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REVIEW PAPER- ASSESSMENT OF PROGRESSIVE COLLAPSE IN ASYMMETRIC HIGH RISE BUILDING

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Abstract: The progressive collapse of high-rise buildings is a critical concern in structural engineering, especially in asymmetric structures where uneven mass distribution and irregular geometry can exacerbate vulnerabilities. This paper presents a comprehensive assessment of the progressive collapse potential in asymmetric high-rise buildings. Using analytical and numerical methods, this study investigates the influence of asymmetry on collapse mechanisms, load redistribution, and structural resilience. The findings contribute to the development of design guidelines and mitigation strategies to enhance the safety and robustness of high-rise structures.

Keywords: *Progressive Collapse, High Rise Building*

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I.INTRODUCTION:

High-rise buildings are an integral part of urban landscapes, designed to withstand various environmental and man-made hazards. Progressive collapse, defined as the spread of an initial local failure that leads to partial or total structural collapse, is a particularly dangerous phenomenon due to its potential to cause catastrophic outcomes. While research has extensively covered symmetric buildings, asymmetric high-rise structures, characterized by irregular mass distribution and geometry, pose unique challenges that have not been fully addressed. This paper aims to evaluate the progressive collapse potential in asymmetric high-rise buildings, focusing on how irregularities influence collapse initiation and propagation. Through this analysis, the study seeks to provide insights into more robust design practices that mitigate the risk of progressive collapse in such structures.

II. LITERATURE REVIEW

2.1 Overview: The concept of progressive collapse has been extensively studied since the collapse of the Ronan Point apartment building in 1968, which highlighted the dangers of local failures propagating through a structure. Various methodologies have been developed to analyze and prevent progressive collapse, including the Alternate Path Method (APM), Specific Local Resistance (SLR), and Tie Force Method (TFM).

2.2 Review:

- **Divyansh Singh Thakur et.al (2021):** model of a 12 storey structure is made on ETABS Software and investigation of fortified cement encircled structure under basic section evacuation has been conveyed utilizing the direct and non-straight static examination techniques according to the rules gave in GSA (2003) and FEMA: 356 rules separately contemplating the arrangements of IS1893:2016 codes to recreate dynamic breakdown issues. The outcomes are then looked at for the parameters, for example, Demand limit proportion and Robustness marker were checked for the acknowledgment criteria gave in GSA 2003.
- **Amit Kumar et.al (2020):** studied typical model of a 12 storey structure is made on ETABS Software and analysis of reinforced concrete framed structure under critical column removal has been carried using the linear static analysis methods as per the guidelines provided in GSA (2003) and FEMA: 356 guidelines respectively taking into consideration the provisions of IS1893:2002 codes to simulate dynamic collapse problems.
- **A.R. Rahai et.al (2019)** the progressive collapse assessment of RC structures under instantaneous and gradual removal of columns. They conclude that the Dynamic amplification effects caused by instantaneous removal of the column lead to higher demand of stress and deformation in the structure compared to gradual removal of the column. It was further added that Plastic deformation in the adjacent beams of the removed column in gradual removal is 70 to 73 percent of the plastic deformation in the instantaneous removal.
- **Shubham Tripathi, Dr. A K Jain (2019)** that For the basic cases seventh story inside evacuation case upper 4 story Beams are a larger number of worries than lower story beams. Since PMM estimations of the greater part of the section (with the exception of C38 and C13) is under 2, segments are not basic in dynamic breakdown

procedure of structure. Interior column removal case is the most critical (since values of PMM are nearer to limiting value i.e. 2.0) and corner column removal case is least critical for ground floor column removal

- **Raghavendra C. et.al (2018)** They examination a commonplace casing of tallness 37.5m by straight static investigation system by the assistance of ETABS v9.7 programming. For RC outline investigation the sections at eight diverse area is eliminated for each case. RC outline in the tremor zones 2, 3, 4 and 5 is planned utilizing ETABS program for dead, live, wind and seismic burdens. The predetermined GSA load blend was applied and the DCR (Demand Capacity Ratio) esteem is determined for the design individuals. They closed the crossing light emissions length takes the over weight load while eliminating the basic segments and the interest limit proportion estimations of that pillars were more contrasted with longer range. The satisfactory support is given to dodge the reformist disappointment.
- **Mohamad reza Rohani and Arash Naji (2017) ,** studied that a simplified analysis procedure to calculate the column removed point displacement atprogressive collapse analysis of reinforced concrete structures. For progressive collapse analysis of structures, linear static analysis, nonlinear static analysis, linear dynamic analysis and nonlinear dynamic analysis can be performed. The accuracy of the proposed method is demonstrated by comparing the results to three experimental and analytical results. Finally, the effects of the span's length, sections dimensions, material properties and the beams reinforcements of column removed spans on substructure behavior is studied, as well.
- **Shaikh Akhibuddin, (2016),** progressive collapse of RC structure in accordance with the guidelines provided in GSA: 2003 using a Finite Element Method based software ETABS. They have conducted the analysis on a RCC structure in which the columns at critical locations were removed to explore the importance of slab's depth in resistance of the progressive collapse and concluded as: The Structure will become more critical when the Interior Column at ground Floor is removed, Since the axial resistance capacity increases with thickness of the slab increases, the slabs having more thickness will have more resistance to progressive collapse, The Corner Column removal influences fixed beam to behave as cantilever beam and due to lack of the reinforcement at top side, beam is liable to failure, Middle Column Removal influences fixed beam to behave as the continuous beam as it leads to the scarcity of reinforcement at bottom side which could be the cause of failure, DCR incessantly decreases in Sagging DCR, due to constant Capacity in sagging of square building.
- **Shefna L Sunamy et.al (2014), studied** that the Progressive collapse analysis of a 12 storey reinforced concrete frame building (Six bays of 5 m in the longitudinal direction, four bays of 5 m in the transverse direction) by the Non-linear static progressive collapse analysis. Structural analysis software SAP 2000 is used and seismic loading considered zone is II,III,IV,V and column removal scenario is long side column, short side column and corner column has been removed for analysis of building structure. They concluded that the seismically designed building resist progressive collapse and nonlinear static analysis revels hinge formation starts from the location having maximum demand capacity ratio.
- **Mojtaba Hosseini et.al (2014)** they examined a 10 story steel working by nonlinear unique strategy utilizing open sees program programming by expulsion of various stories corner sections. Results after the expulsion of corner segments was seen that the compressive hub powers of connecting sections increment and furthermore powers expanded in different segments. They reasoned that the hub powers benefits of abutting sections are 30% and 40% more noteworthy than their definitive qualities and wellbeing is accomplished by expanding segment measurements or utilizing new materials and strategies.
- **Sherif El-Tawil and Honghao Li (2013),** studied that the best in class in dynamic breakdown research and reveals insight into a few subjects including: strategies for evaluation of auxiliary strength; philosophies for improvement of framework breakdown opposition; probabilistic models for dynamic breakdown hazard appraisal; and momentum patterns and research needs, which examines flow holes in our comprehension of dynamic breakdown research and distinguishes investigate endeavors expected to address them.

III. CONCLUSIONS

This study provides a comprehensive assessment of the progressive collapse potential in asymmetric high-rise buildings. The results demonstrate that asymmetry introduces significant challenges in terms of collapse mechanisms, load redistribution, and structural resilience. To enhance the safety and robustness of these structures, there is a need for updated design guidelines that consider the unique vulnerabilities of asymmetric buildings. Future research should focus on developing more accurate modeling techniques and design strategies to prevent progressive collapse in such complex structures.

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