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COMPARISON OF MULTI-STOREY BUILDING WITH NORMAL BEAMS AND CONCEALED BEAMS.

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Abstract

Beam is the major member of multi-storey building. Normal beams interrupt floor clearance, more expensive, require more labor and form work. But Concealed beams have greater floor clearance, economical, save form work and labor charges. An attempt was made in this work to evaluate and compare the seismic performance of G+5 storey made with normal beams and concealed beams. SAP2000 software was used for this purpose. Both models are analyzed by selecting region of earthquake zone II on a medium soil. Response spectrum method is used for analysis. Displacement, Base shear and axial force are considered as parameters.

Key Words: SAP 2000, Concealed beams, Response Spectrum method, Base shear, and Axial force.

1. INTRODUCTION

Concealed beam is defined as the beam whose depth is equal to the thickness of the slab. They are also known as "HIDDEN BEAMS". The concept of concealed beam originated from flat slab concept. By providing concealed beam floor height can achieved, clears way for electromechanical duct work, economical and also aesthetic appearance of the building. This is more applicable in commercial buildings.

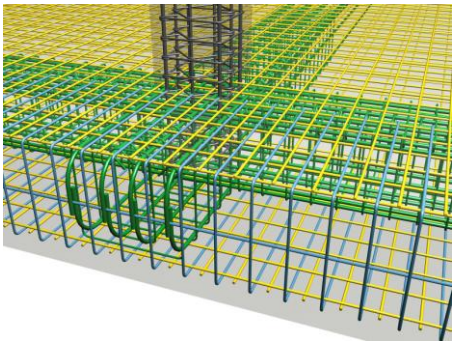

Fig -1: Concealed beam embedded in slab.

2. MODELING AND BUILDING DATA

2.1 BUILDING DATA

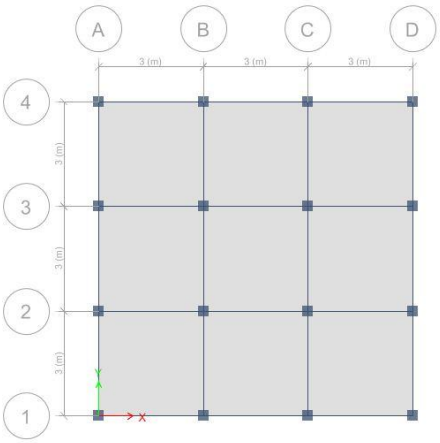

Fig -2: Building Plan

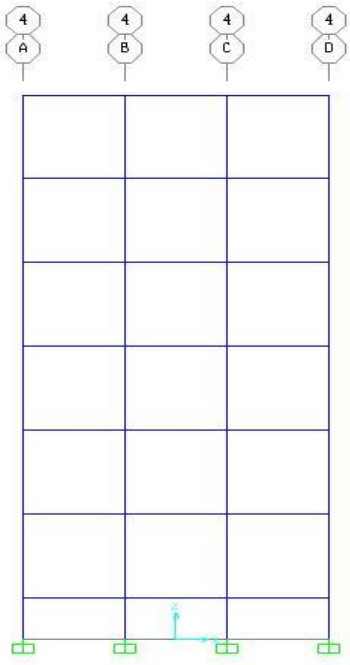

Fig -3: Building Elevation.

Table 1: Building data

Height of the building	19.5m
Floor Height	3m
Normal Beam Dimension	300mm x 450mm
Concealed Beam Dimension	300mm x 250mm
Column Dimension	300mm x 300mm
Slab Thickness	250mm
Height of Parapet wall	1m
Floor Finish	1 kN/m^2
Live load on Floor	3 kN/m^2
Live Load on Roof	1.5 kN/m^2
Density of Concrete	25 kN/m^3
Density of Brick wall	22 kN/m^3
Grade of concrete (f_{ck})	M20
Grade of Steel (f_y)	Fe 415
Seismic Zone	Zone II
Type of Soil	Medium soil
Type of structure	SMRF
Damping ratio	5%
Importance Factor (I)	1.0
Seismic zone factor (Z)	0.16
Response Reduction Factor (R)	5.0

2.2 Analysis of building

Response spectrum method is used in the analysis of multi-storey building with normal beams and multi-storey building with concealed beams. In response spectrum method, dynamic characteristics are considered. Base shear is calculated by multiplying total seismic weight with acceleration spectrum coefficient. Base shear is calculated according to IS 1893 (Part 1) -2002.

RS X – Response Spectrum in X direction.
RS Y – Response Spectrum in Y direction.

2.3 Results and Discussions

2.3.1 Displacements

Table 2: Displacement for Normal beams and Concealed beams.

Type of model	Displacement in mm
With Normal Beam	4.1
With Concealed Beam	4.8

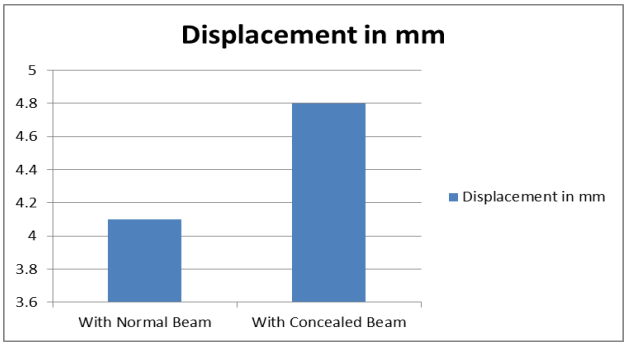

Fig 4: Displacement for Normal beams and Concealed beams.

The displacement of model with concealed beam is 10% more than model with normal beam.

2.3.2 Base Shear

Table 3: Base Shear for Normal beams and Concealed beams.

Type of Model	Base Shear in kN
With Normal Beams	478.49
With Concealed Beams	566.14

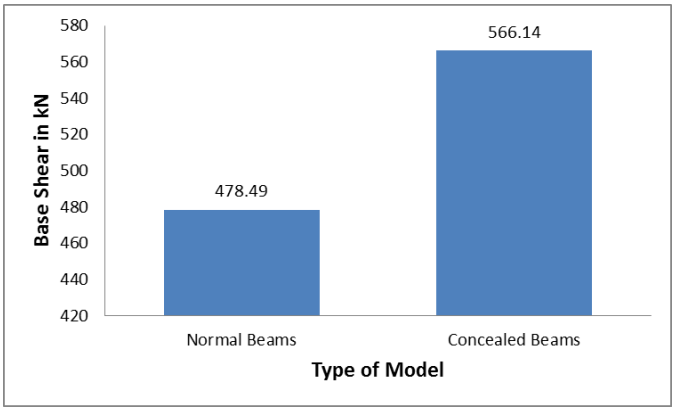

Fig 5: Base Shear for Normal beams and Concealed beams.

The Base Shear in model with concealed beam is around 10% more compared to model with normal beams.

2.3.3 Axial Force

Table 4: Axial Force for Normal beams and Concealed beams.

Models	Axial Force in kN
Normal Beams	1083.58
Concealed Beams	944.86

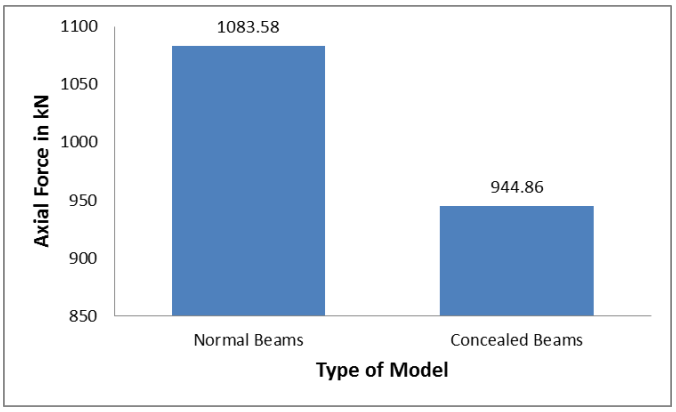

Fig 6: Axial force for Normal beams and Concealed beams.

The Axial Force in model with concealed beam is around 10% less compared to model with normal beams.

3. CONCLUSIONS

a. Displacement of model with concealed beams is more compared to model with normal beams because stiffness of structure reduces with decrease in size of beam.

b. The base shear of model with concealed beam is more than that with normal beam because the fundamental time period is high when concealed beam is provided. Even though the damping percentage of both the structures remains same.

c. The axial forces of model with normal beam are more than model with concealed beam because of increase in self-weight with increase in size of beam.

d. Normal beams can be used in designing building for seismic forces while concealed beams can be used in designing buildings for gravity loads.

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