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Literature survey on Analysis of Multistory Building considering Hybrid Structure

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Abstract— *Hybrid Structures are often built in which the lateral resistance is provided by a mixture of structures. The most common are moment resisting frames combined either with structural walls or diagonal bracing. It is the structure which is the combination of different structural system. In the Multistory building as per our engineering demand parameter, such as floor displacement, Storey Drift, Storey Moment and shear Forces, affected to structures subjected to earthquake load. Tubular frame structure is one of the most efficient systems in tall buildings under lateral load. The analysis of these structures usually involves considerable time and effort due to large number of members and joints. Pushover analysis (PA), static & Dynamic earthquake analysis are widely accepted from the engineering point of view as a practical and computationally attractive method of estimating engineering demand parameters.*

Keywords- *Hybrid structure, Tall Building, lateral force.*

1. Introduction

In Multistory Building we require Control different Engineering Parameters like Floor Displacement, storey Drift, story drift, Story Moment a shear forces affected to structures subjected to earthquake load. Here By doing different analysis which system will become efficient is shown. With combination of different system we can make efficient & economical structure.

2. Hirearchy

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Building structures – Dead loads” 122 16. IS 875 (pt 2) – 1987 “Code of Practice for Design Loads (other than earthquake) for Building structures – Imposed loads” 17. IS 875 (pt 3) – 1987 “Code of Practice for Design Loads (other than earthquake) for Building structures – Wind loads” 18. IS 1893 – 2002 (pt 1) “

[1] Steel braced frame is one of the structural systems used to resist earthquake loads in multistoried buildings. Many existing reinforced concrete buildings need retrofit to overcome deficiencies to resist seismic loads. The use of steel bracing systems for strengthening or retrofitting seismically inadequate reinforced concrete frames is a viable solution for enhancing earthquake resistance. Steel bracing is economical, easy to erect, occupies less space and has flexibility to design for meeting the required strength and stiffness. In the present study, the seismic performance of reinforced concrete (RC) buildings rehabilitated using concentric steel bracing is investigated. The bracing is provided for peripheral columns. A four storey building is analyzed for seismic zone IV as per IS 1893: 2002 4 using STAAD Pro software. The effectiveness of various types of steel bracing in rehabilitating a four storey building is examined. The effect of the distribution of the steel bracing along the height of the RC frame on the seismic performance of the rehabilitated building is studied. The performance of the building is evaluated in terms of global and story drifts. The study is extended to eight storied, twelve storied and sixteen storied building. The percentage reduction in lateral displacement is found out.

No. of stories	G + 4
Storey height	3.00 m
Type of building use	Residential
Foundation type	Isolated footing
Seismic zone	IV
Material Properties	
Young’s modulus of M20 concrete,	E 22.36 x 10 6 kN/m 2
Grade of concrete	M20
Grade of steel	Fe 415
Density of reinforced concrete	25 kN/m 3
Modulus of elasticity of brick masonry	3.50 x 10 6 kN/m 2
Density of brick masonry	19.20 kN/m 3
Member Properties	
Thickness of slab	0.125 m.
Beam size	0.23 x 0.30 m.
Column size	0.23 x 0.60 m.
Thickness of wall	0.23 m.
Dead Load Intensities	
Floor finishes	1.0 kN/m 2
Live Load Intensities	
Roof and Floor	3.0 kN/m 2
Earthquake LL on slab as per	**Cl. 7.3.1 and 7.3.2 of IS 1893(part 1)2002**
Roof	0 kN/m 2
Floor 0.25 x 3.0 =	0.75kN/m 2
Seismic Zone	IV

Zone factor, *Z*	0.24
Importance factor, *I*	1.00
Response reduction factor, *R*	3.00

Table 1: Model data of the buildings
Structure OMRF

The load cases considered in the seismic analysis are as per IS 1893 – 2002.

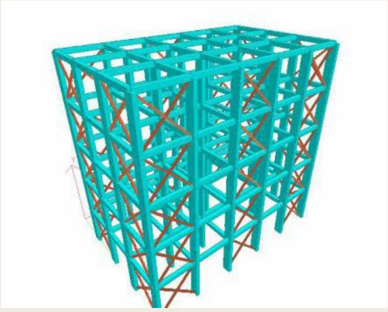

Fig. 1 Building with X Bracings

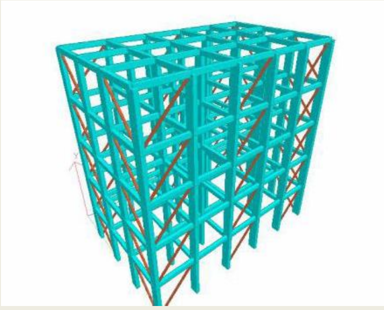

Fig.2 with diagonal Bracings

Comparison of results for displacements

Comparing the results obtained for maximum lateral displacement in X and Z direction for G+4, G+8, G+12 and G+16 storied buildings, it can be found that the X type bracing system reduce the lateral displacement considerably. The variation of displacements and the percentage reduction in displacement for the braced frame in comparison to that of unbraced frame is presented.

No. of stories	**Seismic loads**		**% Reduction**
	Without bracing	**X bracing**	
4 stories	70.10	18.01	74.31
8 stories	126.32	33.04	73.86
12 stories	188.44	63.39	66.36
16 stories	279.13	105.72	62.12

Table 2 Maximum displacements in X direction (mm)

It is found that the X type of steel bracing significantly contributes to the structural stiffness and reduces the maximum inter storey drift of the frames.

[2] Framed tube structures the system consists of an exterior frame in reinforced concrete. The interior floor framing is erected entirely with structural steel. Concrete offers properties for inherent fire protection without resorting to the separate cladding used in fire protected steel surfaces. Under normal service Construction History of the Composite Framed Tube Structura1 System 801 the concrete tube will serve as a layer of insulation causing a reduction of heating and cooling loads. The lateral stiffness of the concrete tube is often adequate to carry the wind loads, while the steel floor framing
carries most of the gravity dead loads, except for the weight of the concrete tube itself. Composite construction practices can
result in construction cycles that are as fast as structural steel erection, demonstrated first in the 50-story CDC Building in Houston, Texas where the entire steel frame for five stories was erected before concrete casting commenced. This separated the two work forces necessary for the two materials and allowed a fast construction pace.

[3] The analysis of these structures usually involves considerable time and effort due to large number of members and joints. Several methods for evaluating shear lag and estimating stress of frame elements are presented recently. According to one of these methods, tube frame is assumed as a web and flange panel and then by considering deformation functions for web and flange frames and writing their stress relations as well as use of Minimum energy basis, functions are presented for lateral and vertical displacement of the structure. Two relation groups suggested in this paper are capable of considering shear lag both in flange and web frames in the base of frame. The simplicity and accuracy of the proposed method is demonstrated through the numerical analysis of several structures. In addition, the results of these proposed deformation functions are compared to previous relations considered by other researchers to find the best relations. In this paper by considering separate deformation functions for web and flange frames and then writing stress-deformations relations as well as the use of minimum energy basis, functions are suggested for lateral and vertical displacements.

(a) web Pannel *(b) Flange pannel*

Fig. 1: Distribution of axial stress in framed tube structure (Kwan, A.K.H., 1994)

Modeling method for frame panels is carried out as orthotropic equivalent members in a way that perimeter frame could be analyzed as a continuous structure. Perimeter frame structure shown in Figure 2 can be considered as two web panels which are parallel to lateral loads direction and two flange frames which are orthogonal to that in accordance with the following assumptions: (1) with regards to the stiffness of floors, out of plane behaviors are negligible in comparison with in-plane behaviors of frames; (2) beams and columns dimensions are similar; (3) four individual columns at corners, so that frame panel can be modeled as continuous equivalent membranes (Kwan, A.K.H., 1994).

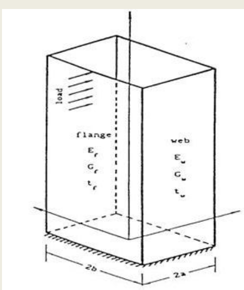

Fig. 2: Typical orthotropic panels of framed tube structure.

3. Mathematical Deformation Functions:

Axial deformations in web (*Ww*) and flange (*Wf*) can be represented by the following equations. Although Kwan, A.K.H., 1994 considered Eq. 1 and 2 in his effort but two groups of relations are proposed in this document to find the compatible equations with structure behavior. Group 1 Relations are shown as Eq. 3 and 4 and group 2 relations are shown as Eq. 5 and 6.

$$W = \varphi\alpha\left[(1-\alpha)\frac{x}{a} + \alpha(\frac{x}{a})^3\right] \quad (1)$$

$$W' = \varphi\alpha\left[(1-\beta) + \beta(\frac{y}{b})^2\right] \quad (2)$$

Group1:

$$W_w = \varphi\alpha\left[(1-2\alpha)\frac{x}{a} + \alpha\left(\frac{x}{a}\right)^3 + \alpha\left(\frac{x}{a}\right)^5\right] \quad \textbf{(3)}$$

$$W_f = \varphi\alpha\left[(1-2\beta) + \beta\left(\frac{y}{b}\right)^2 + \beta\left(\frac{y}{b}\right)^4\right] \quad \textbf{(4)}$$

Group 2:

$$W_w = \varphi\alpha\left[(1-\alpha)\frac{x}{a} + \alpha\left(\frac{x}{a}\right)^5\right] \quad \textbf{(5)}$$

$$W_f = \varphi\alpha\left[(1-\beta) + \beta\left(\frac{y}{b}\right)^4\right] \quad \textbf{(6)}$$

Shear lag.

Table 1: Group 1 coefficients

Load Case	α	β
Single load at top	$\frac{561AC_{1P}}{7240AC_{1P}+12639G_wH^3(H-5)+84260G_wH^2}$	$\frac{693BC_{1P}}{3880BC_{1P}+1611G_fH^3(H-5)+10740G_fH^2}$
Uniform load	$\frac{17671.5AC_{1U}}{22806AC_{1U}+21065G_wC_{2U}}$	$\frac{3759.5BC_{1U}}{4074BC_{1U}+895G_fC_{2U}}$
Triangular distributed load	$\frac{8078.4AC_{1T}}{52128AC_{1T}+455004G_wC_{2T}+147455G_wC_{3T}}$	$\frac{4435.2BC_{1T}}{9312BC_{1T}+19332G_fC_{2T}+6265G_fC_{3T}}$

Table 2: Group 2 coefficients

Load Case	α	β
Single load at top	$\frac{16.5AC_{1P}}{120AC_{1P}+231G_wH^3(H-5)+1540G_wH^2}$	$\frac{18.9BC_{1P}}{56BC_{1P}+27G_fH^3(H-5)+180G_fH^2}$
Uniform load	$\frac{74.25AC_{1U}}{54AC_{1U}+55G_wC_{2U}}$	$\frac{170.9BC_{1U}}{98BC_{1U}+25G_fC_{2U}}$
Triangular distributed load	$\frac{118.8AC_{1T}}{864AC_{1T}+8316G_wC_{2T}+2695G_wC_{3T}}$	$\frac{105.8BC_{1T}}{224BC_{1T}+450G_fC_{2T}+175G_fC_{3T}}$

It can be observed that shear lag coefficients increase as the dimensions of the structure (2a, 2b, H) increase.

[4] The current investigation evaluates modal pushover analysis (MPA) using a 4 and 9 story steel structure with stiffness irregularities. To stipulate a stiffness irregularity we use cross bracing systems to selected locations of the buildings. Results obtained from MPA are compared with rigorous nonlinear time history analysis (NL-THA) using a set of 20 ground motions including near fault excitations. In most
cases, a story mechanism forms between braces and collapse occurs due to amplified P-Delta effects. MPA is not able to predict this behavior. The contribution of higher modes based on MPA to lower levels of intensity is not significant due to the assumption of uncoupled system. MPA can reliably estimate story drifts, overturning moments and story shears for low rise structures with stiffness irregularities and high rise buildings for intermediate hazard levels. Higher modes that cover up to 90% of seismic modal mass are effective to MPA.

4. Summary

Although, there are several researches have been made to correlate the behavior of Multistory Structure, it is at just research level or educational level. There is absence of user friendly guidelines for which a particular analysis of a typical real world problem should be made with changing Story Height & systems which will use guidelines for civil engineers to avoid time consuming calculation or to develop quick decision making system for problems related to analysis and design of Multi story building.

Covered paper Titles

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