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IJIEMR Transactions, online available on 12th Sept 2019. Link :http://www.ijiemr.org/downloads.php?vol=Volume-08&issue=ISSUE-09

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Volume 08, Issue 09, Pages: 634–640.

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PUSH OVER ANALYSIS OF HIGH RAISED BUILDING WITH DIFFERENT LOCATION OF SHEAR WALLS

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ABSTRACT

In this present work, G+10 floor building is analyzed by considering with cracked and without cracked section of beams and column. Now a days, high raised building is built in very small place and useful for creating a living place for all people. But these building are prone to collapse due to earthquake. So that, push over analysis of high raised building are selected in this present work. Importance of sheer wall placement is to analyze the base shear and top storage displacement. SAP 2000 simulation software is used to run the push over analysis. Totally eight types of building models are prepared in this software by changing the sheer wall location. Analysis is performed by considering Indian concrete codes. The modified factors for cracked beam and column section are calculated using American concrete codes. The results of present work are base shear of structure, maximum storey displacement and storage drift. These results are useful to improve the stiffness of high raised building structure.

INTRODUCTION

In multi-storeyed framed buildings, damage from earthquake ground motion generally initiates at locations of structural weaknesses present in the lateral load resisting frames. This behaviour of multi-storey framed buildings during strong earthquake motions depends on the distribution of mass, stiffness, and strength in both the horizontal and vertical planes of buildings. In some cases, these weaknesses may be created by discontinuities in stiffness, strength or mass between adjacent storeys. Such discontinuities between storeys are often associated with sudden variations in the frame geometry along the height. There are many examples of failure of buildings in past earthquakes due to such vertical discontinuities. Structural engineers have developed confidence in the design of buildings in which the distributions of mass, stiffness and strength are more or less uniform. But there is a less confidence about the design of structures having irregular geometrical configurations.An earthquake also known as a quake or tremor is the result of a sudden release of energy in the Earth's crust that creates seismic waves. The most important cause from an engineering point of view, it is believed at present, is the movement of faults which are buried deep below the earth surface. Earthquake causes ground to vibrate and these results a lateral force on the surface. "Earthquakes don't kill people but poorly built buildings do". Poorly built buildings include poor quality of materials used poor shape of the buildings and poor design without considering the codal provisions. Several countries including India have experienced severe losses in the past, in terms of human casualty and property; most recent are the Bhuj earthquake of 26th January, 2001; Sumatra earthquake of 26th December, 20004 leading to Tsunami and Kashmir earthquake of 8th October, 2005. Most of the casualties were due to collapse of poorly constructed buildings in the seismically vulnerable regions.

AIM OF WORK

Identifying the architectural problems in a building during Static nonlinear analysis. However due to the desire to create an aesthetic and functionally efficient structure, architects suggest wonderful and imaginative structures. But in practice more the irregularities, more difficult for the structure to resist earthquakes or lateral forces. Taking present construction building in vijayawada as a case study,

I try to bring out the major differences to vertical load carrying building to earthquake resistant buildings. For the construction building which comes under earthquake zone III and which are not designed as per the earthquake codes are then retrofitted with suitable methods.Improve the stiffness of building with reducing the base shear.

OBJECTIVES OF THE WORK

To study the architectural problems in different geometrical structures and the solutions by SAP2000 using analysis results like ultimate load, ultimate moment, etc.

- To introduce the principle of good earthquake resistant building practices.
- To study the effect of shape of the structure on the overall static nonlinear performance.
- The objective of work is to find out the location of shear wall to improve the structure strength.
- Analysis of cracked and without cracked structure behavior.

LITERATURE REVIEW

Goel and Chopra (1997) evaluated the formulas specified in present U.S. codes using the available data on the fundamental period of buildings measured from their motions recorded during eight California earthquakes from 1971 San Fernando earthquake to 1994 Northridge earthquake. They developed improved formulas for estimating the fundamental periods of reinforced concrete and steel moment resisting frame buildings by regression analysis of the measured period data. Also, the paper recommended factors to limit the period calculated by a rational analysis.

Chandler and Mendis (2000) reviewed the force based seismic design method and also the displacement based seismic assessment approach. They also presented a case study for reinforced concrete moment resisting frames designed and detailed according to European and Australian code provisions having low, medium and high ductility capacity. They used Elcentro NS earthquake ground motion as the seismic input to get the performance characteristics of these frames. The author concluded the displacement-based approach predicts accurately the overall displacement demands for the frames.

Naeim et. al. (2001) described the seismic performance of buildings and performance objectives to define the state of the building following a design earthquake. They also outlined the promises and limitations of performance based seismic engineering. They introduced and

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discussed the methodologies and techniques embodied in the two leading guidelines of this subject i.e. ATC- 13 40 and FEMA-273/274. They provided some numerical examples to illustrate the practical applications of the methods used.

Ghobarah (2001) reviewed the reliability of performance-based design in earthquake engineering, need of multiple performances, and hazard levels for future seismic design practice. He also reviewed the advantage of performance based seismic engineering. He concluded that the advantage of performance-based design is the possibility of achieving predictable seismic performance with uniform risk and there are several challenges to be addressed and much research and development remain to be done before procedures for performance-based design can be widely accepted and implemented.

STRUCTURAL MODELLING AND METHODOLOGY OF FRAMES

In this study, for determination of the performance levels, G+10 R.C.C. Building with cracked and without cracked section were taken. The structural Capacity of cracked and without cracked section compared with performance point value. Different modeling issues were analyzed to study the effect on Capacity of the structure in building with cracked and without cracked section for different position of Shear wall.

Building is G+10 R.C.C. Multi-storey Residential building considered with following details.

- Plan size 33.40m×12m
- No of Stories 11(G+10)
- Floor Height 3m
- live Load 3kN/m2
- Materials Concrete (M 30)
- Reinforcement (Fe 415)
- Depth of Slab 150mm
- Thickness of wall 230mm
- All beams are of uniform size of 400 × 600mm.
- All columns are of uniform size of 650 × 650mm.

3.1. Material Properties

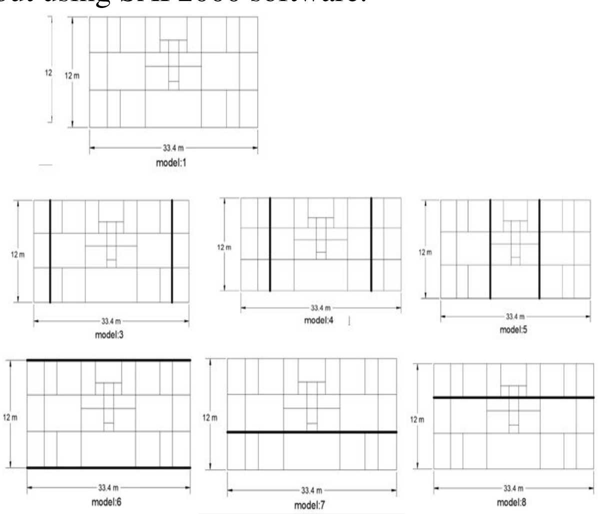
Concrete- M 30

- Density-2500 Kg/m3
- Young's Modulus E- 27386 N/mm2
- Poisson's Ratio-0.2

Steel- Fe 415

- Density-7850 Kg/m3
- Young's Modulus E -2.1 x 105N/mm2
- Poisson's Ratio-0.3

structures and material properties, frame sections, load cases are defined and assigned. Gravity analysis and linear static analysis is carried out as per IS 456-2000 and IS 1893-2002.For beams default hinge (PM3) is assigned and for columns default hinges of axial force and bending moment (PM2-M3) is assigned. Hinges are assigned both for end beams and columns. Two static pushover cases are defined. Initially gravity load is applied to the structure and then lateral load along longitudinal direction is applied to the structure and pushover analysis is carried out using SAP2000 software.



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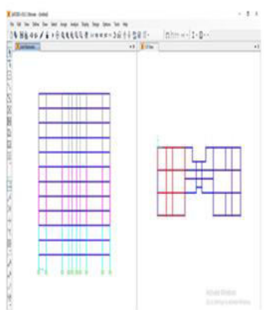
Model 1	Without cracked sections
Model 2	With cracked sections
Model 3	Shear wall location 1
Model 4	Shear wall location 2
Model 5	Shear wall location 3
Model 6	Shear wall location 4
Model 7	Shear wall location 5
Model 8	Shear wall location 6

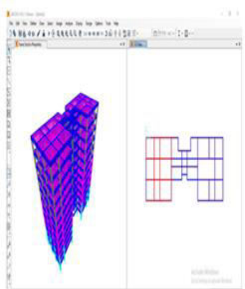
ANALYSIS OF MULTI STOREY BUILDING

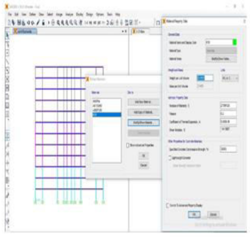
SAP2000 is general-purpose civil-engineering software ideal for the analysis and design of any type of structural system. Basic and advanced systems, ranging from 2D to 3D, of simple geometry to complex, may be modeled, analyzed, designed, and optimized using a practical and intuitive object-based modeling environment that simplifies and streamlines the engineering process. The SAPFireAnalysis Engine integral to SAP2000 drives a sophisticated finite-element analysis procedure. An additional suite of advanced analysis features are available to users engaging state-of-the-art practice with nonlinear and dynamic consideration. Created by engineers for effective engineering, SAP2000 is the ideal software tool for users of any experience level, designing any structural system.

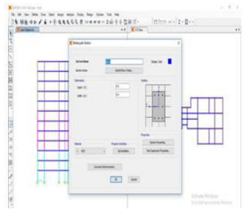
Total SAP procedure can be divided as

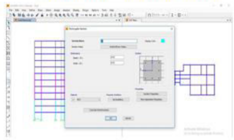
1. Modeling
2. Loading
3. Analsyis

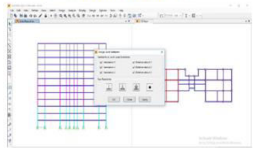

Building front elevation and plan

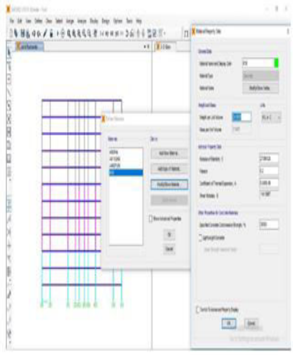

Render view of building

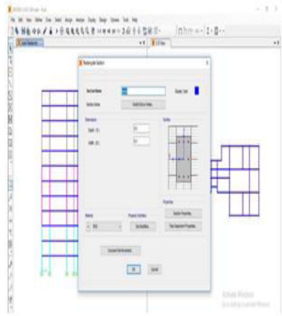

Material properties of building members

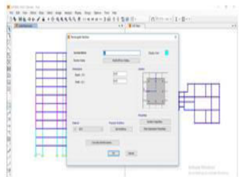

Beam section parameters

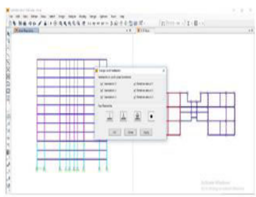

Column section parameters

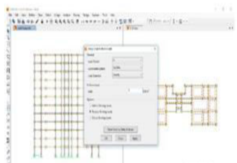

Boundary condition of building.

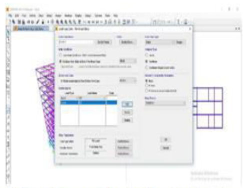

Material properties of building members

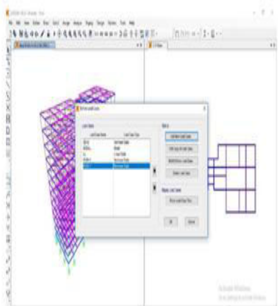

Beam section parameters

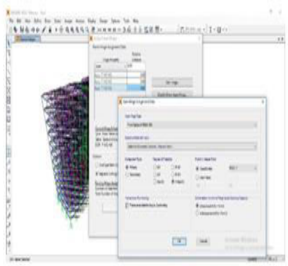

Column section parameters


Boundary condition of building.


Live load applied on the frame model


load case for pushover analysis along Y-direction


Different loads in this study


Hinge formulation

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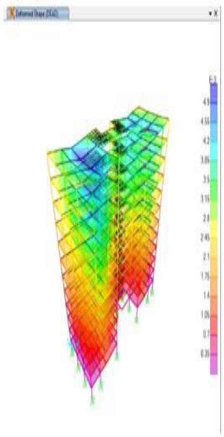
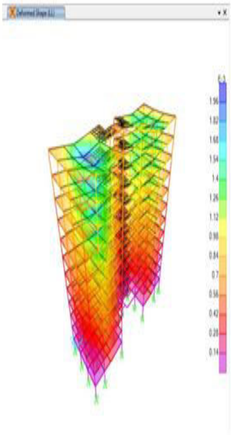
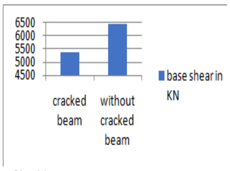


Dead load deformation



Live load deformation

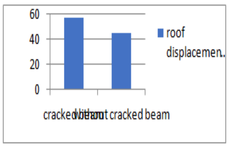
pushover analysis along X direction	
model names	base shear in KN
cracked beam	5503.7
without cracked beam	66223



Base shear of building.

A) Maximum storey displacement is maximum for cracked beam sections as compared to without cracked beam sectional frame

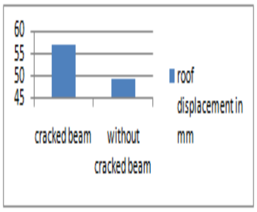
pushover analysis along X direction	
model names	roof displacement mm
cracked beam	57
without cracked beam	45



B) Base shear is minimum value for cracked beam sections as compared to without

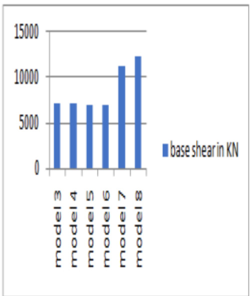
C) Maximum storey displacement is maximum for cracked beam sections as compared to without cracked beam sectional frame.

pushover analysis along y direction	
model names	roof displacement in mm
cracked beam	57
without cracked beam	49.3



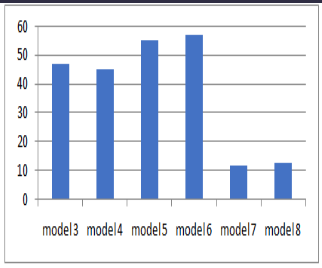
D) Base shear is minimum value for model 6 as compared to remaining models

pushover analysis along X direction	
model names	roof displacement in mm
model 3	47
model 4	45
model 5	55
model 6	57
model 7	12
model 8	12.5



E) Base shear is minimum value for model 7 as compared to remaining models

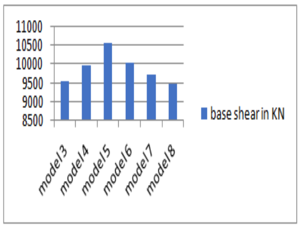
pushover analysis along X direction	
model names	roof displacement in mm
model 3	47
model 4	45
model 5	55
model 6	57
model 7	12
model 8	12.5



maximum storey displacement of building at different location of shear

D) Base shear is minimum value for model 8 as compared to remaining models

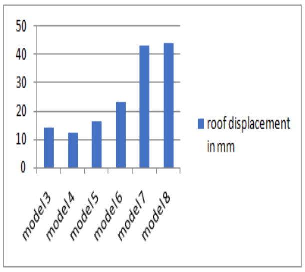
Pushover analysis along Y direction	
model names	base shear in KN
model 3	9542.5
model 4	9951.2
model 5	10562
model 6	10021.1
model 7	9724.6
model 8	9483.7



Base shear of building at different location of shear wall along Y-direction

E) Base shear is minimum value for model 4 as compared to remaining models

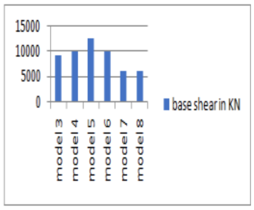
pushover analysis along y direction	
model names	roof displacement in mm
model 3	14
model 4	12
model 5	16
model 6	23
model 7	43
model 8	43.5



maximum storey displacement of building at different location of shear wall along Y-direction.

F) Base shear is minimum value for model 8 as compared to remaining models

pushover analysis along X direction	
model names	base shear in KN
model 3	7052.6
model 4	6984.2
model 5	6910.2
model 6	6892.6
model 7	11124.7
model 8	12141.6



pushover analysis along Y direction	
model names	base shear in KN
model 3	8962.7
model 4	9762.7
model 5	12532.8
model 6	9761.9
model 7	5910.4
model 8	5943.8

Base shear of building at different location of shear wall along Y-direction

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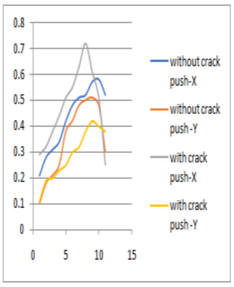
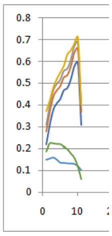
G) Storey drift with and without cracked sectional frame.

	without crack		with crack	
storey drift				
storey	push-X	Y	X	Y
storey 11	0.21	0.1	0.29	0.11
storey 10	0.28	0.18	0.32	0.19
storey 9	0.31	0.21	0.38	0.2
storey 8	0.34	0.25	0.44	0.23
storey 7	0.42	0.38	0.51	0.25
storey 6	0.48	0.42	0.55	0.3
storey 5	0.51	0.48	0.63	0.32
storey 4	0.52	0.5	0.72	0.38
storey 3	0.57	0.51	0.61	0.42
storey 2	0.58	0.48	0.51	0.4
storey 1	0.52	0.3	0.25	0.38

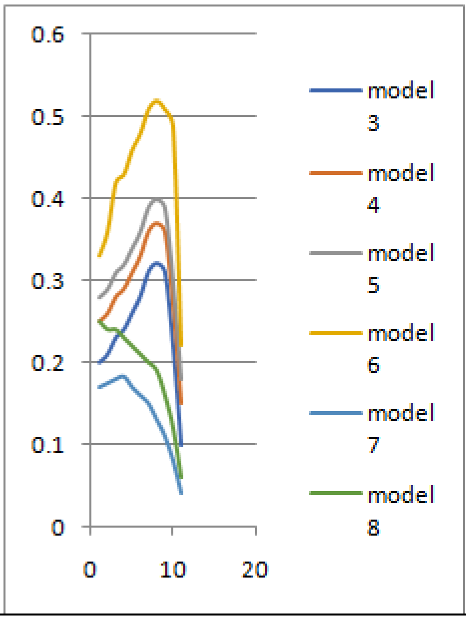


H) Storey drift without cracked sectional frame with shear wall location.

storey drift without crack structure						
storey	push-X	X	X	X	X	X
	model 3	model 4	model 5	model 6	model 7	model 8
storey 11	0.22	0.28	0.31	0.37	0.15	0.189
storey 10	0.31	0.37	0.4	0.42	0.155	0.224
storey 9	0.38	0.44	0.47	0.48	0.16	0.223
storey 8	0.41	0.47	0.5	0.52	0.15	0.221
storey 7	0.43	0.49	0.52	0.55	0.136	0.22
storey 6	0.47	0.53	0.56	0.58	0.135	0.21
storey 5	0.48	0.54	0.57	0.63	0.133	0.2
storey 4	0.52	0.58	0.61	0.65	0.132	0.18
storey 3	0.58	0.64	0.67	0.68	0.13	0.16
storey 2	0.6	0.66	0.69	0.71	0.12	0.12
storey 1	0.31	0.37	0.4	0.4	0.1	0.06



I) Storey drift with cracked sectional frame with shear wall location



storey drift without crack structure						
storey number	push-X	Push -X	push- X	push - X	push- X	push - X
	model 3	model 4	model 5	model 6	model 7	model 8
storey 11	0.22	0.28	0.31	0.37	0.15	0.189
storey 10	0.31	0.37	0.4	0.42	0.155	0.224
storey 9	0.38	0.44	0.47	0.48	0.16	0.223
storey 8	0.41	0.47	0.5	0.52	0.15	0.221
storey 7	0.43	0.49	0.52	0.55	0.136	0.22
storey 6	0.47	0.53	0.56	0.58	0.135	0.21
storey 5	0.48	0.54	0.57	0.63	0.133	0.2
storey 4	0.52	0.58	0.61	0.65	0.132	0.18
storey 3	0.58	0.64	0.67	0.68	0.13	0.16
storey 2	0.6	0.66	0.69	0.71	0.12	0.12
storey 1	0.31	0.37	0.4	0.4	0.1	0.06

RESULTS AND DISCUSSION

Base shear of building:

The G+10 building is analyzing for the performance objective of Life Safety Performance level (FEMA-273) and the result obtained from the analysis for performance point value using software SAP-2000 is presented in the form of table as below,

CONCLUSION

In this present work, analysis has done on multi storey building by considering the cracks in beam and column sections. Here G+10 building is considered and analysis has done on location of shear wall on particular building. The entire project is divided into 8 models. According to shear wall location and parameter of beam and column sections. Push over analysis has done all these types of buildings to find out the maximum storey display, base shear and drift of the building. Base shear of without cracked beam building has 60% increased as compared to cracked beam and 10% storey displacement is reduced. From model 3 to model 8 are considered as different shear wall locations, model 8 has maximum base shear when compared to remaining models. Almost 30% variation can be observed in the previous chapter. Maximum storey is reduced as compared to remaining models. In this work, consider a building which is not a symmetrical structure, which is why X and Y- direction results can be observed clearly different and has more variations. Base shear in X- direction has higher value when compared tp Y-directions. As well as storey displacement has reduced in X- direction when compared to Y*directions. Storey drift also analyzed, which is continuously increased up to 8thstorey and from that it gradually reduces.

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