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STUDY OF PROGRESSIVE COLLAPSE OF RC BUILDING

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Abstract: The progressive collapse of building is the collapse of whole building or part of building in progressive manner due to spread of local failure from element to element. Due to progressive collapse there will be severe loss of building and life of humanity as progressive collapse happens suddenly. To avoid the loss, need to design a building by proper study and analysis of building for progressive collapse. Due to earthquake, blast, vehicular sudden impact, etc if the column is not capable to withstand sudden impact then column may get failed and due that other columns also get failed, which causes loss of whole structure. A linear static analysis and non-linear dynamic analysis using time history method is carried out using finite element software Sap2000. Three column removal scenarios namely corner, middle & mid-central column removal scenario are taken into consideration. In Linear Static Analysis Demand Capacity Ratio (DCR) values is considered and Non-linear Dynamic Analysis (NDA) Maximum Axial force, bending moment & shear force results where the column is removed are taken into considerations and find out which column removal is affecting maximum to the building.

Keywords: - *RC frame buildings, Progressive, Linear Static, Non-linear Dynamic.*

I INTRODUCTION

In 1968, one corner of the 22-story Ronan Point apartment building in England collapsed almost completely following a gas explosion in the kitchen of an apartment on the 18th floor. The building was constructed using precast reinforced concrete panels and the explosion blew out an exterior wall panel. This resulted in a loss of support of the stories above, which caused a collapse chain reaction upwards to the roof. Debris falling from the stories above caused the stories below to collapse in a similar chain reaction almost to the ground level as shown in Figure 1. This type of chain reaction, where failure of members propagates through a major portion of a structure, following damage to a relatively small portion of it, bas been termed progressive collapse.

II CAUSES OF PROGRESSIVE COLLAPSE:-

Progressive Collapse may be initiated by a range of extreme loadings hazards that can be either man made or accidental. There are many factors, because of which structure collapse in the form of progressive manner such as,

- •Sudden impact
- •Blast load
- •Fire
- •Earthquake
- •Gas explosion
- •Vehicular collision
- •Design and construction error
- •Overload due to occupant misuse

III OBJECTIVE OF STUDY

On Reinforced Concrete (RC) bare frame used, a linear static analysis and non-linear dynamic analysis using time history method is carried out using finite element software Sap2000. Three column removal scenarios namely corner, middle and mid-central column removal situation are taken into consideration

•Study behaviour of frame after removal of column at different positions at corner, middle & mid-central position and finding out DCR value.

•Finding the maximum Axial force, shear force and bending moment value by Non-linear Dynamic Analysis.

•Finding remedial measures to prevent progressive collapse of frame by providing various types of bracings.

IV METHODOLOGY

•Three dimensional 2-bay and 5-storey RC frame is modelled in Sap2000 software.

•Do Linear Static Analysis (LSA) and study the DCR value.

•Do Non-linear Dynamic Analysis (LSA) and study the results maximum axial force, bending moment & shear force values.

V MATHEMATICAL MODEL

Building Specification

•No. of Stories = G+5

•Typical floor height =3.2 m

•Plinth height = 2 m

•No. of bays = 2 bays of 3 m and 2 bays of 3 m

Material properties

M30 grade of concrete, Fe-415 grade of steel & seismic parameters includes zone-5, soil type-2, Importance facror-1, Response reduction factor-5

Loading Data

Live load at floor = 2 kN/m^2

Floor finish at typical floor = 1 kN/m^2

Water proofing roof =1 KN/m^2

Wall load (230mm thick) = 13.685 kN/m

weight of slab (150mm thick slab) = 3.75 kN/m^2

Building design and progressive collapse analysis is carried out using computer program. Final member sizes of the building, after analysis and design are as follows,

Beam-300x300 mm

Column- 450x300 mm

Slab Thickness – 150mm

Steel design for this building is governed by earthquake load combinations.

VI RESULTS

•The maximum DCR values for corner column removal is 1.121, for middle column removal is 0.988 and for mid-central column removal is 1.164.

•The maximum axial forces values for corner column removal is 382.741 KN, for mid column removal is 280.844 KN and for mid-central column is 351.864 KN.

•The maximum bending moment values for corner column removal is 22.8240 KN.M , for middle column removal is 23.1638 KN.M and for mid-central column removal is 21.4655 KN.M.

• The maximum shear forces values for corner column removal is 18.424 KN, for mid column removal is 20.085 KN and for mid-central column is 20.025 KN

VII CONCLUSIONS

•DCR value is maximum for mid-central column removal.

•In non-linear dynamic analysis corner column removal gets maximum axial force.

•Progressive collapse is avoided by providing various types of bracings like X, V, K & Diagonal type of bracings.

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