A Review Paper on Dynamic Breakdown analysis of High Rise RC Building

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Abstract- *The world has recently witnessed tremendous increase in terrorist activities. This led to the requirement of blast resistant design of structures. The Dynamic Breakdown of structures, being the most severe consequence of blast generated waves, has been the subject of several studies. Although structural engineers are developing methodologies for the mitigation of Dynamic Breakdown, there is a lack of adequate tools that can be employed for simulating and predicting the progressive collapse response of structures with acceptable confidence. An attempt has been made in this paper to develop a practical and acceptable procedure for the progressive collapse analysis of reinforced concrete (RC) framed structures. The adequacy of the procedure has been demonstrated by studying the Dynamic Breakdown behavior of a typical RC framed high-rise building in Bhopal when exposed to blast generated waves. Dynamic Breakdown has become a topic of interest in recent years leading to a greater focus on the resilience of structures. The propagation of a local failure can become catastrophic and lead to multiple deaths, injuries and destruction of property. These types of events have been predominant in mid to high-rise buildings under both accidental and intentional circumstances. The dire consequences associated with these types of buildings have fueled research efforts into preventative measures for dynamic breakdown.*

Keywords- Dynamic Breakdown, GSA, Demand capacity ratio, base shear, ETABS, PM Mratio.

I. INTRODUCTION

Dynamic breakdown is a phenomenon which has gained a lot of attention over the last few decades. It is formally defined as "the spread of an initial local failure from element to element, eventually resulting in the collapse of an entire structure or a disproportionately large part of it." (ASCE, 2010). This propagation of a local failure has been creating concern for the structural integrity of buildings. These types of events can become catastrophic as the collapse may lead to multiple deaths, injuries and destruction of property in the immediate vicinity of the building. The consequences associated with progressive collapse are incredibly dire, which is why the topic has become of interest for government agencies, building owners and researchers. The trigger of the phenomenon may be a result of one specific event or a combination of causes that lead to local failure. Examples of these causes include vehicular impact, earthquakes, fire, explosions as well as human error in design or construction of the structure. The majority of these causes occur under accidental circumstances, however, in light of recent events there has been an emphasis on deliberate initiation of progressive collapse. A typical example of this would be the intentional removal of a column by an explosion. The structural components of the floors above this column would experience a sudden increase in stress as well as large deflections. This amplification of the load may continue to cause failure in other primary members of the structure until the building stabilizes with noticeable deformations or until the complete collapse of the structure.

Figure 1: Dynamic breakdown

II. REVIEW OF SOME LITERATURE

To supplement automated search, a manual search was also done. The manual procedure involved searching the reference sections of the papers identified by the automated search and referring the text/reference books. Any relevant references within those papers/reference books were followed up on.

- Meshal A. Abdulsalam& Muhammad Tariq A. Chaudhary studied in 2021 Progressive collapse assessment of a

reinforced concrete (RC) building designed only for gravity loads and lacking a dedicated lateral load resisting system was carried out using the alternate load path (ALP) method and finite element method (FEM) numerical model created in software SAP2000. It was found that consideration of M-N-V interaction resulted in plastic hinge capacities that were lower than the flexure-only capacity of the plastic hinges available in the FEM software which caused the progressive collapse to initiate at a lower load and also resulted in increased collapse area.

- Nur Ezzaryn Asnawi Subki, ,Hazrina Mansor studied in 2019 the merits of utilising the energy-based approach against the force-based approach for a collapsed structure and explains the collapse mechanism of a steel frame in the perspective of the energy concept. The state of the art of energy-based progressive collapse assessment for a structural steel frame is reviewed. The comprehensive review will include insights on the development of the energy-based method,assumptions, limitations, acceptance criterion and its applicability with the European standards. Finally, potential research gaps are discussed herein.
- Stanislav Pavlov, and Olga Tusnina studied in 2019 determined the approaches to such analysis and to identify the degree of survivability of the building. Probable emergency situations associated with the actual condition of steel structures, as well as with new and existing technological processes occurring in the industrial workshop were defined. Under the identified scenarios of emergency situations, the possibility of local damage of steel structures and their individual elements was determined. The extent of the impact of emergency situations on bearing steel structures has been determined.
- A.R. Rahai, M. Banazadeh, M.R. Seify Asghshahr & H. Kazem have studied in 2019 .that 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 Studied in October 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. what's more, Mr. Pradeep A. R. have concentrated in 2018, about the "reformist breakdown investigation of built up cement outlined construction". 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.
- Y.A. Al-Salloum a, H. Abbas a Studied in October 2017 to develop a practical and acceptable procedure for the progressive collapse analysis of reinforced concrete (RC) framed structures. The adequacy of the procedure has been demonstrated by studying the progressive collapse behavior of a typical RC framed high-rise building in Riyadh when exposed to blast generated waves.
- Mohamadreza Rohani and Arash Najistudied in October, 2017, thata simplified analysis procedure to calculate the column removed point displacement at progressive 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, L.G. Kalurkar studied in September, 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, Binu P, Dr.Girija K studied in the year of December, 2014, 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 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.
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- H.R. Tavakoli, A. RashidiAlashti studied in October, 2012, that utilization investigation techniques are nonlinear static examination for dynamic breakdown under seismic stacking and 3-D and 2-D models of SMRF were considered for push over investigation (ETABS). Parallel Loading examples are Triangular burden design, Uniform burden example and Capacity bend for both the example in decided. Basic segment is made to lose 40%, 70% and 100% of successful region. Limit bend for each case are resolved and looked at. Finish of their examinations are Number of stories and coves are expanded limit of the structure to oppose dynamic breakdown under horizontal stacking additionally expanded. Expanding the quantity of bayous and stories, incites a more elevated amount of vigor record..
- Abhimanyu Abitkar and Rajendra Joshi have studied in 2013, carried out the Sustainable Analysis Procedures for assessment of Progressive Collapse in 2011 using SAP2000 for nonlinear dynamic analysis and concluded that heavy penalty in terms of increase in load factor is arisen in linear Static and Nonlinear static procedures and

it is possible to find the exact loading that can provide correct behaviour. The applied loading in these procedures is quite less than that of in actual analysis and design. It is very important to consider the nonlinear effect of floor slab in the analysis.

- AlirezaKazem, Hossein Kazem and Benyamin Monavarihave studied in 2012, the effect of irregularity in height of RC Structures on the Progressive Collapse through 3 RC buildings of 6 stories each designed according to Iranian concrete code (ABA) and have been checked by ACI. designs for different assessment procedures to take a gander at DCR esteems. It was seen that powerful improvement factor of 2 used in straight static condition is a good check for static assessment framework since direct static and straight remarkable examination strategy yield around a comparative most noteworthy moment. Static examination has low DCR worth glance at dynamic philosophy this may be a direct result of dynamic heightening variable of 2 used in straight interesting assessment. Straight remarkable assessment gives more assurance results than static examination. They wrapped up since direct static and straight special assessment procedures yield around a comparable most extraordinary redirection. Case II of LDA for instance RC Frame with removal of area has most imperative DCR regard in assessment with LDA case and other LSA case. Results showed that DCR of area is 1.98 which is under 2 for instance GSA criteria.Hence the packaging is less frail against dynamic breakdown.
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III. CONCLUSIONS

After reviewing all the above literature it can be concluded that Progressive collapse is defined as either partial or overall failure of the structure due to losing one of the main structural elements. In order to control this chain reaction, it is important to study the main structural elements behavior under column removal. Precast concrete structures become widely used recently due to the quality control assurance, economical aspects and time saving construction. Due to this many researchers studied the precast concrete structures behavior under earthquake loading, observing the failure patterns, weak points, and how to overcome all those parameters, however, regarding progressive collapse, Precast concrete structures need intensive researches to cover all the parameters that will affect the structure's behavior due to accidental loading. One of the main parameters that still ambiguous is the precast beam span lengths and its behavior on the overall structure When subjected to progressive collapse.

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