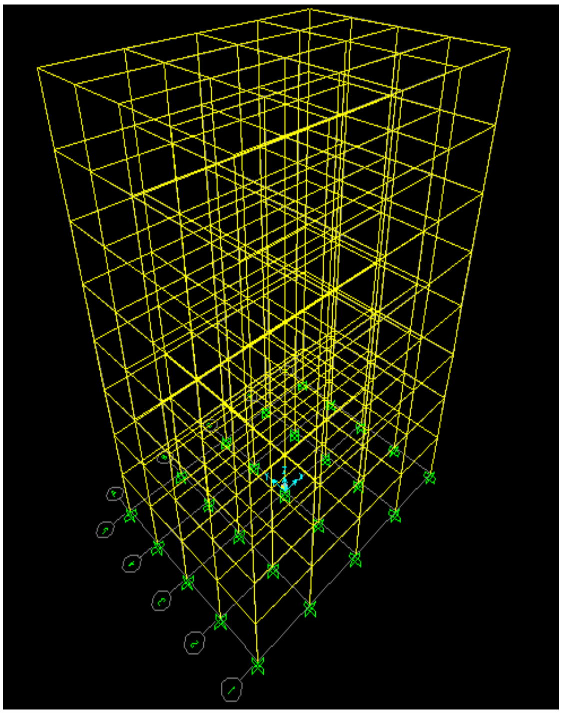


Figure 13-D Elevation View of Model I

2.1 Description of Investigated Structure

The data assumed for the problem to be analyzing in SAP 2000 are as follows:

Table 3.1 Column and Beam Sizes for Modelling of Building

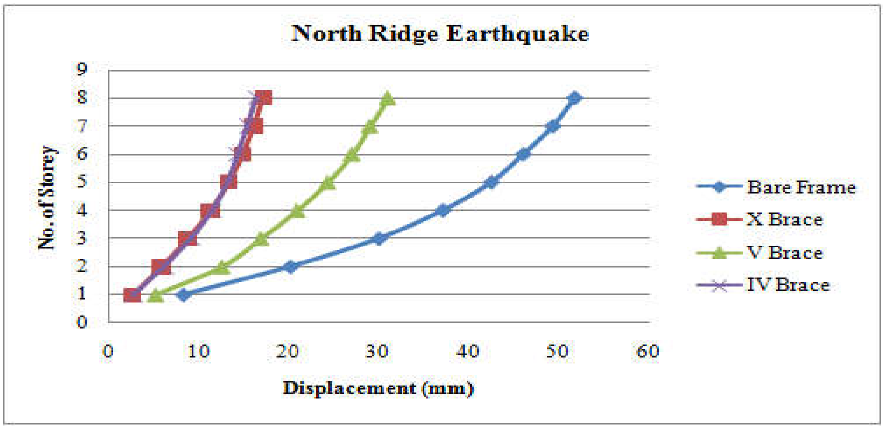
Sr. No.	Element	Notation	Size (mm)
1	Column	C1	350 X 400
		C2	450 X 500
2	Beam	B1	300 X 350

		B2	350 X 400

Building = G + 7 Storey
Slab Thickness = 150 mm
Live Load = 3 kN/m^2
Floor Finish = 1 kN/m^2
Concrete Grade = M20
Concrete Density = 25 kN/m^3
Steel Grade = Fe415
Steel Density = 7850 kN/m^3
Earthquake Used = North Ridge, Imperial Valley and Loma Prieta Earthquake.

3. Results and Discussion

The main purpose of applying nonlinear dynamic time history analysis is to examine the response of modeled building structure under real earthquake ground motions. The analysis exhibits actual behavior caused due to seismic disturbances. The resulting response found from such an evaluation is very realistic in nature. Therefore, the consequences of installing PED's in structure could be investigated on a factual basis. NTH is carried out by imposing three time histories on to the modeled structure which are applied in the horizontal direction and their outcomes are discussed in following points.



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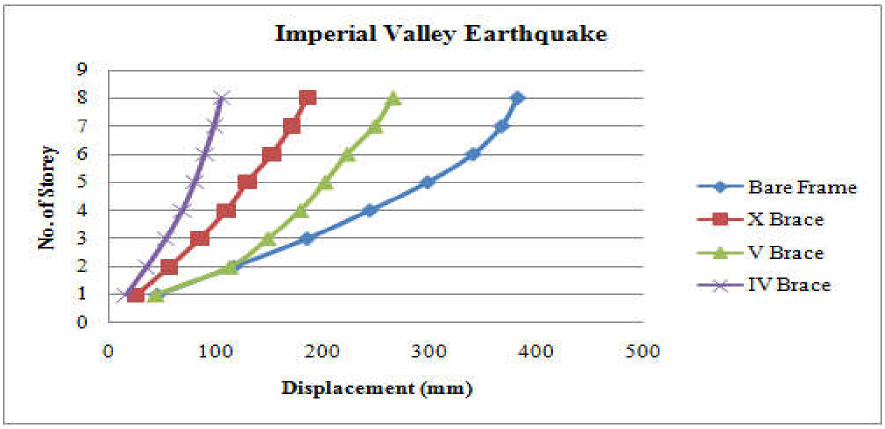

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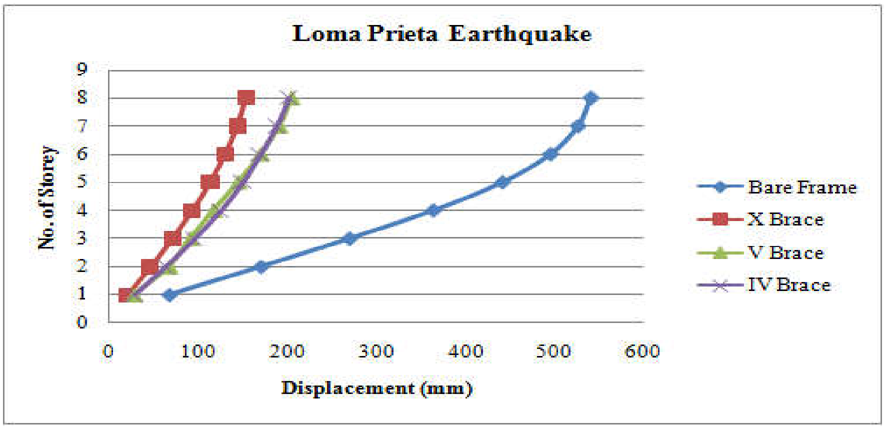

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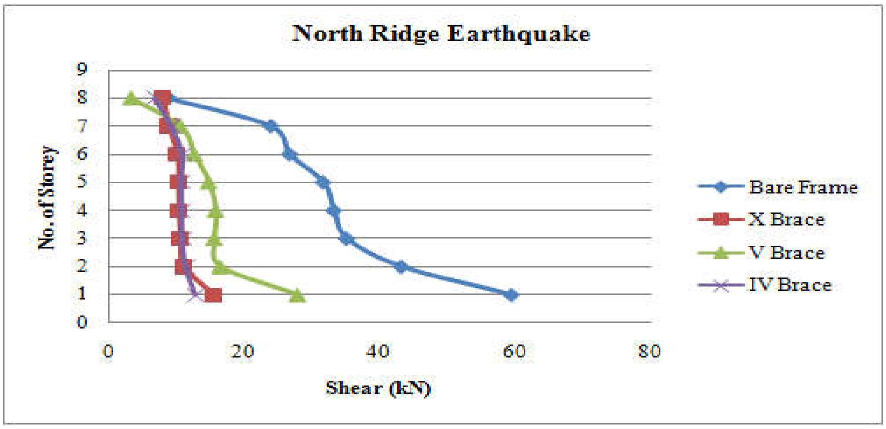
Figure 2 Displacement Comparisons for Model I, II, III and IV (a) North Ridge Earthquake (b) Imperial Valley Earthquake (c) Loma Prieta Earthquake

Incorporating bracing system as energy dissipaters in bare frame structure there is a drastic reduction in storey level displacement due to the resisting force imparted by braces. For the considered earthquake in the study there was a significant percentage reduction in top storey displacement. Amongst all the considered bracing patterns X and inverted V proved to very effective in curtailing displacement at all the storey levels. The increase in stiffness of bare frame structure due to the installation of bracing is the reason for reduction in storey level displacement.



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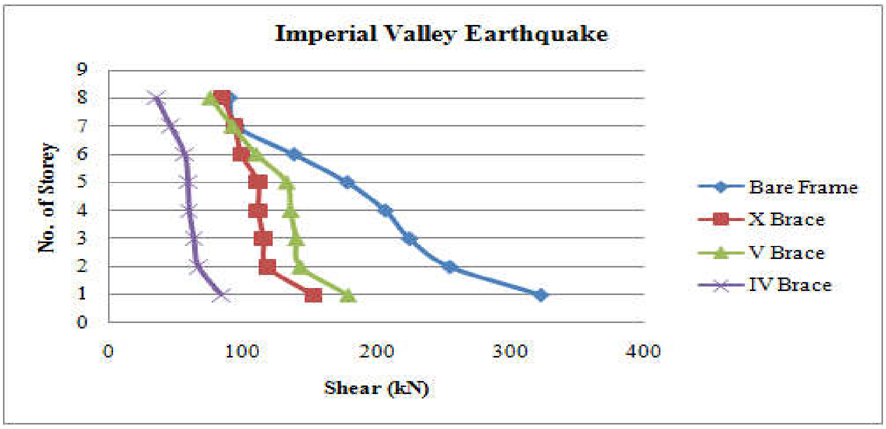

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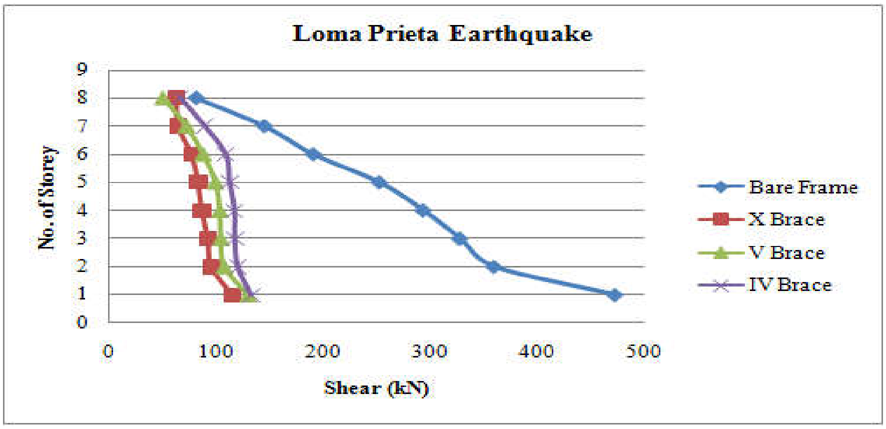

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Figure 3 Shear Force Comparison for Model I, II, III and IV (a) North Ridge Earthquake (b) Imperial Valley Earthquake (c) Loma Prieta Earthquake

A comparative study of shear force from graphs as shown in Figure3 reveal that imparting different configuration of bracing to building structure reduces shear force level. Shear force is maximum in ground floor column and reduces with increase in storey height. All configuration of bracing proved effective in curtailing shear force but X brace proved the best significantly reducing the shear force. Shear in column decreased due to the participation of bracing which shared shear along with column.

4. Conclusions

In present work nonlinear analysis is carried out i.e. dynamic for studying the performance of bracings. Results were assessed in form of storey displacement, shear,nonlinear time history analysis. The conclusions of these results are discussed in this chapter.

1. Top storey displacement reduced by 63.35%, 44.25% and 67.85% for X, V and Inverted V bracing system respectively.
2. The maximum shear in bottom storey column reduced by 67.61% for X bracing, 56.81% for V bracing and 74.92% for inverted V bracing system.

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