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Progressive Collapse of Building Structure

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Abstract: **Progressive collapse is spread of an initial local structural damage causing partial or total collapse of structure. It is one of the most devastating types of building failures, most often leading to costly damages, multiple injuries, and possible loss of life . Therefore it is neccessary to study the basic aspects of progressive collapse from historical background, mechanism, development of guidelines, Indin standard code etc and check the performance of structure. After mishap of blasting or mishap by any other reason, if structure sustain the excessive load then same structure can use for rehabilitation. Study of progressive collapse of Saptashringi apartment, Nashik said that structure was stable after blasting due to explosion in shop and it could be reuse instead of demolishing and constructing new structure.**

Keywords: **Progressive collapse, analysis, deformed structure use for rehabilitation.**

I. INTRODUCTION

Progressive collapse is the result of a localized failure of one or two structural elements that lead to a steady progression of load transfer that exceeds the capacity of other surrounding elements, thus initiating the progression that leads to a total or partial collapse of the structure.

The progressive collapse of building structure is initiated when one or more vertical load carrying members (typically column) are removed. Once a column is removed 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 properly design to resist and redistribute the additional gravity load that part of the structure fails.

Analysis of structure after removing critical columns one by one gives the performance of the building at the stage of progressive collapse.

II. ANALYSIS OF 12 STOREY BUILDING

A computational study was carried out using the Etab9.7.1 software. The model was used to study the global failure of the building structure.

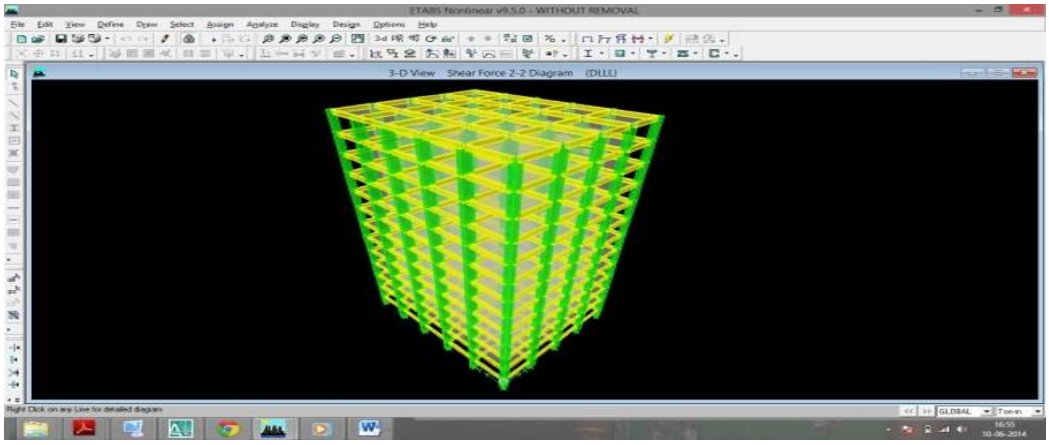

Fig1. Model of building

Model was made by using M-30 grade concrete to beam and slab and M-40 to column. Analysis carried out after removing each column one by one. Result of analysis revealed that structure donot collapse progressively due to axial load of unsupported column. Its collapsed due to incapability of sustaining load of adjoining structural member.

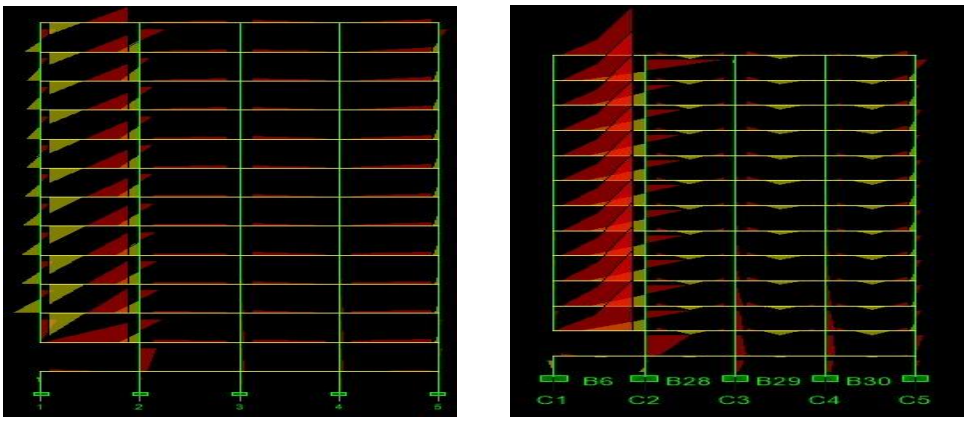

Fig.2 SFD and BMD of Building after removing column 1

Above figure shows that forces amd moment transferred to adjoining member after removing column at ground floor.

All other member is remaining intact except adjoining member of removed column.

Mishap probably occure in fully dead load and partial live load condition. This model has been analysed for fully dead load and live load condition. so it could give result at sever stage of the building.

Beams could transfer the load successively after considering its flange action in analysis. There fore one must consider flange action of the beam to design progressive collapse resistant structure.

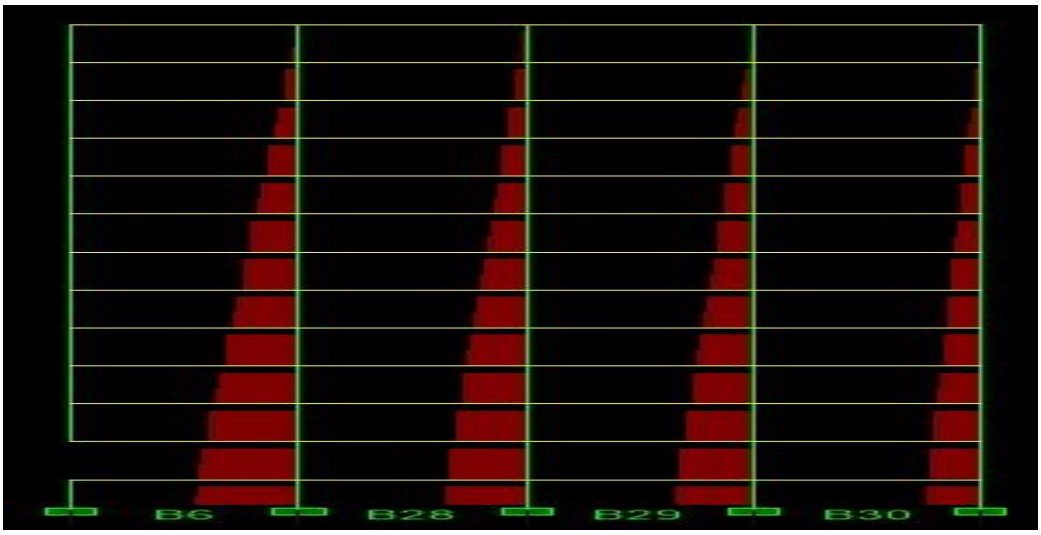

Fig.3 Axial load in Building after removing column 1

It can be seen that axial force in very negligible in upper columns after removing column 1 at ground floor. It transfrred the additional load in adjoining column. If coulumn designed as per ductile design code, it could resist the additional load up to certain extent.

III. STUDY OF SAPTASHRINGI APARTMENT, TARVALA NAGAR, NASHIK

On June 8 2011, blast took place in the shop of saptashringi apartment because of miss handling explosive chemical. The blast was so powerful that it blew off the slab of shop.

Without analysis it has been declared as failed structure and it was demolished and constructs a new building to rehabilitate the residense. Analyses give the exact idea of behaviour of structure after blast.

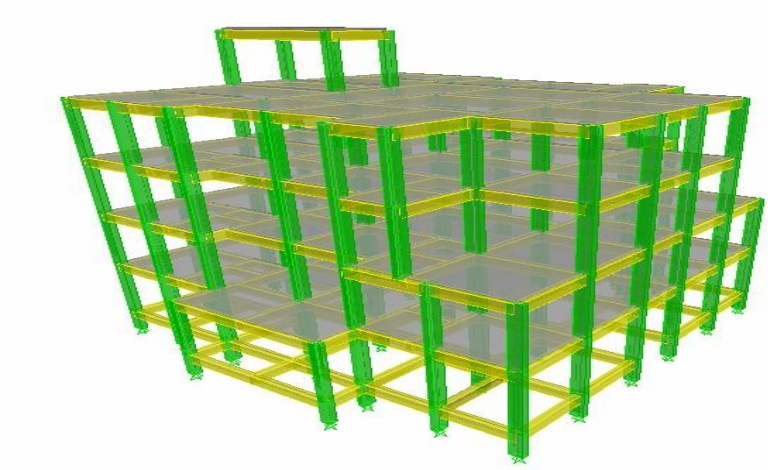

Fig.4 Model of apartment

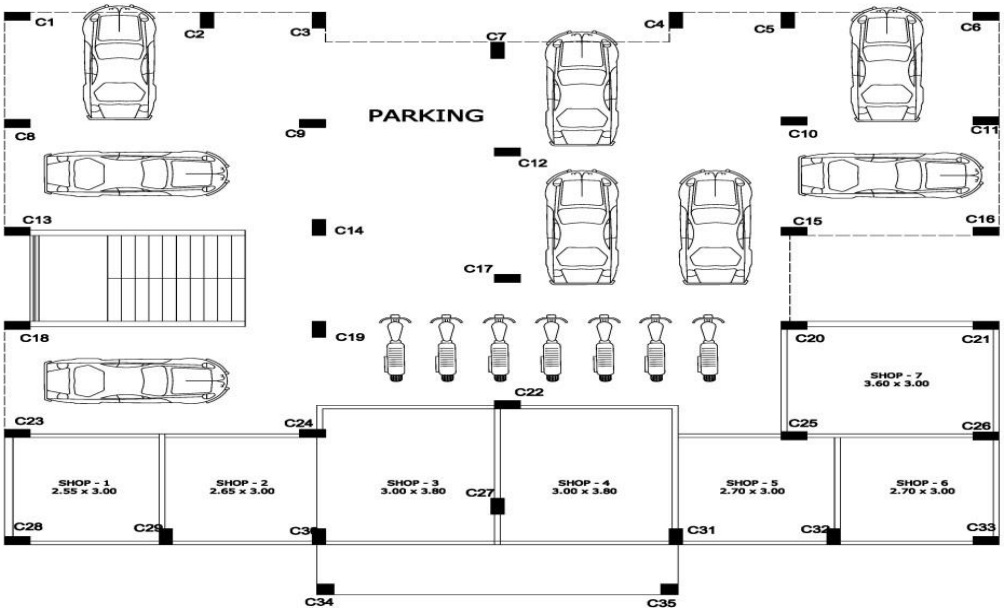

Fig.5 Layout of building

Analysis has carried out by removing all column one by one and checking shear force and BMD of all structural member. From analysis it was conculded that middle portion of the building (column C14,C17 & C19) is critical region. Additional moment should be consider to strtural member of this region while design the building to protect it from progressive collapse.

Blast blew of the column C27. In analysis, if we remove the column C27, other structural member succesively make path for additional load.

Removal of C27 developes the shear force of 14.13 tonn. Where it could resist shear force of 28.98 Tonn. Maximum bending moment after blast is 10 T-m where it could resist bending moment up to 40 T-m and maximum axial force produce in column C22 and C24 which is 118 T which was capable to resist axial force up to 244 T

IV. CONCLUSION

The research conducted included the analytical model of typical G+12 building structure and Saptashringi apartment, Tarwala Nagar, Nashik by using Etab9.7.1. From the no. of iterations of the removal of the members, it was found that the critical members were the middle members of the structure. Removal of outer member make path successively to transfer the excess load.

These critical members should be given much safety.

If we remove the column of outer region of the structure, it do not fail the mechanism of transfering the load. Hence, Structure can reuse after rectifying some repair and damges.

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