A Review on Progressive Collapse of Composites Structures

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Abstract - *The objective of this study is to investigate the progressive collapse of composite structures. For this G+20 building has been taken. For this linear static analysis and linear dynamic analysis, of structure has been carried out. The behavioral changes have been investigated to the sudden collapse of structures. The composite structure is design based on Indian Standard code of practice is considered. The investigation is carried out using ETABS software. Progressive collapse is to be considered for analysis as given by the US General services administration (GSA). Percentage change in the values of demand capacity ratio, base shear and roof displacement considering progressive collapse effect of structures were carried out. This simple analysis is used to analysis the structures for different failure conditions and then optimize it for various threat scenarios.*

Key words: Progressive Collapse Analysis, composite structures, U.S. General Service Administration (GSA) Guidelines, Removal of Columns, Demand Capacity Ratio (DCR), Linear Static Analysis, ETABS.

1. INTRODUCTION

Progressive collapse is occurs when any one or more major structural load carrying element is removed suddenly from structure due unfavorable condition and if remaining element are not capable to carrying load of structures. If these columns are not much strong to capable to carrying loads and not properly, design to resist additional load so that part of structure also failed. Then the vertical carrying load elements continued failed until additional load is stabilized, as results on Heavy losses of human life and property. Progressive collapse implies a phenomenon of sequential failure of part of structure by sudden loss of vertical load carrying member such as columns. As a failure will transfer from one member to another which leads to collapse of whole structure. Such type of failure of structure is known as progressive collapse. Progressive collapse is generated for localized failures of one or more major structural elements due to vehicle impact, explosions and blast or terrorist attacks. Designing for example a reinforced concrete building against progressive collapse due to blast loading is a big challenge. Analyzing such a building and checking if a progressive collapse could happen or not depends on many assumptions. For example the major unknown's problems are: how far from the building the explosive is detonated, and whether the blast affects building the ones situated in the middle and sides the corner load-bearing elements of the of the building's etc.

2. LITERATURE REVIEW

Suraj B. Gaikwad (2017) (1) work on Assessment of Progressive Collapse of Steel Structure. In this study G+15 regular as well as irregular building with missing column at different locations has taken. For this study linear static analysis, linear dynamic analysis, nonlinear static and nonlinear dynamic analysis of structure has been carried out. It was observed that regular structure base shear is maximum when transverse direction middle column is removed and irregular structure base shear values is maximum when transverse direction middle column is removed. Percentage change in the values of demand capacity ratio, base shear and roof displacement considering progressive collapse effect of structures has been carried out.

Mohamadreza Rohani (2017) (2) studied Progressive Collapse Analysis of Reinforced Concrete Structures: A Simplified Procedure. In this study analysis procedure to calculate the columns removed point displacement at progressive collapse analysis of reinforced concrete structure. In this paper linear static analysis, nonlinear static analysis, linear dynamic analysis and nonlinear dynamic analysis was performed. The accuracy of the proposed method was demonstrated by comparing the results to three experimental and analytical results. This investigation was done for concrete structure but procedure would be valid for both steel and concrete structures. Finally, the effect of the material properties, sections dimensions, spans length and the beams reinforcements of column removed spans on substructure behavior was studied.

Kripalsinh Kheradiya (2017) (3) work on Progressive Collapse on Rcc Multistorey Building. In this paper a symmetrical and unsymmetrical 5m x 5m bay frames with four-storey building was studied for progressive collapse analysis with SMRF design without Infill masonry wall using alternate load path method. All the building frames are designed with dead load, imposed load and earthquake load with different zone and importance factor I = 1. The progressive collapse potential for seismic loading was carried out using linear static analysis and it was performed in ETABS software. In this study, it was observed that to avoid the progressive failure of beams and columns, after failure of particular column due to extreme loading, adequate reinforcement is required to limit the DCR within the acceptance criteria.

Yogesh T. Birajdar (2017) (4) studied Progressive Collapse Analysis of Multi-Storied RCC Building. The objectives of this paper to study various types of progressive collapse and its mechanisms and analyze (G+15) RC earthquake resisting building for seismic zone III as per IS 1983:2002 by using ETABS 2016 software for linear dynamic analysis procedure. The Complete the mathematical modeling of multistory building and different types of loading combination and to find out axial forces variation time period, DCR for column, bending moment variation, and beam in different cases, and knowing the response of the structure for progressive collapse by using ETABs software. The results obtained increasing beam size will be more effective in avoiding or delaying collapse rather than increasing column sizes.

A. Choubey (2016) (5) work on Progressive Collapse Analysis of Rcc Structures. In this paper aims to investigate the progressive collapse behavior of RCC building under extreme loading events such as gas explosion in kitchen, terroristic attack, vehicular collisions and accidental overloads. Different studies was carried out to investigate the behavior of progressive collapse under the umbrella of changes in such as shear forces, bending moment, beam forces, reactions at nodes, node displacement and induced beam stresses subjected to sudden loss of a vertical support member. The behavioral change has been investigated and a node displacement was computed. Here RCC building was design and base on Indian standard code of practice. The investigation was carried out using commercially available software. The paper results obtained that the node displacement values was found under the column removal conditions and collapse resistance of building frame is studied due to increased loading for different scenarios.

C. R. Chidambaram (2016) (6) work on A Study on Progressive Collapse Behavior of Steel Structures Subjected to Fire Loads. In this study G+ 7 moment resisting steel frame residential building was analyzed using ETABS software to predict the sensitivity of the structure to progressive collapse due to fire loads. The Columns at different levels were given a temperature of 550℃ with reduced material properties and yield strength as per code IS 800 and Progressive collapse load combination was adopted as per GSA guidelines. The Corner, edge, intermediate and re-entrant columns was removed separately at alternate storeys. It was observe that the lower storey was found to be more susceptible than the upper storeys. This paper shows that intermediate column was 27.8 % and 16.36% more critical when compared to re-entrant column and corner column respectively.

Jian Weng (2016) (7) work on Damage assessment for reinforced concrete frames subject to progressive collapse. In this paper presents a set of damage assessment criteria that can be easily implemented for progressive collapse analysis of reinforced concrete (RC) frames. Shear, Flexural and axial damage criteria for RC members are separately proposed incorporating axial-shear-flexural interactions in the analysis. Three scaled moment resisting RC frame structure tests were conducted to validate the proposed axial damage criteria and flexural. The results show that proposed flexural damage criteria predict well the critical damage characteristics (cracking and crushing of concrete, yielding of rebar etc.) of RC frames at the stage of flexural action.

Floriana Petrone (2016) (8) studied the Modeling of RC Frame Buildings for Progressive Collapse Analysis. In this paper, the progressive collapse analysis of reinforced concrete (RC) moment-frame buildings under extreme loads was discussed from the perspective of modeling issues. Using a prototype RC frame building, issues and considerations in constitutive modeling of materials, options in modeling the structural elements and specification of gravity loads was discussed. One of the objectives of the study was to consider simplified approaches for progressive collapse analysis using advanced finite element software was used in the simulations presented in this study. Finally, a new collapse index was proposed that can be used to assess both the damage state and the reserve capacity of the system and also serve as a means to identify critical load-bearing element in the structure. Finally, an energy-based approach for identifying the proximity to collapse of regular multi-story buildings was proposed.

Mrs. Mir Sana Fatema (2016) (9) studied the Progressive Collapse of Reinforced Concrete Building. In this study to carry out progressive collapse analysis of 13 storey RC frame building by removing different column one at a time as per the GSA guidelines. The building consists of 5 X 5 bay 5 m in both direction and designed by Indian code as a special moment resistant frame. Structural model created on ETABS software and load was applied as per GSA guidelines. As per GSA guidelines three column removal case one at a time has studied, namely Corner column removal at ground floor, interior column at ground floor and Exterior column at ground floor. For all three cases linear and non-linear analysis has done. The result obtained that shear in beam is not critical in any case, Columns are also not critical in Progressive collapse. But by Linear static analysis and nonlinear static it is obtained that beams was going to fail in flexure.

S Jeyarajan (2015) (10) work on Analysis of Steel-Concrete Composite Buildings for Blast Induced Progressive Collapse. In this paper to investigate the progressive collapse behavior of steel concrete composite buildings subject to ground blast explosion using nonlinear dynamic analysis and conventional alternate path approach. In this present study, composite slab model based on equivalent area approach and composite joint model based on Euro code's component method was proposed for nonlinear analysis of building framework. The results show that a heavy blast load may wipe out a series of columns/beams at once instead of a single one. High blast pressure may induce large lateral drift and lead to significant damage to structural elements spreading over several storeys of the building.

3. SUMMERY

Some of the previous papers are studied on steel and concrete structures. They carried out using linear static analysis, linear dynamic analysis, and nonlinear static and nonlinear dynamic analysis. They also carried out regular as well as irregular building with missing column at different locations. Some studies are conclude that regular structure base shear is maximum when transverse direction middle column is removed and irregular structure base shear values is maximum when transverse direction middle column is removed.

4. CONCLUSION

Many experimental, analytical, performance and comparative works has been done by many researchers related with progressive collapse of structures. The analysis previous researches works done only Concrete

and Steel Structures. There was no works are done on composite structures, so this study is concerned with Progressive collapse of composites structures using Etabs software.

5. REFERENCES

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