International Journal of Innovative Research and Advanced Studies (IJIRAS)
Volume 4 Issue 7, July 2017
ISSN: 2394-4404

Progressive Collapse Of Structure On Sloping Ground

Agrawal Akshata Manohar

S. A. Karale

U. S. Ansari

Department of Civil Engineering,
SND COE & Research Center, Bhabulgaon, Yeola,
Nashik, Maharashtra, India

***Abstract:** Nowadays there has been a considerable increase in the number of high rise building both residential and commercial and the modern trend is towards taller and slender structure because of security and value of land. In this study we are going to assume the structure is resting on sloping terrain and another on normal terrain in high seismic zone. The objective of work is to study the behavior of structure in high seismic zone under sequential collapse condition. Progressive collapse in structure may occurs due to fire, tsunami, landslides, earthquake, or due to other external damage. It may lead to failure of adjoining structural elements which may turn further collapse of total structure. For the analysis purpose, ETABS software is used to determine bending axial force, moment, shear force, torsion in various structural elements. After analysis, the structure is then compared with another structure at normal terrain.*

***Keywords:** ETABS Software, Finite Element Model, Multistory RC Building, Linear Static Analysis, Progressive Collapse*

I. INTRODUCTION

Progressive collapse is the aftermath of a localized failure of one or two structural elements that lead to anabiding evolution of load transfer that oversteps the capacity of other circumambient aspects, thus initiating the amelioration that leads to an absolute or fractionaldisintegration of the structure. The progressive collapse of building structure is established when one or more vertical load carrying members (typically column) are excised. erstwhile a column is excised due to vehicle impact, fire, earthquake or any other man made or natural hazards, the building's weight (gravity load) transfer to neighboring columns in the structure. If this columns are not rightly design to abide and reshuffle the additional gravity load that part of the structure deteriorates. Normal design practice, the abnormal events like, gas explosions, bomb attack, vehicle impacts, foundation failure, failure due to construction or design error etc. are not considered. It is not economical as well to design the structures for accidental events unless they have reasonable chance of occurrence. Contemplating these outlooks, a number of government authorities and local bodies have worked on materializing some design guidelines to prevent progressive collapse. Among these guidelines, U.S. General Services Administration (GSA) and Department of Defense (DOD) guidelines by United Facilities Criteria (UFC) - New York, provide detailed stepwise procedure regarding

Methodologies to resist the progressive collapse of structure. In this procedure, one of the important vertical structural elements in the load path i.e. column is removed to simulate the local damage scenario and the remaining structure is checked for available alternate load path to resist the load.

II. AIM OF THE PRESENT STUDY

In the recent past years, there have been many incidents of structural collapses in terms of bridges or other structures, whether they were because of improper designs, poor maintenance, natural calamities or terrorist attacks. The research towards collapse or progressive collapse has been increasing. This will make the structure more safe avoiding casualties.

- ✓ Study the progressive collapse of the RC building by looking into history of building collapses.
- ✓ Analyzing & designing of RC building using ETAB software taking progressive collapse into consideration using various guidelines & design methods suggested by researchers & codes.
- ✓ Investigation of load redistribution to the remaining members.
- ✓ Observing their behavior & the susceptibility of the entire structure to collapse

III. LITERATURE REVIEW

Review of literatures has been carried out from various sources. It includes the information regarding phenomenon of progressive collapse and methods of its prevention.

KamelSayedKandil et al.: has study on progressive collapse of steel frames using the finite element method. The Non- linear finite element models have been developed and verified it against the test conducted by authors and existing data reported in the literature. The nonlinear geometry and nonlinear material properties of steel were considered in the finite element models. The models were used to perform parametric studies investigating different parameters affecting the behavior of steel frames under progressive collapse. The parameters which are investigated are comprised of different number of stories, different dynamic conditions and different geometries. The force redistribution and failure modes were evaluated from the finite element analyses and detailed discussions presented.

A. RashidiAlashti et al.: has presents the three and two dimensional modeling and push-over analysis of seismically designed special dual system steel frame buildings with concentrically braced frames with complete loss of critical elements. The study is conducted on multi story buildings by applying alternate load path method. The results show that parameters such asheight, location and no of bays of removed elements have great influence on progressive collapse potential of buildings under seismic loading.

Nabil A. Rahman et al.: has study to provide the design requirements necessary to reduce the potential of progressive collapse for new and existing DoD facilities. Since then, engineers are on the lookout for design guides that explain the implementation of DoD guidelines in conventional and new construction systems. This paper provides some guidance for implementing the DoD progressive collapse criteria in buildings constructed with cold-formed steel stud bearing wall systems.

F. NateghiAlahi et al.: Has study, to navigate the initial damage toward a specific part of the structure a corner-column was intentionally weakened. Then, push over analysis is carried out on the three dimensional model of the building and the behaviour of structure, such as deformations are studied and the energy absorption of the frames are investigated and finally the collapse pattern of the building is obtained.

Weifeng Yuan et al.: has study, simple mechanical model is proposed to demonstrate qualitatively the pancake type progressive collapse of high rise structures. The impact of two collapsed storeys is analyzed using a simple algorithm that builds on virtual mass spring damper system. To simulate various collapse modes, beam and column are considered individually. The study based on parameter is show that the process of progressive collapse includes a complex mechanism in more number. The proposed model gives a simple numerical tool to assess the overall behavior of collapse initiate from a few arising causes. It gives Unique features, such as beam to column connection failure criterion, and beam to beam connection failure criterion are incorporated into the program. The local failure criterion of structural members can also be easily incorporated into the proposed model.

Hamburger and Whittaker et al.: Provided an overview of design methods and recommendations that can improve resistance of steel structures to progressive collapse such as the use of steel moment frames at all levels of a multistory building and the consideration of catenary action after a column is removed. The authors described the differences in characteristics of loads generated from blasts and earthquakes and the corresponding differences in structural response. The authors suggested that further research is needed to introduce steel moment-resisting connections that are capable of providing the rotational capacity needed for the development of catenary action

IV. METHODOLOGY

The study of analytical approaches for evaluating progressive collapse is carried out by linear static analysis using Alternate Path Method recommended in the General Service Administration (GSA) guidelines is presented in the work.

A. (G+11) building plan is selected for the study.

Name of parameter	Value	Unit
Type of structure	RC	
Number of stories	11	NOS
Storey height	3	M
Total height of the structure (above GL)	39	M
Length in long direction	20	M
Length in short direction	20	M
Thickness of Deck	125	MM
Brick	RED	
Floor finish	1.5	KN/m2
Live load	2	KN/m2

Table 1

Methodology of Work

- ✓ Extensive literature survey by referring books, technical papers or research papers carried out to understand basic concept of topic.
- ✓ Identification of need of research.
- ✓ Formulation of stages in analytical work which is to be carried out.
- ✓ Data collection.
- ✓ Analytical work of modeling is to be carried out using software.

- ✓ Interpretation of results & conclusion

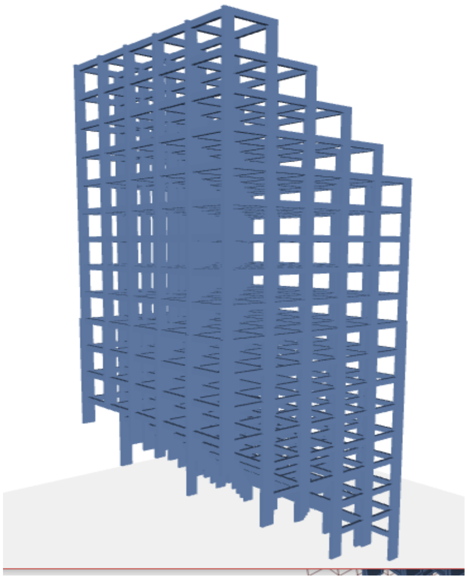


Figure 1: Building On Sloping Gl

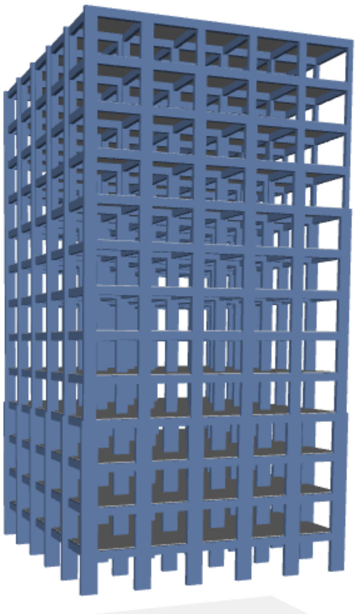


Figure 2: Building On NormalGl

V. RESULTS AND DISCUSSION

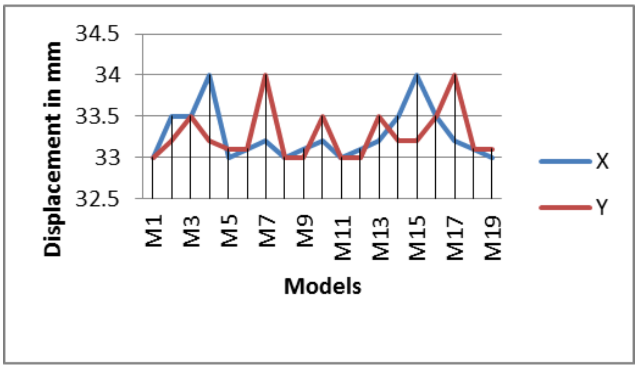


Figure 3: Displacement In X & Y Direction Of Building On Plain GL

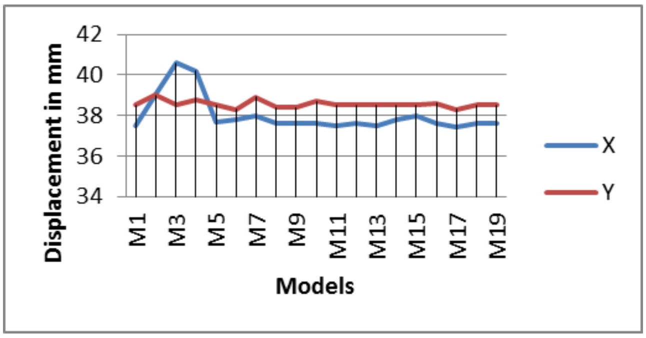


Figure 4: Displacement In X & Y Direction Of Building On Sloping GL

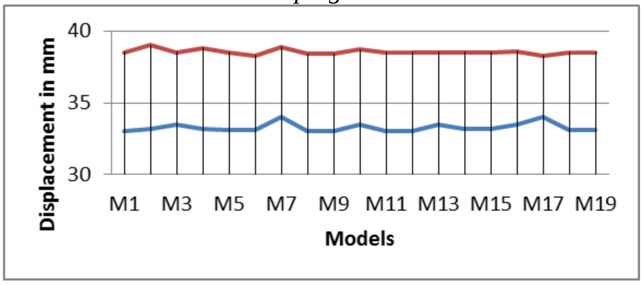


Figure 5: Displacement In Y Direction Of Building On Plain GL & Sloping GL

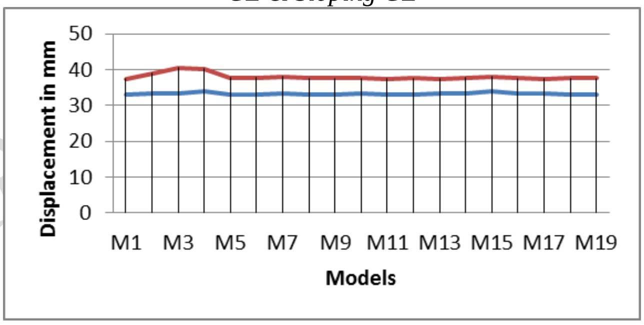


Figure 6: Displacement In X Direction Of Building On Plain GL & Sloping GL

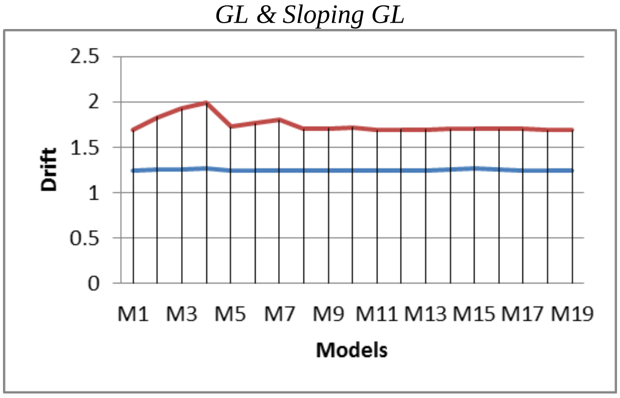
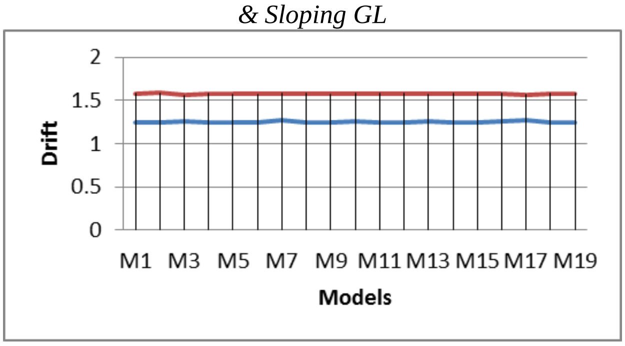


Figure 7: Maximum Drift In X Direction Of Building On Plain & Sloping GL



 ISSN: 2394-4404

Figure 8: Maximum Drift In Y Direction Of Building On Plain & Sloping GL

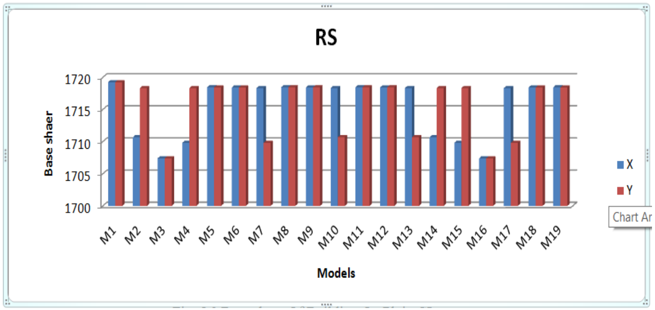


Figure 9" Base shear Of Building On Plain GL

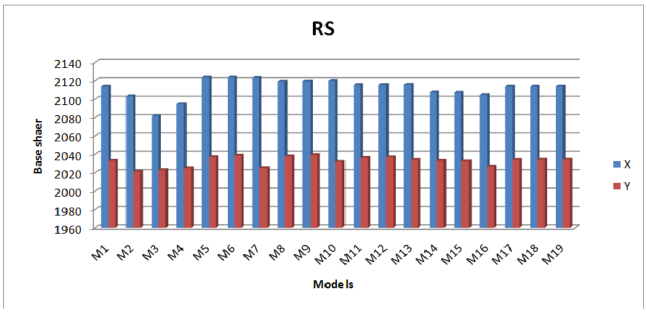


Figure 10: Base shear Of Building On Plain GL & Sloping GL(X Direction)

VI. CONCLUSION

Those there in symmetrical Plain of building but their in change on Displacement after removal of columns (building on Plain/Normal GL)

There is change on Displacement in X and Y of sloping building as compare with building resting on Normal Ground level.

Storey drift is (in X and Y Direction) also observed to be more of building on sloping Groung, but is within the limit.

Also there is increased in base shear in X and Y of sloping building as compare with building resting on Normal Ground level.(22.95% & 18.25% in X and Y Direction REspectively)

After removal of particular column there is decreased in Axial and Banding moments of respective column.

Bending Moments for adjust beams goes on increased and lead to failure (after Removal of column).

From the analysis most critical column is C33 and C43. (for Normal and Sloping building Respectively).

REFERENCES

[1] KamelSayed Kandil1, EhabAbd El Fattah Ellobody, Hanady Eldehemy1, "Progressive Collapse of Steel Frames", World Journal of Egineering and Technology, 1, 39-48, 2013.

[2] H. R. Tavakoli, A. Rashidi Alashti & G.R. Abdollahzadeh, "3-D Nonlinear Static Progressive Collapse Analysis of Multi-story Steel Braced Buildings", 15 WCEE LISBOA, 2012.

[3] Nabil A. Rahman, Ayman Elfouly, Michael Booth, "Alternate Path Progressive Collapse Analysis of Steel Stud Bearing Wall Structures1" Proceedings of the Structures Congress, 2011.

[4] F. Nateghi Alahi, "Analytical Study of Seismic Progressive Collapse in one-Story Steel Building", 15 WCEE LISBOA, 2012.

[5] Weifeng Yuan and Kang Hai Tan, "Modeling of progressive collapse of a multi-storey structure using a spring-mass-damper system", Structural Engineering and Mechanics, Vol. 37, No. 1 79-93, 2011.

[6] Hamburger, R., and Whittaker A,"Design of Steel Structures for Blast-Related Progressive Collapse Resistance. Modern Steel Construction" 44(3), pp. 4551

