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Time History Analysis Of Steel And Composite Frame Structure

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Abstract
Steel-concrete composite construction means steel section encased in concrete for columns & the concrete slab or profiled deck slab is connected to steel beam with the help of mechanical shear connectors so that they act as single unit. Earthquakes occurred in recent past have indicated that if the structures are not properly designed and constructed with required quality may cause great destruction and also loss of life. Time history analysis is an important technique for structural seismic analysis especially when the evaluated structural response is nonlinear. To perform such an analysis, a representative earthquake time history is required for a structure being evaluated. Time History Analysis (THA) is a step-by-step analysis of the dynamic response of a structure to a specified loading that may vary with time. In Time History Analysis, time history of representative earthquake is used to determine the seismic response of a structure under dynamic loading. In this work steel sections and composite sections (steel + concrete) are considered for comparative study of high rise residential building. Building is situated in earthquake zone IV. For analysis purpose Time History Method is used. In this work same plan is used for comparison. Load combinations are taken from IS code.

Keywords: Steel Structure and Composite Structure, Time History Analysis, Seismic Responses, E-TAB.

1. Introduction

In India most of the building structures fall under the category of low rise buildings. So, for these structures reinforced concrete members are used widely because the construction becomes quite convenient and economical in nature. But since the population in cities is growing exponentially and the land is limited, there is a need of vertical growth of buildings in these cities. So, for the fulfillment of this purpose a large number of medium to high rise buildings are coming up these days. For these high rise buildings it has been found out that use of composite members in construction is more effective and economic than using reinforced concrete members. The popularity of steel-concrete composite construction in cities can be owed to its advantage over the conventional reinforced concrete construction. Reinforced concretes frames are used in low rise buildings because loading is nominal. But in medium and high rise buildings, the conventional reinforced concrete construction cannot be adopted as there is increased dead load along with span restrictions, less stiffness and framework which is quite vulnerable to hazards.

Braced Frame is designed primarily to resist wind and earthquake forces in a structural system. These braced frames are made of steel members. Steel braced frame is the structural systems used to resist lateral loads in the multistoried buildings. Lateral loads are often resisted by using braced frame but they can interfere with some architectural components. The steel braces are usually placed in vertically aligned spans lateral loading. The main aim of study has been to identify the type of bracing which causes minimum storey displacement such contributes to greater lateral stiffness to the structure. This system allows a great increase of stiffness with a small amount of added weight, and thus it is very effective for the existing structure in which the poor lateral stiffness is the main problem.

The Time History Response of a structure is simply the response (motion or force) of the structure evaluated as a function of time including inertial effects. The time history analysis in the advanced level of visual analysis allows four main loading types. These include base accelerations, base displacements, factored forcing functions, and harmonically varying force input.

2 Methodology

This study involves Time History analysis of steel and composite building by using software. Structural steel of grade Fe 250 Mpa and concrete of grade M30 is used.

2.1 Model Description

A G+10 residential building plan is selected for the study.

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Same model used for steel structure and composite structure.

Table I: Key features of the structure

Name of parameter	*Value*	*Unit*
Number of stories	11	NOS
Storey height	3.0	m
Total height of the structure(above GL)	35.5	m
Length in long direction	17.53	m
Length in short direction	8.35	m
Thickness of Deck	150	mm
Dead Load(1) Wall	5	kN/m
(2) Floor finish	1.5	kN/m²
Live load	4	kN/m²

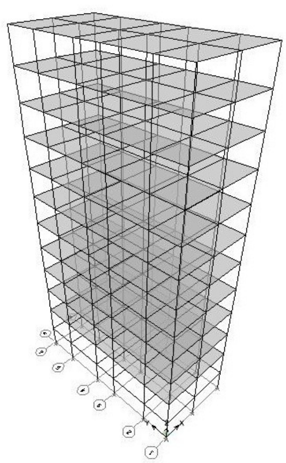


Figure 1: 3D view of building

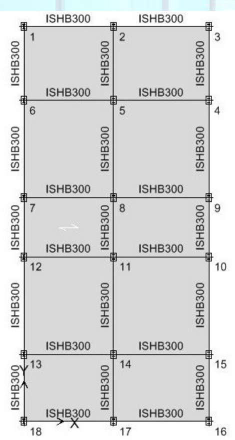


Figure 2: Plan

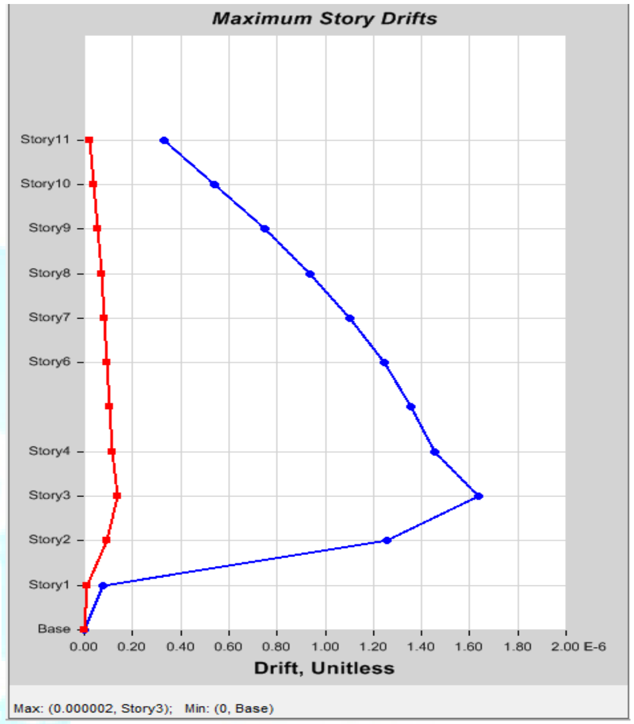
2.2 Model Description

Model 1: Steel structure
Model 2: Composite structure

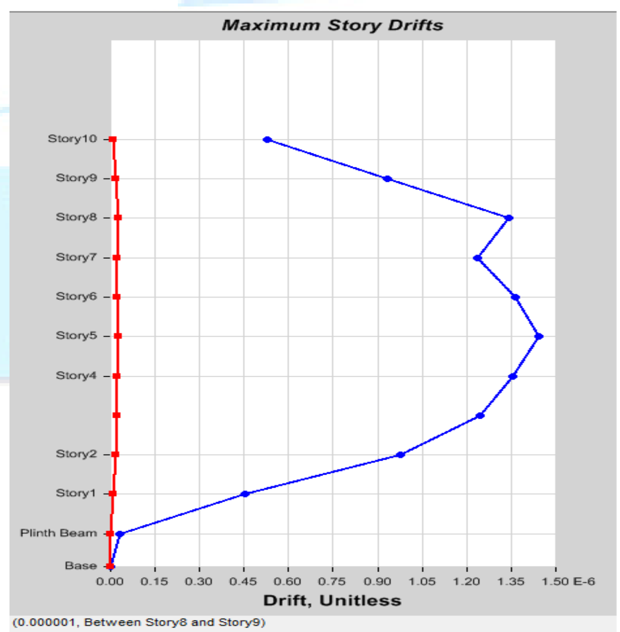
TABLE II: PROPERTIES OF FLANGE SECTION (FE 250 MPA)

SECTION	*d*	*bf*	*tf*	*tw*
I-Section(col.)	327	311	25	15.7
Beam ISHB	300	250	10.6	7.6

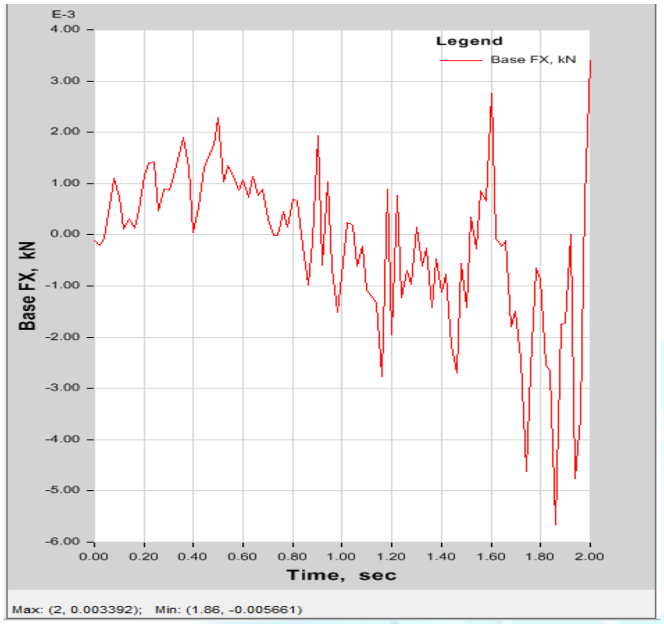
3 Results



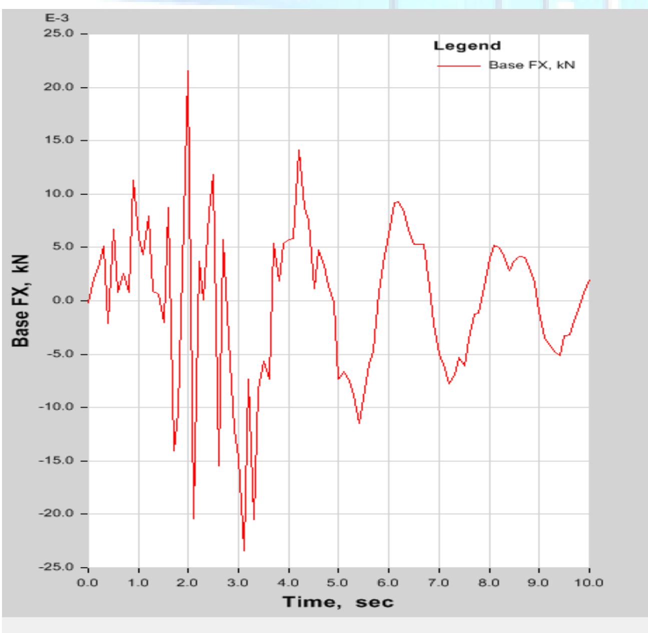
Graph-1:-Story Drift of Steel Structure in X-direction



Graph-2:-Story Drift of Composite structure in X-direction



Graph-3:-Base shear of Steel Srt. along X-direction



Graph-3:-Base shear of Composite Srt. along X-direction

4 Discussion

⑧ It is observed that storey drift in Time History Analysis in X-direction is more for Steel frame as compared to Composite frames. Composite frame has the lowest values of storey drift because of its stiffness.

⑧ The differences in storey drift for different stories along X and Y direction are owing to orientation of column sections. Moments of inertia of column sections are different in both directions. Angle section place back to back is most economical section to reduced lateral deflection.

⑧ Base Shear for Composite frame is maximum because the weight of the concrete use in composite frame is more than the steel use in steel structure.

5 Conclusions

⑧ Composite frame has the lowest values of storey drift because of its stiffness.

⑧ The differences in storey drift for different stories along X and Y direction are owing to orientation of column sections. Moments of inertia of column sections are different in both directions.

⑧ Base shear gets reduced by 10% for Steel frame in comparison to the Composite frame.

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