

# RESPONSE CHARACTERISTICS OF STRUCTURES HAVING IRREGULARITY SUBJECTED TO VERTICAL EXCITATIONS

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**Abstract:-** Previous earthquakes in India have discovered that most of the buildings aren't designed to be earthquake resistant. In general, buildings are designed taking into account just the gravity loads. Furthermore, the present look seismic codes are not completely practiced while developing a building. A thus higher degree of damage might be expected during an earthquake in case the seismic resistance of the structure is insufficient. The existing work describes the various reinforced concrete (RC) frames having various irregularities but with same dimensions which are analysed to study the behaviour of theirs when put through seismic lateral loads. All of the frames were analysed with the same strategy as mentioned in IS 1893-Part-1:2002. By the end result, it's been interpreted the base frame (regular) evolves least story drifts while the structure with floating columns shows maximum storey drifts on the soft story levels. Hence, this is very vulnerable to damages under this particular type of loading. The structures with irregularities also proved unsatisfactory consequences to some degree. The frame with heavy loads produces maximum storey shears, which ought to be accounted for design of columns suitably. The evaluation proves that irregularities are unsafe for the buildings and it's crucial that you have regular and simpler shapes of frames in addition to uniform load distribution within the building. Thus, as far as possible irregularities in a construction must be stayed away from. Nevertheless, if irregularities need to be introduced for every reason, they should be designed properly following the circumstances of IS 13920:1993. The complex shaped structures are in current days getting common but they have a threat of sustaining damages during earthquakes. Thus, such buildings must be designed effectively taking proper care of the dynamic behaviour of the Structure.

**Keywords:-** Dynamic response, structural irregularity, mass irregularity, stiffness irregularity

## 1. INTRODUCTION

Irregularities in structures are typical function in today's morden times. Aesthetics of the structure is given a great importance and thus all planning are done from initial stage of the structure making the structure irregular. Vertical irregularities in structures makes the structure more vulnerable at the time of earthquakes. Earthquakes in recent times have proved that the irregularities in the structure plays a vital role in failure of the building. At the time of earthquake the failure starts at the weak spot of the structure and the weak zone in the structure lies where the mass, geometry, stiffness etc changes of the structure. The irregularities in structure also arise due to unexpected change in strength at a specific floor in the structure, even for an experienced and intelligent structural engineer it is a difficult task to avoid such conditions. Hence the focus of existing study is assessing the relative performances of typical vertically irregular structures in a probabilistic domain. Due to scarcity of land in large number of structures ground floor is planned as parking floor thus making this floor as OGS storey, also the floors above the ground floors are proposed with setbacks for proper ventilation and aesthetic purposes making it a stepped kind of building. Recent studies have shown that the OGS of soft storey kind of building have collapsed and has shown negative results when subjected to ground excitations.

Open ground storey structures may also be known as 'open first storey buildings' or perhaps 'pilotis stilted buildings'. Due to the scarcity of land, the earth storey is kept open for no infill and parking purpose walls are not provided in ground storey although all above storey are as supplied with infill walls. The 2001 Bhuj earthquake (Magnitude M7.9 and PGA 0.11g) was among the most devastating for a person to witness the collapse of several open ground storey RC buildings. A typical open ground storey residential building at Ahmadabad. The soil storey columns are badly harmed as found in Figure 3 and 4. Figure 5 displays the failure of the very first storey columns as a result of shear in Earthquake. Figure 6 and 7 stand for the soft storey ground floor at China Earthquake of a 6 storey structure developing cracks because of the plastic hinge formation at the soft storey column which is likely to increase the inter storey drift at ground floor.



Figure 1 Vertically irregular OGS (Open Ground Storey) building    Figure 2 Vertically irregular Stepped Typed Building



Figure 3 Failure of OGS buildings in bhuj earthquake (ref : [www.nicee.org](http://www.nicee.org))



Figure 4 Failure of OGS buildings in bhuj earthquake (ref : [www.nicee.org](http://www.nicee.org))



Figure 5 Shear failure of ground storey columns (ref : world housing encyclopedia eeri & aiee)



Figure 6 Plastic hinged formation at column ends of the ground storey columns in China Earthquake 2008



Figure 7 Plastic hinged formation at column ends of the ground storey columns in China Earthquake 2008

**Criteria of Vertical Irregularity in Buildings** - IS 1893 definition of Vertically Irregular structures:- The irregularity in the building structures may be due to irregular distributions in their mass, strength and stiffness along the height of building. When such buildings are constructed in high seismic zones, the analysis and design becomes more complicated. In the prior code of IS 1893, there was no design recommendations particularly for OGS frames mentioned for vertical irregularity. However in the aftermath of Bhuj earthquake code was revised in 2002. In the latest version of code IS 1893 (2002) (part1) incorporated a brand new design recommendation for OGS buildings. Clause 7.10.3 (a) states "The columns & beams of the soft storey are to be designed for 2.5 times the storey shear and moments calculated under seismic load of bare frame type of buildings". The magnification factor (MF) 2.5 is examined by Subramanian (2004), Kanitkar and Kanitkar (2001), Kaushik and (2006). The Magnification factor MF 2.5 is not advisable for design of beam as that very likely to end up a "strong beam-weak column" situation. It is needed to develop the beams of the soft-storey additionally to design for larger storey shears as highly recommended by the above mentioned clause. Strengthening of beams will even further increase the need on the columns, and also deny the plastic development within the beams. These suggestions have met with a bit of opposition in style & construction practice due to congestion of heavy reinforcement within the column. IS code 1893 have defined the vertical irregularities within the structure this irregularities in mainly due to change in height, change in bay size, change in stiffness, change in strength and mass of the structure. Thus in area with high seismic vulnerabilities it is important to consider the above factors. IS code 1893:2002 specifies two types of irregularities. [1] Plane irregularities, [2] Vertical irregularities. This study mainly focus on vertical irregularities.

Vertical irregularities are of six types:-

- (a) Stiffness Irregularity - (Soft Storey):- A storey having lateral stiffness less than 70% of the above storey or less than 80% of the average of above 3 stories.
- (b) Stiffness Irregularity - (Extreme Soft Storey) :- A storey having lateral stiffness less than 60% of the above storey or less than 70% of the average of above 3 stories.
- (c) Mass Irregularity :- When the seismic weight of any storey is 200% of its adjacent storeys mass irregularity occurs.
- (d) Vertical Geometric Irregularity :- Vertical Geometric Irregularity occurs when the horizontal dimension of lateral force resisting unit is more than 130% of adjacent storey.
- (e) In plane discontinuity in vertical lateral force resisting elements :- Occurs when the in-plane dimension offset is greater then its adjacent offset dimension.
- (f) Discontinuity in capacity - (Weak storey):- When the storey's lateral strength is less than 80% of the storey above the storey is said to be weak storey.

When this types of irregularities are present in the buildings the building may be classified into different types as follows:-



1. OGS (open ground storey) building:- In this structure the ground storey is kept open for the use of parking i.e no walls are been provided at this level of the structure, thus irregularity is been induced making the structure less stiff. Due to the lack of the infill walls in the ground storey which of existing at the storey above, the stiffness is abrupt decreases that are called as stiffness irregularity. The base shear is registered through the ground storey columns. Due to the increased the shear pressure will cause the increased bending moment and thereby greater curvature which may possibly will higher inter storey drift formation at the ground storey which enhance by the  $P\Delta$  effect the plastic hinges are formed. Top of the shop will go as one block. This kind of collapse is called as smooth storey collapse. Due to the reduction in the stiffness at ground storey this particular kind of buildings are viewed as probably the most susceptible sort through the seismic point of view. The fig reveals the soft storey collapse of typical OGS structures.

2. Stepped Building :- In this structure the upper floors are proposed with upper setbacks for proper ventilation, aesthetic purpose, and also to compliance with "floor area ratio" in the building by-laws. Reduction of lateral dimension of the structure along their level is categorized as "stepped building". Due to the aesthetic and functional design these types of buildings are chosen in contemporary to the multi storey building construction. The main benefits of this particular kind of structures are they offer excellent ventilation with sufficient sun lights on the reduced storey, Sarkar et.al. (2011). This particular kind of building type also provides for compliance with building bye law restrictions associated to 'floor area ratio'. Stepped buildings are being used to boost the heights of masonry structures by distributing gravity loads created by building components like brick stone etc. These buildings also allow the all-natural erosion to take place without compromising the structural integrity of the structure.

3. Bare frame buildings :- Usually while developing the building the walls are not erected thus making the whole structure more prone to lateral loads. In the seismic point of view this is more vulnerable because lateral load are totally resisted by the bare frame. As per the Indian standard code for earthquake resistance structure created it is talked about that while developing a framework the contribution of infill are neglected. The Buildings are specially designed as a bare frame which will be the sole style of columns and also beams are looked at. In the seismic point of view this is the worst case as compared to various other building sorts in which the vulnerability is more money against lateral loads due to the lack of the infill.

4. Infilled masonry building :- In this building the frame structure is filled with masonry walls thus masonry walls transfers the forces in the compressive action acting diagonally in the opposite path to the beams below. Thus making the complete structure more stiff. The usual infill masonry structures will be the regular buildings considering infill walls provided uniformly throughout the components which improve the power and stiffness of the components. The infill walls are viewed as a non-structural component from the convenience design practice as per IS code. But in the particular exercise the presence of infill walls create a strut compressive action acting diagonally in the path opposite to the use of the lateral pressure which might attempt to counter act the lateral force which causes less deflection. In a bare frame, the opposition to lateral force happens by the development of bending moments and also shears forces in the different columns and beams through the rigid jointed activity of the beam column joints, but in the situation of infill frame due to the strut action, causing reduced bending moments but improved axial forces within the beams & columns.

**PROBLEM STATEMENT** - A large numbers of structures are designed to withstand live and dead loads only, individuals are not aware of earthquake resistant design of structure even if they are most of them avoid taking seismic factors into account while designing. In the seismic vulnerable areas like zone IV and zone V one must consider earthquake factors.

In this thesis a framed structure having G+9 stories is considered, the structure is intended for the use of residential purpose. The ground storey is planned as a parking floor thus making the structure an OGS type of building. On the roof water tank is also provided. The symmetrical configuration pattern is taken and complete analysis is been carried out using live load, dead load, and seismic loads in the STADDPro V8i software. RSM (response spectrum method) of seismic analysis is used.

## OBJECTIVE -

1. To understands the behavior of the structure in higher seismic zone. In this purpose a 10 storey-high building on eight various configurations having re-entrant sides with a typical setup.
2. To study IS Code 1893 (Part I): 2002 the entire models have been analysed with the help of STAADPro.
3. The present study additionally considered the accidental torsion in each positive and negative of both Y and X directions.
4. To compare regular building with building with different types of irregularity.
5. To understand the behaviour of various irregular buildings when subjected to lateral and seismic loads and conclude which type of irregular building is more dangerous.

## SCOPE AND LIMITATION OF THE STUDY -

The scope of thesis is comparison between regular and irregular building.

The limitations are as follows:-

1. The RC framed Buildings are considered for the analysis by assuming regular in plan.
2. The Out of plane action of walls is neglected in the analysis.
3. The asymmetric arrangement of walls is ignored of the buildings.
4. The Soil structure interaction effects are not considered in the analysis.
5. The Flexibility of floor diaphragms are neglected and considered as rigid diaphragm.
6. The base of the column is assumed to be fixed in the analysis.

## 2. LITERATURE REVIEW

**Afarani and Nicknam et al. (2012)** - They observed the behaviour of the vertically irregular building under seismic loads by Incremental Dynamic Analysis. They have been talking about eight stories regular building using two bays with four meters width in y direction has and four bays with three meters width in x direction with three meters storey height is believed. They considered Dead load as two ton/m is sent out on beams. In order to stay away from torsional effects they considered symmetric building and also steel moment resisting frames that are created based on IBC 2006 and ANSI/AISC 360-05.

**Tantala and Deodatis et al. (2002)** - In this analysis of a 25 story of reinforced concrete moment resisting frame Building having three-bays. generated fragility curves they have broad variety of ground motion intensities. They have utilized a bit of time histories are modelled by stochastic processes. Simulation is accomplished by power spectrum probability and duration of earthquake by conducting 1000 simulation for every parameter. The nonlinear analysis is done by considering the P- $\Delta$  effects and by ignoring soil-structure interaction. The simulation with the durations of effective ground motions is completed at two, seven and twelve second's labels to look at the consequences. They thought the consequences on the assumption of Duration and gaussianity. They've implemented stochastic process for modelling. The analyses have been carried out by utilizing DRAIN-2D like a dynamic analysis with inelastic time records data. The arbitrary material strengths have been simulated for virtually any column and beam using Latin Hypercube sampling.

**Murat and Zekeria et al. (2006)** - Studied the yielding and also collapse behaviour of RC frame buildings in Istanbul was analysed through fragility analysis primarily based on numerical simulation. They've studied amount of accounts of buildings as three, five & seven storeys designed as per Turkish seismic design code (1975). The fragility curves have been designed with the assistance of the outcomes of regression analysis. They've examined with twelve artificial ground motions because of the evaluation. Incremental powerful analysis (IDA) method is employed for estimating structural performance under many ground motions. Performance limit state inelastic displacement demand as well as corresponding deformations for fast collapse and occupancy prevention is evaluated. From the fragility curves last they've realized that with the collapse prevention performance level, a good correlation between spectral displacement limit and also the quantity of stories was noticed though similar observation wasn't valid for the instant occupancy level.

**Erberik et al. (2008)** - Studied the mid-rise and low-rise reinforced concrete (RC) buildings through Fragility analysis which qualities within the Duzce Damage database that affected by 2 devastating earthquakes in 1999 at Marmara region in turkey. They have considered the structures of amount of stories ranges between 2 and 6. In the analysis the structure having 2 and 3 stories are viewed as low rise (Buildings and lr) having 4 to 6 stories are viewed as mid-rise (MR). They have studied with twenty eight RC buildings obtained from a construction collection of around 500 buildings in Duzce. Post-earthquake damage assessments of the buildings had been readily available. The mid-rise and low-rise RC structures are analysed as one level of independence process with the worldwide response statistics of simplified (or maybe equivalent) analytical models.

**Samoah et al. (2012)** - Observed the fragility behaviour of non-ductile reinforced concrete (RC) frame buildings in lower medium seismic areas and they've chosen at Accra that's the capital of Ghana, West Africa. The structural capability of the buildings is analysed by inelastic pushover analysis and seismic demand is analysed by inelastic time history analyses. They've analyzed with three generic no ductile RC frame buildings using regular and symmetrical in each program and elevation are made based on BS 8110 (1985). The buildings taken into account are a 3- 3-bay and storey, a 2-bay and 4-storey and a 6 storey and three bay structures to get a suitable consequence. The evaluation for the non-ductile RC frame buildings, modelling are successfully done properly depending on the structural properties of theirs.

**Scarlet et al. (1997)** - Identified the qualification of seismic forces of OGS buildings. A multiplication factor for base shear for OGS building was offered. The modelling the stiffness of the infill walls in the evaluation was focused. The result of in Multiplication element with the increased storey height was studied. He observed the multiplication factor ranging from 1.86 to 3.28 as the amount of storey increases from 6 to 20.

**Hashmi and Madan et al. (2008)** - Conducted nonlinear time historical past plus pushover analysis of OGS buildings. They realized that the MF recommended by IS 1893 2002 for such buildings is enough for stopping collapse.

**Sahoo et al. (2008)** - Observed the behaviour of open-ground-storey of Reinforced concrete (RC) framed buildings having masonry at above storey by employing Steel Caging along with Aluminum Shear Yielding Dampers. He's created an easy spring mass item for the layout of braces for enough power and stiffness needs of the strengthening program. A shot a five storey four bay non ductile RC frame having open ground storey for his observation. And furthermore decreased scale 1storey one bay RC frame was analysed experimentally under continual gravity loads and reversed cyclic slowly increasing lateral Displacement by Full strengthening technique. For flexural strength and also inelastic rotation at a goal yield mechanism the performance based design technique was created to withstand the likely seismic demand as the lateral strength, inelastic deformation and also electric energy dissipation demand on structures. He noticed for load transferring assemblies the steel cage-to-RC footing brace-to-steel cage connection and connection exhibited performance that is excellent under lateral cyclic loading with no signal of early failures. Whereas the RC frame strengthened with just steel caging exhibited the improved lateral strength, drift capacity and power dissipation potential when compared to the non-ductile frame but couldn't stay away from collapse completely.

**Patel et al. (2012)** :- Proposed both linear as the Equivalent Static Response and Analysis Spectrum Analysis as well as the nonlinear analyses as the Pushover Analysis and also Time History Analysis for Low rise open ground storey framed building

with infill wall stiffness as being an equivalent diagonal strut model. The result on the infill wall is studied considering the Indian standard code IS1893 2002 criteria mention for OGS buildings. She found that the evaluation results demonstrate a MF of 2.5 is pretty high to always be multiplied towards the beam and column forces of the soil storey of the structures. Their study determine that the issue of open ground storey buildings can't be identified properly through elastic analysis since the stiffness of open ground storey creating along with a comparable bare frame construction are just about identical.

**Sarkar et al (2009)** - Research the irregularity in stepped framed building by considering Regularity index. 78 building frames with even number plus bay width of four and 6m respectively with varying level of stepped irregularity are deemed 7 amounts of structures with various level can also be provided without considering step. 50 modes are focused for 4 distinct situations of building. They noticed by histogram that with the increases in irregularity, the first mode participation decreases with higher participation on some higher modes. Delhi Secretariat building ten storied office building placed in New Delhi (Seismic Zone IV with designed PGA of 0.24g as per IS 1893:2002). The modelling and evaluation had been carried out by utilizing an application SAP2000.

**Sykora, M., & Holicky, M., et al. (2011)** - Investigated the same target reliability level for the assessment of existing structures. The variation of the cost as well as the reliability index is determined by considering the different parameters. By considering the various codes the target reliability has estimated for the building and based upon this the performance levels are evaluated. The target reliability levels are primarily dependent on the failure consequences and on the marginal cost per unit of a decision parameter; upgrade costs independent of the decision parameter; remaining working life and discount ratio are less significant. The design values are specified on the basis of an appropriate reliability index ( $\beta$ ).

**Rota et al (2010)** - He observed the fragility curves for masonry buildings prototype of a three storey masonry building located in Benevento (southern Italy) that has built in 1952 are analysed primarily based on stochastic nonlinear analysis. The variables can be found out by Monte Carlo simulation by way of an application STAC for the evaluation. The structure used is basically tuff masonry many experimental tests have performed by Faella et al. The program TREMURI, a frame type macro element worldwide analysis program was developed by Lagomarsino and Gambarotta as well as further modified by Penna for any nonlinear pushover plus time history analyses on masonry Buildings. In this particular research various sources of uncertainty are associated with the issue, by derivation of the probability distributions of equally demand and capacity through 3d nonlinear analyses of entire structure. They have used in plane cyclic shear compression tests completed on specimens made of cement mortar and also tuff units. The evaluation has been carried out by considering four mechanical damages for the components. 2 of them may be recognized from the result of one masonry pier even though the other 2 can be found from the worldwide response of the structure. For starters damage state is determined through the attainment of the yield displacement is  $y$  of the bilinear approximation to the capability curve associated with one masonry pier. The next damage state is determined by the drift corresponding to the very first shear cracking of the pier is  $S$  which gotten through the experimental test. The fourth and third damage states in America have been derived from worldwide pushover curves of the structure since the 3rd status is assumed to match to the attainment of the optimum shear resistance while the fourth phase corresponds to the attainment of eighty % of that significance. All the physical qualities of the structure are assumed to be random variables; standard deviations and the mean value are calculated by normal probability distributions of the construction typology.

**Guneyisi and Altay et al. (2008)** - Observed the behaviour of current R/C office buildings through fragility curves thinking about the circumstances as before and also after retrofitted by fluid viscous (VS) dampers. Braced frames are viewed at the middle bay of the frame with passive fluid VS dampers at every brace. A 12 storey office building designed as Turkish seismic design code version (1975) from Istanbul. VS dampers are utilized for retrofitting specially designed as FEMA 273-274 with many different effective damping ratios of ten %, , and 15 % and 20%. Main structural method of the structure includes moment resisting R/C frames in 2 directions with 12-storey located at average seismic zone with fairly rigid soil type as per Turkish seismic design code has taken. The storey position of the structure is 2.75 m with 989 m<sup>2</sup> floor area. 240 earthquake ground motions are generated by considering the spectral representation strategy according to the stochastic engineering Approach by using MATLAB program limited to 1PGA. The R/C building is modelled as a three dimensional analytical type of the structure was started in ETABS version 7.2 Structural Analysis Program for the evaluation. For the seismic result of the buildings are concentrated through the nonlinear time history analyses with push over analysis by IDARC version 6.1 programs. The distinctive energy and yield strength is viewed as of 16 MPa and 220 MPa. The fragility curves are generated for 4 damage states as slight, major, moderate, as well collapse conditions plus Load deformation connection just for the vulnerable axis ( $y$  axis) and also the structural damage limit values found for every damage type. The fragility curve produced for the structure are realized that with the assistance of retrofitting the failure risks of creating is minimized so that the before retrofitting is much more flimsy than after retrofitting case.

**Rajeev and Tesfamariam et al.(2012)** - Analyzed the seismic overall performance of non-code conforming RC structures created for gravity loads. The analysis highlights the necessity for reliable vulnerability assessment and retrofitting. The vulnerability is compounded since the RC buildings are subject to various problems such as for instance weak storey, soft storey, plan irregularities sand various other types Fragility based seismic vulnerability of structures with consideration of very soft storey(SS) plus quality of construction(CQ) is evidenced on three, five, and also nine storey RC frames created prior to 1970s. Probabilistic seismic demand model (PSDM) for considered structures is produced, by utilizing the nonlinear finite element analysis. Additionally, the fragility curves are created for the 3 structures considering of, CQ, and SS the interactions of theirs. Finally,



confidence bounds within the fragilities are also provided as a measure of the accuracy of theirs for risk informed decision-making. With the PSDM models the corresponding fragility curves are generated. in the evaluation. They realized that the vertical construction and irregularities quality in seismic risk assessment enjoy a major influence within the decision making stage. The proposed strategy of creating a predictive tool is able to improve local damage assessment tool, for example HAZUS, to build enhanced fragility curves for known CQ and SS.

**Menon and Davis et al. (2004)** - Examined the presence of masonry infill panels modifies the structural force distribution considerably within an OGS building. They considered verities of creating case studies by boosting the storey heights plus bays in OGS buildings to study the modification in the behaviour of the functionality of the structures with the increased the variety of bays and storey also the storey heights. They found that with the total storey shear force improves since the stiffness of the structure improves within the presence of masonry infill at top of the flooring of the structure. Furthermore, the bending moments in the ground the failure and floor columns increase is created because of delicate storey mechanism which would be the development of hinges in ground storey columns.

**Pallav et al (2012)** - Estimated the spectral acceleration on the Manipur region through the probabilistic seismic hazard analysis (PSHA). The region considered for the evaluation is divided into various zones. By factor of past earthquake data the earthquake recurrence relations are examined for the evaluation Seenapati, tamenglong, churachandpur, chandel, Ukhrul, Imphal west, imphal east, Bishnupur and Thoubal places belongs to that particular region are viewed for the evaluation. Counter maps are considered for the different places of Manipur region by thinking about the variation of good ground acceleration for return periods. These benefits might be of use to engineers and planners for choice of site, earthquake resistant structures designing and, might assist the state administration in seismic hazard mitigation.

**Celik and Ellingwood et al. (2010)** - Observe the seismic functionality of the reinforced concrete frames is in the hands of low seismic area are intended and also analysed for gravity loads. They considered the uncertainty in the content qualities & structural methods (i.e. structural damping, concrete strength, and also cracking strain in beam-column joints have the greatest effect on the fragilities of such frames. Confidence bounds within the fragilities are also provided as a degree of the accuracy of theirs for risk informed decision-making, for prioritizing risk mitigation work in areas of low-to-moderate seismicity.

**Bhattacharya et al (2001)** - Focused on the development of the target reliability of the novel structures that calibrated to existing structures. They adopted a general risk methodology of reliability framework is considered for finding out the significant limit state and the identification of the target reliability for the structures analytically. The methodology is illustrated with the US Navy's Mobile Offshore Base concept is the unique offshore structure in terms of function and size, and where no industry standard exists. A survey of reliability levels in existing design standards and engineered structures, target reliabilities recommended by experts, and analytical models for establishing acceptable failure probabilities is presented. The MOB target reliabilities presented here are subject to modification in the actual acquisition phase when more input becomes available. It is concluded that setting target reliabilities for high-value novel structures is not an engineering decision alone active involvement on the part of the owners and policy- makers is also required.

**Kim & Shinozuka et al. (2004)** - Studied the fragility assessment of 2 sample bridges retrofitted by steel jacketing of bridge columns in southern California. Among the 2 bridges the first one bridge was 34m very long with 3 span with 2 half shells of rolled steel plate and a RC deck slab 10m width supported by 2pairs of circular columns(each having three columns of diameter as 0.8 m) with abutments. And also the 2nd bridge was 242m long with a deck slab dimension (13m wide & 2m deep) that supported by four circular columns of 2.4m diameter and level of 21m have an expansion joint at centre was taken.60 ground acceleration time records have been collected from the Los Angeles the historic documents then Adjusted. After which and then they've grouped into 3groups each of owning 20data.The bridges had been modelled as a two dimensional response analysis with a computer system program SAP2000 and also nonlinear limited method. The fragility curves were developed by considering before and also after column retrofit with steel jackets cases with probabilities of exceedence of ten % in fifty years, two % in fifty years as well as fifty % in50 years, respectively. Nonlinear response characteristics connected with the bridges are based on moment-curvature curve analysis. They considered two parameter lognormal distributions operates by the median and log standard deviation to analysis the fragility curves. They have completed the evaluation for performance levels that are different as no cracking, Slight Cracking Moderate, Extensive Incipient column collapse Complete. The fragility curves were Produced from the experimental outputs then compared.

**Summary :-** Overviews of guidelines for vertically irregular buildings are carried out in the first chapter. The review of the study indicates that there are numerous research efforts found on the seismic behaviour of RC buildings, OGS buildings also with regard to seismic performance of the vertically irregular buildings, there are few studies conducted. But all this studies are based on a deterministic approach. The main motivation is to study the performance of the vertically irregular buildings and to fine tune the design guidelines as per the Indian standards. For example, with regard to an OGS building, the IS 1893(2002) suggests a multiplication factor of 2.5 for ground storey columns. The multiplication factor proposed by IS 1893 (2002) needs to be more of rational than an empirical number The seismic hazard analysis is adopted for the OGS buildings and the stepped type buildings by considering the criteria from various codes by identifying the reliability index calculation for the buildings to evaluate the appropriate MF values for the design of the buildings belongs to various region of India.

## CONCLUSION

Considering the storey displacement, the frame and structure with floating columns (frame 2) may be the most fragile since it suffers the highest displacement as the base frame and structure exhibits the very least displacement. So far as storey drift is concerned, frame two (with bottom 2 soft storeys) may be the most fragile since it's the maximum storey drift which changes abruptly. Frame 8 also shows pattern that is similar for bottom 2 storeys. Storey shear is however maximum in frame four and structure four (with 3rd and 6th storeys major). It may be inferred naturally the frame and structure with floating columns represents the even worse situation since it faces the highest displacement and is very susceptible to damages under this particular lateral loading. While, on the flip side it could be observed that the base frame and structure contains the very least drift and displacement, hence least vulnerable to the harm. In this particular thesis different structures and frames having completely different irregularities but with exactly the same dimension were analysed to learn their behaviour when put through lateral loads. All of the frames and also components have been analysed with exactly the same technique as mentioned in IS 1893 part 1: 2002. The starting frame and structure that is ideal develops least story drifts while the structure with floating column shows maximum storey drifts on soft story levels. Thus this's probably the most susceptible to damages under this particular type of loading. The many other structures with irregularities also proved unsatisfactory success to some degree. The frame with heavy loads produces maximum storey shears that should always be accounted for in design of columns suitably. The analysis reveals the dynamic approach provides us much more refined results as than static evaluation of the structure.

The evaluation too demonstrates that irregularities are unsafe for the buildings and also it's crucial that you have regular and simpler shapes of frames in addition to even load distribution within the construction. Thus, as much as potential irregularities in a construction should be avoided. But if irregularities need to be introduced without any reason, they should be designed effectively adhering to the circumstances of IS 13920: 1993. And now days, complex shaped buildings are becoming famous though they have a threat of sustaining damages during earthquakes. Therefore such structures must be created effectively taking care their dynamic behaviour.

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