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STEEL FRAMES WITH KNEE BRACES BASED ON PUSHOVER ANALYSIS

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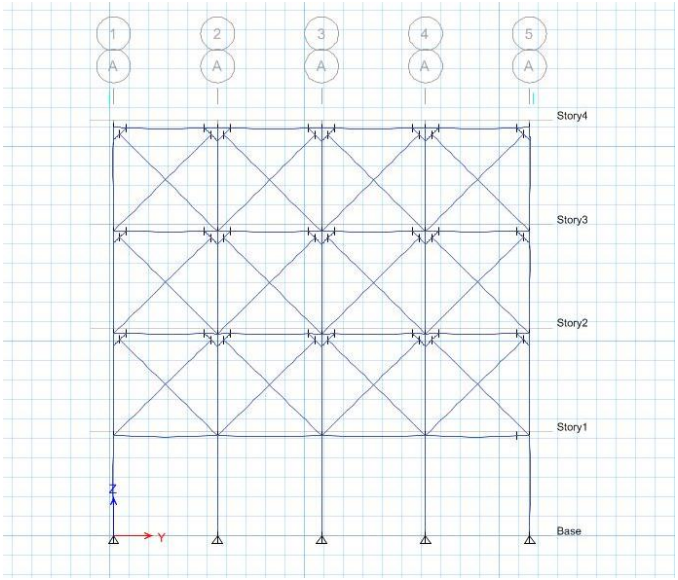
ABSTRACT

The great strength, uniformity, light weight and many other desirable properties makes steel the material of choice for numerous structures such as steel bridges, high rise buildings, towers and other structures. Steel bracing provides an effective solution for resisting lateral forces in a framed structure. Knee braced steel frame has got excellent ductility and lateral stiffness. Since the knee element is properly fused, yielding occurs only to the knee element and no damage to major elements. In this study, steel frames with knee braces had been modeled using ETABS software. And after that, performance of both the frames had been studied using non-linear push over analysis and nonlinear time history analysis. Various parameters such as displacement and stiffness were studied.

Keywords - Displacement, Nonlinear static analysis, Nonlinear time history analysis, Steel bracing, Stiffness.

INTRODUCTION

A reinforced concrete building should be designed to have a capacity to carry combined loads (dead, live and seismic loads) at certain safety level and at certain degree of reliability. Proper account of loads, material properties, structural system, and method of analysis are fundamental factors in the design of structure. When this design is finally executed in the construction process, the expected performance of the structural building should come into satisfaction. However, this ideal condition is not always realized. Performance of structural building could be below the expected criteria in term of safety level and service life due to a variety of causes. In addition to faulty design and improper construction, there are other situations that could impair the future performance of structural building such as alteration of building functions, changes of seismic load characteristics in the area, ingress of aggressive agents from the environment, etc



In term of seismic load characteristics, it is common to come across buildings which used to be meeting the seismic requirements and now their seismic performance are in question due to increase in the current seismic demand. It is also common to discover buildings with degrading performance after damaged by earthquake and therefore, their seismic performance also do

not meet the current standard. Retrofitting of deficient existing building to improve its seismic performance will be a pathway to assure the safety of the structure in the event of future earthquake. There are several technologies that could be chosen for this purpose such as adding a diagonal structural elements (bracing), shear walls, or by changing the relationship between structural elements. The use of steel bracing for retrofitting reinforced concrete structures has some advantages such as it is relatively cost-effective, does not significantly add the structural weight, is easy in application and can be customized with the necessary strength and rigidity

SCOPE AND OBJECTIVE

SCOPE

Steel plays an important role in construction industry due to its high strength to weight ratio. A study regarding the seismic response of steel structures is necessary. In the present study, modeling of the knee braced frame under non linear time history analysis and non linear static analysis was performed. Since in knee bracings, the replacement of knee element is very easy after severe earthquakes, it provides an effective way to seismic retrofitting.

OBJECTIVES

- To study the seismic effect in knee braced frames.
- To conduct pushover analysis in knee braced frame
- To conduct time history analysis in knee braced frame.

METHODOLOGY

- Literature review.
- ETABS software is used.
- Frames are modelled with knee element.
- Knee element of dimension ISMB 175 is used.
- Material properties are assigned.
- Dynamic loading i.e., an incremental loading is given for non linear static analysis.
- Configuration of knee braced frame is arrived.
- Push over analysis is done.
- Time history analysis is done.
- Solution of problem and result interpretation

PRESENT STUDY

A four storey frame of height 5 m is selected in this study. The beams and columns were I-sections and knee braces of cross shape were used. Beam: ISLB 200 Column: ISHB 250 Bracing: ISMB 175.

Material properties of frame

 Young's modulus of elasticity = 200 Gpa

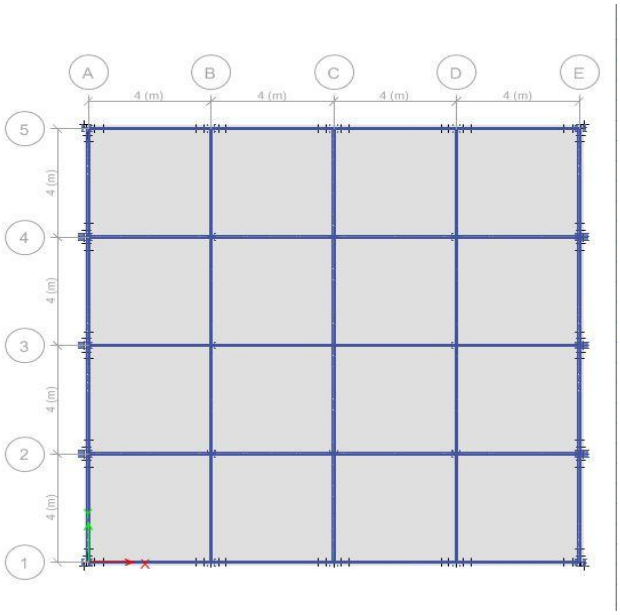
 Poisson's ratio of steel = 0.3

 Density = 7850 kg/m3

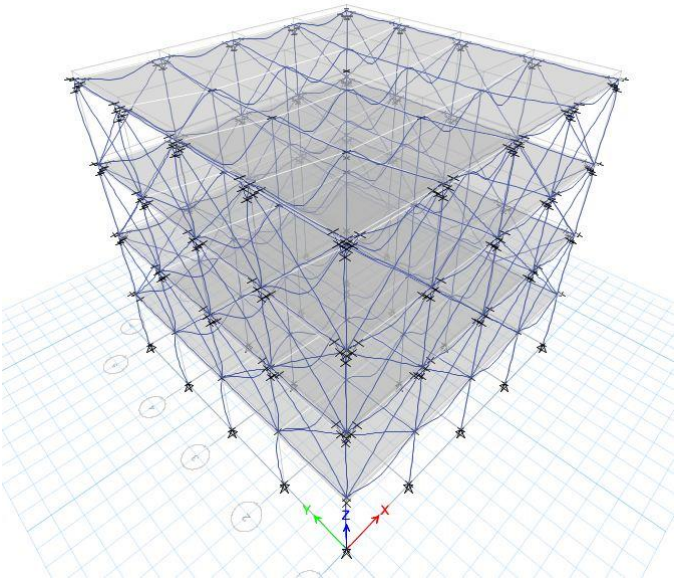
 Yield stress = 250 Mpa

 The base of the frame is fixed .

Sl. no	Building description
1	Bay Width ; 4m
2	Total height;20m
3	Slab thickness;100mm
4	Grade of condrete;M20
5	Grade of steel; Fe 250
6	Zone 5
7	Zone factor ;0.36
8	Response reduction factor;5
9	Importance factor;1
10	Soil type; medium
11	Column details; ISHB 250
12	Beam details; ISLB 200
13	Brace details; ISMB 175



ANALYSIS AND RESULT



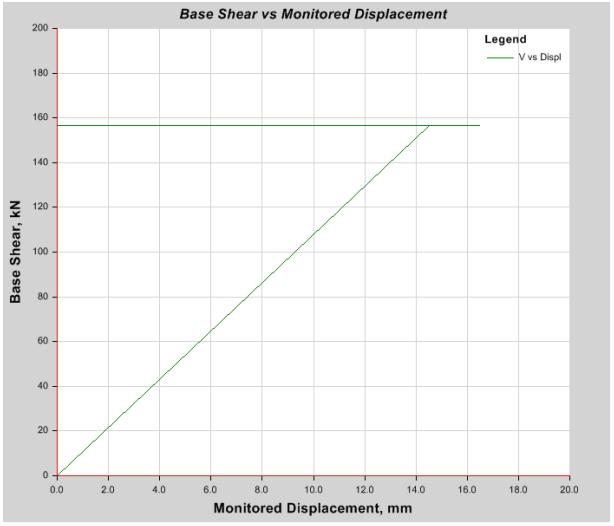
Story Response - Maximum Story Displacement

Tabulated Plot Coordinates

Story Response Values

Story	Elevation	Location	X-Dir	Y-Dir
	m		mm	mm
Story4	16	Top	14.5	7.849E-03
Story3	12	Top	14.3	1.129E-02
Story2	8	Top	14.2	1.039E-02
Story1	4	Top	13.5	1.026E-09
Base	0	Top	0	0

Pushover Curve - Base Shear vs Monitored Displacement



Tabulated Plot Coordinates

Capacity Curve Coordinates (Part 1 of 2)

Step	Monitored Displ	Base Force
	mm	kN
0	0	0
1	14.5	154.665
2	7.788E-10	154.665
3	12.5	154.665
4	1.1	154.665
5	16.5	154.665

CONCLUSIONS

The main advantage of bracing system is to prevent lateral loads like seismic loads and wind loads. This type of lateral load resisting bracing system are called knee braced system. We are identified the same with the help of etabs software. In this study a non linear push over analysis was performed. Knee bracings showed more lateral stiffness compared to other type of bracings. steel frames with knee bracings showed very good behavior during a seismic activity.

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