iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** IX **Month of publication:** September 2020

DOI: https://doi.org/10.22214/ijraset.2020.31310

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue IX Sep 2020- Available at www.ijraset.com

A Review Paper on Progressive Collapse Assessment of Asymmetric High Rise Building and it's Modelling using ETABS Software

Amit Kumar[1], Nitesh Kushwaha[2]
[1, 2]*Department of Civil Engineering, Millennium Institute of Technology & Science*

Abstract: ***The collapsed of any building is due to the loss of one or a few structural components which then progresses over the successive other components. This process is called as progressive collapse of the structure. Progressive collapse is the process of extensive failure initiated by local structural damage, or a chain reaction of failures. Local damage that initiates progressive collapse is called initiating damage. Progressive collapse can be triggered by many different actions and the prediction of such abnormal actions is very difficult and depends on many factors Hence, there occurs the loss in load-carrying capacity of the small portion of a structure due to abnormal or haphazard load which progresses in series of failures of other components and thus the collapse of the building take place. Therefore, a typical analysis approach for determining robustness against the local failure and accidental occurrences for a RC framed structure has been attempted in this study to evaluate the demand capacity ratio and robustness to evaluate the safety of the structure, which reckons as a fundamental step in decision-making. A finite element model has been developed for the 12 storey building. Then the analysis of reinforced concrete framed structure under critical column removal has been carried using the linear and non-linear static analysis methods as per the guidelines provided in GSA (2003) and FEMA: 356 guidelines respectively taking into consideration provisions of IS1893:2002 codes to simulate dynamic collapse problems using ETABS software v16.2.1 (software for modelling or analysis of structure) to assess the vulnerability to progressive collapse.***

Keywords: Structural Components, Initiating damage, Local damage, GSA, FEMA, ETABS.

I. INTRODUCTION

The R.C.C. building is comprises of components, for example, segment, shafts, Slab, Foundation and so forth these components are additionally alluded as burden bearing components of the structure. Despite the fact that there are principally two sorts of burden that follows up on structure and are dead (DL) and live (LL) loads. The dead burden comprises of the heaviness of changeless structure components, for example, segment; bar though the live burden comprises of weight of moving individuals, furniture and so forth and the breeze load and seismic burden likewise follow up on the structure. At the point when the inside burden bearing auxiliary component flops because of quite a few methods, for example, impact action or vehicular mishap which brings about the disappointment of a structure or segment to keep up its basic honesty this marvel is called breakdown wonders. This circumstance might be started by a quake, inside or outside blasts and development exercises.

The grouping of the reasons for the structure breakdown is determined under broad headings given beneath:

1) Faulty Construction
2) Unexpected Failure Modes
3) Extraordinary Loads
4) Foundation Failure
5) Column and bar disappointment

The overall issue of guaranteeing the dependability of structures of elevated structures against dynamic breakdown because of fire and impacts is turning out to be more earnest since, prompts intense outcomes. Mileage of fixed resources of the nation, expanding the rate and thickness of development in urban regions, an expansion lately, the quantity of psychological oppressor acts (bombings, torching, and so on.)

Planning of private structures is completed considering the elements that caused crises, including fire. The basic arrangement of private structures must be planned in order to guarantee its general security during crisis Norm neighbourhood damaging burdens on the individual burden bearing structures, at any rate for the time required for clearing of individuals (the blasts of different kinds, fires, falling hefty items, effect of weighty vehicles, and so forth.)

©IJRASET: All Rights are Reserved

Because of flames in elevated structures with the suitable ends, and the response of the specialists of various nations, their belongings have been corrected in the guidelines [1-6], because of the way that the flames in tall structures, more awful and lead to more harm than ordinary flames structures. A fire in a structure higher than 25 stories, is 3-4 times a bigger number of casualties than the 9-16-story building.(B. Stafford Smith, Tall structure structures, John Wiley and Sons. Inc., USA, 1991)

The breakdown of the WTC structures was the principal instance of complete demolition of the tall structure. The report National Institute of Standards and Technology (USA) as indicated by the examination accentuated the significance of satisfactory fire security. The primary thought of the suggestions was restricting administrative prerequisites for the structure premise danger. The proposals, which were introduced at the NIST report, are reflected in the extension to the US public guidelines.

The case of failure of WTC building is shown below.



Fig.1.1 progressive collapse Simulation of WTC

A. History of Progressive Collapse (Dynamic Breakdown)

The dynamic breakdown of the structure has been seen after the fractional breakdown in London (Roman point high rise structure). These starts then the significant examination to build up the fitting arrangements and strategies for dynamic breakdown investigation. This prompts the joining of the vital arrangement for the first run through in UK guidelines. Current techniques and strategies are a progression in those norms and approaches. The examination of the dynamic breakdown of the structure get the further energy after the breakdown of the Alfred p. Murrah Federal Building structure (Oklahoma City, 1995) and the structure breakdown of the World Trade Center Towers, caused because of the psychological militant assaults.

A few Examples of Progressive breakdown:

1) The first example is a disappointment of a whole corner of a 22-story square of pads called Ronan Point in east piece of London (the United Kingdom). The structure of this multi-story building is the huge precast solid boards which were embraced in the United Kingdom toward the finish of the 1950s. This kind of structure was acknowledged to accomplish quicker development of new abodes after the misfortunes from the Second World War.

2) Another case of that sort of disappointment was the Alfred P. Murrah Federal Office Building in Oklahoma City (the United States of America). In any case, the reason for this situation was bomb blast. The Alfred P. Murrah Federal Building was intended for the GSA Public Buildings Service in the mid 1970s. The task comprised of a few sections. The first and primary part was a nine-story place of business at that point goes two one-story subordinate wings, and a staggered parking structure. Two figures of the Alfred P. Murrah Federal Building when the bomb blast is introduced beneath.

3) On 19 January 2017, the Plasco Building, an elevated structure in Tehran, Iran, burst into flames and fallen. The fire began the eighth floor and the dynamic breakdown happened during salvage activities. As per local group of fire-fighters representative, Jalaal Maleki, around 200 firemen were on the scene. It was accounted for that Plasco building dynamic breakdown was a flapjack type in light of the fact that the breakdown happened straight down the breakdown seemed like WTC tower collapse.16 firemen and 10 regular citizens kicked the bucket because of the fire and breakdown.

4) The spread of fire on high-rise buildings with the most serious consequences, as a rule, takes place on the facades. A typical example is a fire in a government 32-storey skyscraper "Transport Tower" in the Kazakh capital Astana, 30 May 2006 Flames destroyed facing about 15 floors on one side of the building and all the 32 floor to another. The fire was accompanied by the dispersion of shards of glass façade.

©IJRASET: All Rights are Reserved

5) On September 11, 2001, World Trade Center structures 1, 2 and 7 in New York City crumbled because of fear monger assaults and the resulting fires that followed. Following a 3-year examination by the National Institute of Standards and Technology, it was inferred that fire debilitated the steel structure until the long scaffold like floor segments (called brackets) started to continuously droop. This hanging changed over the downwards pull of the brackets into an inwards pull. This heightening inwards pull on the dividers in the end caused the external segments of Tower 2, and later the internal segments of Tower 1, to clasp and overlap, consequently starting the breakdown. 2,752 individuals kicked the bucket in the structures, including 157 travelers and team individuals who were on board two captured planes that struck structures 1 and 2, starting flames in both, with flotsam and jetsam starting flames in building 7 upon the breakdown of structures 1 and 2.
6) The latest structure breakdown at Moulivakkam, Chennai on June 28, 2014 taking existence of around 61 people.
7) An additional 117-year-old structure likewise fallen in Dongri, Mumbai in August 2017 and sixteen people lost their life. While, the structure at Mumbra (close to Mumbai) fallen a year ago (2017) in which 74 individuals lost their life.
8) Ongoing structure falls in Madhya Pradesh Region. Four-story building falls close the packed sarvate territory in Indore, April 1, 2018.
9) On August 1, 2007, the I-35W Mississippi River Bridge fallen during night substantial traffic, achieving the death of 13 people. The breakdown was credited to the mistake of a gusset plate partner two people inside one of the guideline bend ribs. Frustration of this split essential joint achieved hard and fast breakdown of the structure.
10) On February 12, 2005, the 28 story Windsor Tower in Madrid, Spain persevered through the breakdown of the upper 11 accounts of the structure. The zenith had a reinforced concrete internal focus included by a standard webbed steel-plot outer edge. Between floors 16 and 17 was a 7-foot thick, fortified strong trade floor, proposed to go about as a bulkhead and to help the steel arrangement of the upper 11 stories. An office fire began the 21st floor and following 5 hours, the strong internal focus could no longer assistance the catching steel outside framework. The upper 11 stories disintegrated down to street level with extras of the upper 3 stories tumbling down on to the trade floor. No one was killed. The structure was a composite steel encompassed and steel RC building.
11) The 159-meter 44-story Mandarin Oriental housing working in Beijing February 9, 2009 the fire quickly spread down the outside. The fire continued for around 5 hours. During this time, generally 80% of building devoured. In extinguishing fires required around 600 fire fighters. In view of the extraordinary fire in the city fell ashy day away from work, happens on volcanic launch. The fire is known as the fireworks, the rest of the pieces of which fire fighters found on the head of the structure. As demonstrated by various appraisals going before the fire, 65 people were - the housing staff. 5-star dwelling with 241 rooms didn't have the chance to put into movement. The total enthusiasm for its improvement indicated $ 700 million.

II. LITERATURE REVIEW

The writing on the subject of "Progressive Collapse Assessment of Asymmetric High rise building and Its Modelling utilizing ETABS Software" is surveyed in this part. A few papers managing identified with the above point are examined in the current section. The writing audit search has been performed for important distributions utilizing many Web based web crawlers and databases. To supplement robotized search, a manual hunt was additionally done. The manual system included looking through the reference segments of the papers distinguished by the robotized search and alluding the content/reference books. Any important references inside those papers/reference books were followed up on.

A. Mohamadreza Rohani and Arash Najistudied in October, 2017, that a rearranged examination strategy to calculate the segment eliminated point removal at progressive breakdown investigation of strengthened solid structures. For dynamic breakdown examination of structures, direct static investigation, nonlinear static investigation, straight powerful examination and nonlinear unique investigation can be performed. The exactness of the proposed strategy is exhibited by contrasting the outcomes with three trial and logical outcomes. At last, the impacts of the range's length, segments measurements, material properties and the bars fortifications of section eliminated ranges on base conduct is examined, too.
B. Sherif El-Tawil and Honghao Li concentrated in January, 2013, that the top tier in powerful breakdown research and uncovers understanding into a couple of subjects including: systems for assessment of helper quality; methods of reasoning for development of structure breakdown restriction; probabilistic models for dynamic breakdown danger examination; and force examples and exploration needs, which looks at stream gaps in our appreciation of dynamic breakdown research and recognizes examine tries expected to address them.

©IJRASET: All Rights are Reserved

C. Shaikh Akhibuddin, L.G. Kalurkar concentrated in September, 2016, dynamic breakdown of RC structure as per the rules gave in GSA: 2003 utilizing a Finite Element Method based programming ETABS. They have led the investigation on a RCC structure in which the sections at basic areas were eliminated to investigate the significance of piece's profundity in opposition of the dynamic breakdown and closed as: The Structure will turn out to be more basic when the inside Column at ground Floor is taken out, Since the pivotal obstruction limit increments with thickness of the section expands, the chunks having more thickness will have more protection from dynamic breakdown, The Corner Column evacuation impacts fixed bar to act as cantilever shaft and because of absence of the support at top side, bar is obligated to disappointment, Middle Column Removal impacts fixed pillar to carry on as the persistent bar as it prompts the shortage of fortification at base side which could be the reason for disappointment, DCR unremittingly diminishes in Sagging DCR, because of consistent Capacity in hanging of square structure.

D. T.S. Moldovan, L. Bredean& A.M. Ioani have studied in 2012, the parametric study regarding the influence of Romanian seismic codes evolutions on progressive collapse behavior of a mid-rise RC framed structures located in high seismic zone through three distinct models of 13-storey RC framed structures. They concluded that there is risk of progressive collapse for those beam sections only where low inelastic demands are identified ($1.00 \leq DCR \leq 1.02$). They further concluded that the highest values the DCR for flexure and shear causes damage to the structure and 3D framed structure becomes more vulnerable when its interior column is removed.

E. Miss. Preeti K. Morey, Prof S.R.Satone studied in June-July, 2012, that the progressive collapse of building are analyses using STADDPro. Software. The two diverse investigation methods for surveying their adequacy in displaying dynamic breakdown situations; direct static and straight unique techniques. Investigation is done for (G+4) RC earth shake safe structures for various examination strategies to look at DCR values. It was seen that dynamic enhancement factor of 2 utilized in straight static condition is a decent gauge for static examination system since direct static and straight unique investigation technique yield around a similar greatest minute. Static investigation has low DCR worth look at dynamic methodology this might be because of dynamic intensification factor of 2 utilized in straight unique examination. Straight unique examination gives more protection results than static investigation. They finished up since direct static and straight unique examination techniques yield around a similar most extreme diversion. Case II of LDA for example RC Frame with expulsion of section has most noteworthy DCR esteem in examination with LDA case and other LSA case. Results demonstrated that DCR of section is 1.98 which is under 2 for example GSA criteria. Hence the casing is less powerless against dynamic breakdown.

F. Raghavendra C. what's more, Mr. Pradeep A. R. have studied in 2018, about the "dynamic breakdown investigation of fortified cement confined structure". They examination a commonplace casing of stature 37.5m by direct static investigation system by the assistance of ETABS v9.7 programming. For RC outline investigation the sections at eight diverse area is taken out for each case. RC outline in the quake 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 structure individuals. They finished up the crossing light emissions length takes the over trouble load while eliminating the basic sections and the interest limit proportion estimations of that pillars were more contrasted with longer range. The sufficient support is given to dodge the dynamic disappointment.

G. Abhimanyu Abitkar and Rajendra Joshi have concentrated in 2013, did the Sustainable Analysis Procedures for appraisal of Progressive Collapse in 2011 utilizing SAP2000 for nonlinear powerful investigation and presumed that weighty punishment as far as increment in load factor is emerged in straight Static and Nonlinear static techniques and it is conceivable to locate the specific stacking that can give right conduct. The applied stacking in these techniques is very not as much as that of in genuine examination and plan. It is imperative to think about the nonlinear impact of floor piece in the investigation.

H. Shubham Tripathi and Dr AK Jain studied the assessment of progressive collapse on a symmetric rectangular 12 storied commercial structure which was subjected to load combinations as per Indian standard and IS 1893:2002.U se of linear static method was done with the help of ETABS software for modelling and simulation. They concluded that the beams in the flexure are most critical when the building is subjected to sudden loss of any column and especially in the interior column loss case.

I. Alireza Kazem, Hossein Kazem and Benyamin Monavari have concentrated in 2012, the impact of abnormality in stature of RC Structures on the Progressive Collapse through 3 RC structures of 6 stories each planned by Iranian solid code (ABA) and have been checked by ACI. They presumed that, the structures having unsure and pliancy has greater capacity in vitality ingestion and results in less harm. It implies that structure is safer.

J. A.R. Rahai, M. Banazadeh, M.R. SeifyAsghshahr &H. Kazemstuied have concentrated in 2018.that the dynamic breakdown appraisal of RC structures under quick and steady evacuation of sections. They reason that the Dynamic enhancement impacts

©IJRASET: All Rights are Reserved

brought about by quick expulsion of the segment lead to more appeal of pressure and distortion in the structure contrasted with continuous evacuation of the segment. It was additionally included that Plastic twisting in the neighbouring light emissions eliminated section in steady expulsion is 70 to 73 percent of the plastic misshaping in the prompt evacuation.

K. Mohit, Sudhir and Danish (2016), observed behaviour of flat slab and wide beam system in comparison to conventional moment resisting frame, they have considered a G+3 model of a building and analyzed for gravity loads and seismic loads and linear static and linear dynamic methods were used by them. Their research concluded that by linear static analysis structure shows less deformations in case of flat slab than conventional slab and wide beam system because of reduced weight of structure and from seismic analysis a large amount of lateral deformation is observed in case of flat slab case because of less amount of lateral stiffness of flat and wide beam system.

L. A. Marchis, M. Botez and A.M. Ioani, have analyzes the lack of protection to dynamic breakdown of mid-climb RC limited structures from a moderate seismic area through four particular models. They contemplated that the valuable effect of seismicity is viewed as decreased for mid-rising structures which are from low or moderate seismic zones. There happens the helpful result by the seismic arrangement when progressively bendable parts are given in the structure. The more powerless structures to dynamic breakdown are the structures arranged in the high flexibility than similar structures proposed for a medium pliability class.

M. O. Yagob and K. Galal examined in 2009 a modern far reaching audit dynamic breakdown and its earth shattering quality in auxiliary designing networks and reasoned that three-dimensional reproductions are needed to survey the genuine conduct of the whole structure outline framework.

III. CONCLUSIONS

A study of progressive collapse resistance of different high rise RC building has been done for column removal cases namely interior as per General Service Administration (GSA) 2013 guidelines. Based on results and comparing DCR values of different beams and columns with acceptance criteria given in GSA 2013 and American Society of Civil Engineering (ASCE) 41 [10], it can be concluded that a impact assessment of the symmetry and anti-symmetry of the structurer can be performed with the concrete framed structure. ETABS is the latest software that can be used for such kind of assessment, linear method of analysis and equivalent static method can be used. Redesigning of beams in flexure is required to prevent the progressive collapse of building.

IV. ACKNOWLEDGMENT

My thanks are due to Professor Subhadra Yadav, Executive director MGI, for her encouragement, Shri.R.S.Yadav, chief administrative officer and Er.Shishir Nigam, CEO for their support. My special thanks to Dr. R. N. S. Yadav, Group Director MGI, for overall guidance. I am very much grateful to Er. Vinod Yadav, Chairman MGI for providing me a Platform for completion of my thesis. I am thankful to, Principal MITS for providing the platform to complete my dissertation work. I express my sincere thanks to professor Dileep Suryavanshi, supervisor (CE) and Prof. Nitesh Kushwaha H.O.D.(CE).At last but not least, I would like to convey my thanks to all the faculty members of Civil Engineering Department MITS Bhopal who helped me in completion of the dissertation at every stage.

REFERENCES

[1] S. Mohan Kumar, R. Jeyanthi – “Progressive Collapse Analysis of a Multi-storey RCC building using Pushover Analysis” - International Journal of Engineering Research & Technology (IJERT), Department of Civil Engineering MNM Jain Engineering College Chennai – 600 097, INDIA, March 2016, Vol. No.- 5, ISSN: 2278-0181.

[2] Shaikh Akhibuddin, L.G.Kalurkar – “Evaluation of Progressive Collapse Resistance of MultiStorey RC Building by Linear Static Analysis Method” - IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), Department of Civil Engineering, JNEC College, Aurangabad, India, Jul. - Aug. 2016, Volume 13, Issue 4 Ver. VII, e-ISSN: 2278-1684, pISSN: 2320-334X.

[3] Shubham Tripathi , Dr A K Jain." Progressive Collapse Assessment of RCC Structure under Instantaneous Removal of Columns and its Modeling Using Etabs Software." IOSR Journal of Engineering (IOSRJEN), vol. 09, no. 10, 2019, pp. 27-36

[4] A. Choubey and M.D. Goel – “Progressive Collapse Analysis of Rcc Structures” - International Journal of Optimization in Civil Engineering, 2016; 6(2): 287-301.

[5] Syed Asaad Mohiuddin Bukhari, Shivaraju G D, Ashfaque Ahmed Khan – “Analysis of Progressive Collapse InRc Frame Structure For Different Seismic Zones” - International Journal of Engineering Sciences & Research Technology, Department Of Civil Engg, MVJ College Of Engineering,Bengaluru, India, June-2015, ISSN: 2277-9655.

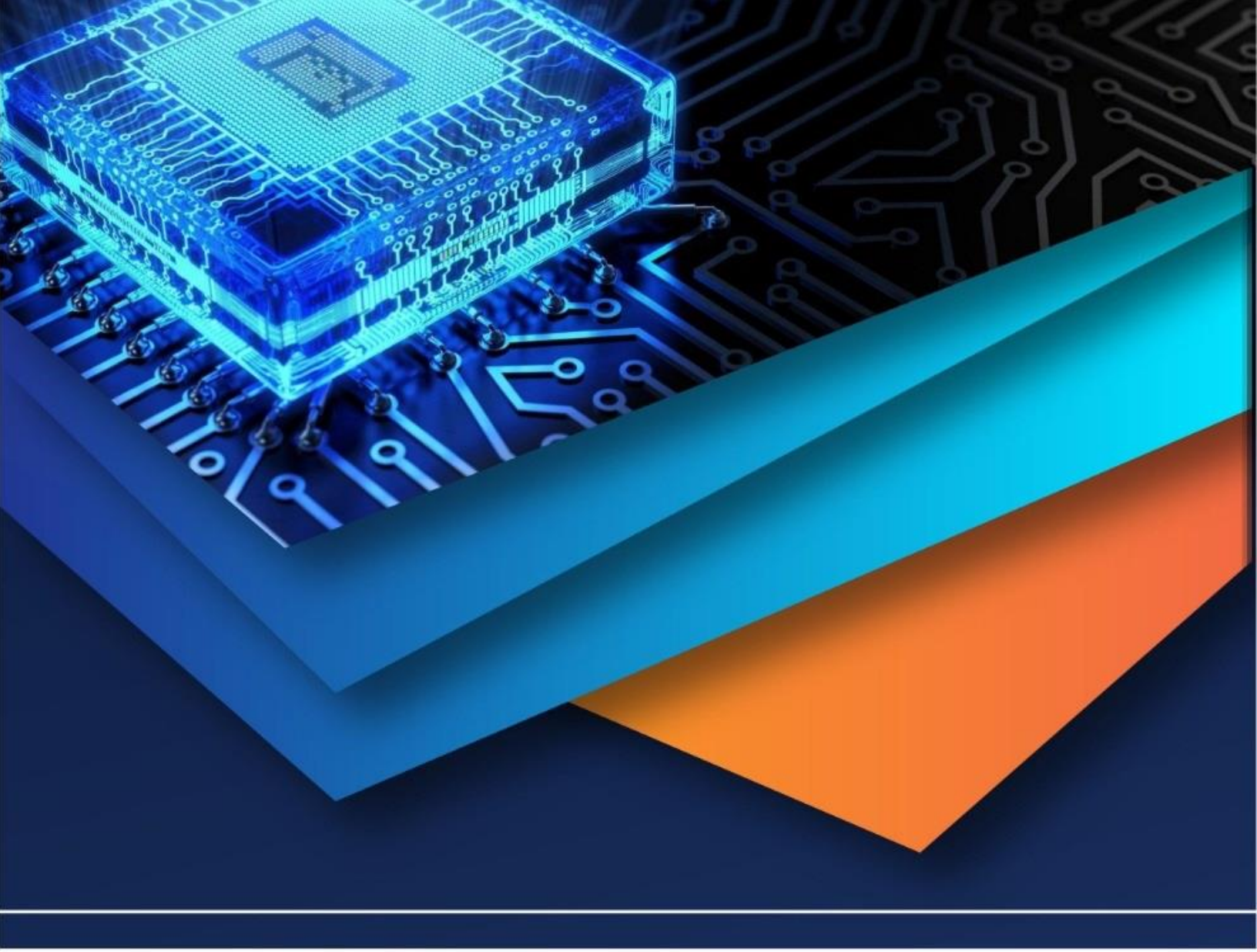
[6] Mahmadsabeer and D. GousePeera – “Comparison Design Result of Rcc Building Using Staad and Etabs Software” - International Journal of Innovative Research in Advanced Engineering (IJIRAE), JNTUA, Anantapura Department of civil engineering, August 2015, Volume 2, ISSN: 2349-2163 Issue 8.

[7] Shefna L Sunamy, Binu P, Dr.Girija K – “Progressive Collapse Analysis Of A Reinforced Concrete Frame Building” - International Journal of Civil Engineering And Technology (Ijciet), Volume 5, Issue 12, December (2014), ISSN 0976 – 6316(Online).

©IJRASET: All Rights are Reserved

[8] Rakshith K G, Radhakrishna – "Progressive Collapse Analysis of Reinforced Concrete Framed Structure" - International Journal of Research in Engineering and Technology, issue in Nov 2013, eISSN: 2319-1163 | pISSN: 2321-7308.
[9] Raghavendra C and Mr. Pradeep A R – "Progressive Collapse Analysis of Reinforced Concrete Framed Structure" - International Journal of Civil and Structural Engineering Research, Department of Civil Engineering, Sri Siddhartha Institute of Technology, Tumkur, India, April 2014 - September 2014, ISSN-2348-7607.
[10] Mojtaba Hosseini, Nader Fanaie and Amir Mohammad Yousefi1 – "Studying the Vulnerability of Steel Moment Resistant Frames Subjected to Progressive Collapse" - Indian Journal of Science and Technology, Place- Lorestan University, Lorestan, Iran, Vol. No.7, 335– 342, March 2014, ISSN (Print): 0974-6846, ISSN (Online): 0974-5645
[11] Srinivasu, and Dr. Panduranga Rao. – "Non-Linear Static Analysis of Multi-Storied Building" - International Journal of Engineering Trends and Technology (IJETT), Department of Civil Engineering, V.R. Siddhartha Engg. College, Vijayawada, A.P, India, Volume 4 Issue 10 - Oct 2013, ISSN: 2231-5381.
[12] H.R. Tawakoni, and A. Rashidi Alashti – "Evaluation of progressive collapse potential of multistory moment resisting steel frame buildings under lateral loading" - Sharif University of Technology, Department of Civil Engineering, Babol University of Technology, P.O. Box 484, Babol, Iran, 24 October 2012.
[13] Miss. Preeti K. Morey and Prof S.R.Satone – "Progressive Collapse Analysis Of Building" - International Journal of Engineering Research and Applications (IJERA), Department of Civil Engineering KDKCE, RTM University, Nagpur-09, Vol. 2, Issue 4, June-July 2012, ISSN: 2248- 9622
[14] T.S. Moldovan, L. Bredean and A.M. Ioani – "Earthquake and Progressive Collapse Resistance based on the Evolution of Romanian Seismic Design Codes" - World Conferences on Earthquake Engineering (WCEE), Technical University of Cluj-Napoca, Romania, 2012.
[15] A.R. Rahai, M. Banazadeh, M.R. SeifyAsghshahr and H. Kazem – "Progressive Collapse Assessment of RC Structures under Instantaneous and Gradual Removal of Columns" - World Conferences on Earthquake Engineering (WCEE), Department of Civil Engineering, Amirkabir University of Technology (Tehran Polytechnic), Iran, 2012.
[16] A. Marchis, M. Botez and A.M. Ioani – "Vulnerability to Progressive Collapse of Seismically Designed Reinforced Concrete Framed Structures in Romania" - World Conferences on 66 | P a g e Earthquake Engineering (WCEE), Technical University of Cluj-Napoca, Faculty of Civil Engineering, Cluj-Napoca, Romania, 2012.
[17] Alireza Kazem, Hossein Kazem and Benyamin Monavari – "Effect of Progressive Collapse in Reinforced Concrete Structure with irregularity in height" - World Conferences on Earthquake Engineering (WCEE), University of TarbiatMoallem (Kharazmi), Tehran, Iran, 2012.
[18] Abhimanyu Abitkar, and Rajendra Joshi – "Progressive Collapse of RC Buildings – Sustainable Analysis Procedures and Their Effects" - Civil Engineering Systems and Sustainable Innovations, College of Engineering Pune, Shivajinagar, Pune, Maharashtra, India, 2011, ISBN: 978-93-83083-78-7.
[19] Yash Jain"Simulation of Progressive Collapse Process of Multi-Storey RC Framed Structure by Linear and Non- Linear Static Analysis Technique Using ETABS Software", National Institute of Technical Teachers Training and Research, Bhopal, M.P., (2018).
[20] O. Yagob, K. Galal and N. Naumoski – "Progressive collapse of reinforced concrete structures" - Structural Engineering and Mechanics, Department of Building, Civil and Environmental Engineering, Concordia University, Montréal, Québec, Canada, June 12, 2009, Vol. 32, No. 6 (2009) 771-786.
[21] S. M. Marjanishvili, - "Progressive Analysis Procedure for Progressive Collapse" Journal Of Performance Of Constructed Facilities © ASCE, Vol. 18, No. 2, May 1, 2004. ©ASCE, ISSN 0887-3828/2004/2-79–85.

©IJRASET: All Rights are Reserved



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)