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Seismic Response of Regular and Irregular Reinforced Concrete Buildings under Ground Motions of Different Frequency Content

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Abstract- Earthquakes produce ground motions with varying frequency characteristics that influence the seismic response of reinforced concrete buildings. This study examines regular and irregular G+9 and G+19 reinforced concrete structures subjected to low-, intermediate- and high-frequency ground motions across different seismic zones. Nonlinear time-history analysis is performed using ETABS to compare base shear, natural time period, storey displacement and storey drift. The study evaluates the effects of building height, structural irregularity, seismic zone and earthquake ground-motion characteristics on structural response. Comparative results are presented through the original numerical tables, structural models and graphical outputs.
Keywords: reinforced concrete; seismic response; regular and irregular buildings; ETABS; nonlinear time-history analysis; ground motion frequency.

Keywords: Reinforced concrete structures; seismic performance; regular and irregular buildings; earthquake ground-motion frequency; low-, intermediate- and high-frequency ground motions; seismic zones; nonlinear time-history analysis; ETABS; base shear; storey displacement; storey drift; natural time period; structural irregularity; building height.

I. INTRODUCTION

General

Seismic activity is a significant natural threat accountable for the loss of thousands of lives. The release of seismic waves harms structures thoroughfares and non-load-bearing components. Structures particularly buildings are essential for humanity therefore it is imperative to analyse the seismic forces on them and their subsequent reactions. The extent of damage to the structural component mostly relies on the intensity and epicentre of the earthquake as well as the nature of the structure. To mitigate the impact of seismic forces on structural edifices the design and analysis of the structure must adhere to the BIS (Bureau of Indian Standards) guidelines. Structures with controlled seismic reaction are becoming recognised as an innovative approach that addresses societal demands in the next century. structure control is a potential field of contemporary study aimed at mitigating structure vibrations during events like earthquakes and high winds. The current research aims to investigate the impact of frequency content and duration on the seismic performance of both regular and irregular reinforced concrete structures while also comparing them across various zones.

Types of Irregularity in Building Structures:

In the event of an earthquake weak spots in a building will eventually give way. A structural discontinuity in mass stiffness or geometry causes this weakness. Irregular buildings are those that display this kind of discontinuity. A significant amount of urban infrastructure consists of irregularly shaped buildings. When earthquakes strike buildings with vertical abnormalities are more likely to collapse. The most prominent constructions to fall during earthquakes for instance were those with soft storeys. This highlights the critical importance of considering the impact of vertical anomalies on seismic performance.

Because stiffness and mass vary with height these structures' dynamic properties are distinct from those of "ordinary" buildings.

Structures with vertical irregularities:

An uneven distribution of mass strength and stiffness along the building's height might be the cause of the building's irregularities. "Irregular Structures" describe buildings with these kinds of breaks while "Vertically Irregular Structures" describe buildings with these kinds of breaks running vertically up the building. Complex study and design are required for such structures when built in areas prone to strong seismic activity. There are two kind of anomalies:

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- **Vertical Irregularities**
- **Plan Irregularities**

Vertical Irregularities

The most common kinds of vertical irregularities are:

a) Stiffness Irregularity — When the lateral stiffness of a storey is less than 70% of the story above it or less than 80% of the average lateral stiffness of the three storeys above it we say that the storey is soft.

b) Stiffness Irregularity — When the lateral stiffness is lower than 70% of the average stiffness of the three storeys above or lower than 60% of the lateral stiffness of the storey above we say that the storey is very soft.

- **Mass Irregularity**- Any level with a seismic weight more than 200 percent of the levels below it is said to have mass irregularity. Roof irregularities are not to be considered.
- **Vertical Geometric Irregularity**- A structure is said to possess vertical geometric irregularity when the horizontal extent of the lateral force-resisting system on any level exceeds that of others.

Horizontal Irregularity

- **Torsion Irregularity:** Torsional irregularity is deemed to occur when the greatest storey drift calculated with design eccentricity at one end of the structure perpendicular to an axis exceeds 1.2 times the mean of the storey drifts at both ends of the structure.
- **Re-entrant Corners:** The layout designs of a building and its lateral force resisting system have re-entrant corners when the extensions of the structure beyond the re-entrant corner exceed 15 percent of its plan dimension in the specified direction.
- **Diaphragm Discontinuity:** Diaphragms exhibiting sudden discontinuities or changes in rigidity particularly those including cut-outs or openings over 50 percent of the total enclosed diaphragm area or variations in effective diaphragm stiffness beyond 50 percent across consecutive storeys.
- **Out-of-Plane Offsets:** Disruptions in a lateral force resistance trajectory shown by out-of-plane displacements of vertical components.
- **Non-parallel Systems:** The vertical components countering the lateral force are not parallel nor symmetrical about the primary orthogonal axes or the parts resisting lateral forces.

Effects of Irregularity:

The performance of a building is contingent upon the configuration of its structural components. The important factors influencing the structural configuration are the geometry form and dimensions of the edifice. When a structure experiences dynamic loads inertia forces are generated and accumulate near the center of mass of the building. Vertical elements like columns and shear walls counteract horizontal inertia forces with the resultant of these forces converging at a location known as the center of stiffness. When the center of mass does not align with the center of rigidity eccentricity arises in the structure. Eccentricity arises from the uneven distribution of structural elements which subsequently generates torsion inside the structure. The position and dimensions of structural components greatly influence torsional coupling leading to structural damage. Geometric anomalies in the architectural layout of buildings may lead to unintended twisting of floors a phenomenon referred to as torsional irregularity when the center of mass does not align with the center of stiffness potentially resulting in both translational and torsional movement of the floor. Torsional rotation may be mitigated using retrofitting methods such the incorporation of shear walls, infill walls, bracing wall, thickening mass reduction base isolation and the reinforcement of columns and beams. Minimising torsional effects may be achieved by decreasing the separation between the center of mass and the center of rigidity. The rigidity attributes govern the dynamic behaviour of the building framework and selecting the rigidity characteristics of buildings is a crucial aspect in the conceptual design process. The effective performance of the structure may be guaranteed by a properly allocated lateral load resisting system.



Fig 1.1 "showing an Irregular Building"

Seismic Zones Of India: According to the nation's seismic zoning map the whole region is categorised into four distinct seismic zones. Roughly 11% of the nation's territory is classified as zone V 18% as zone IV 30% as zone III with the remainder designated as zone II. The diverse geological conditions throughout various regions of the nation suggest that the probability of destructive earthquakes occurring in certain areas varies. A seismic zone map is essential for pinpointing these areas. The 1970 iteration of the zone map categorised India into five zones - I II III IV and V based on the intensity levels experienced during destructive historical earthquakes. The seismic

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zone maps are periodically updated as more insights are acquired into the geology seismic tectonics and seismic activity inside the nation. The Indian Standards issued the first seismic zone map in 1962 which underwent revisions in 1967 and subsequently in 1970. The chart underwent another revision in 2016 now including just four seismic zones - II III IV and V.

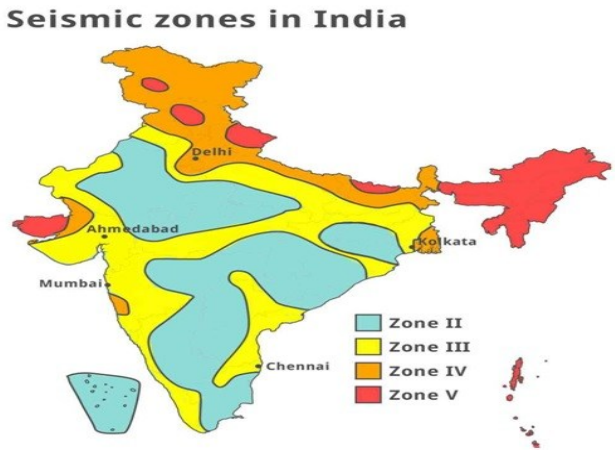


Fig 1.2 "Seismic Zones of India"

II. ANALYSIS METHODS:

1.Seismic Analysis:
To better understand how structures, react to seismic excitations seismic analysis is a powerful technique in earthquake engineering. Buildings were formerly only constructed to withstand gravity loads; but with the advent of seismic analysis lateral stresses are now also considered. Seismic analysis is an integral aspect of structural design and structural analysis in areas prone to earthquakes.
Various approaches for earthquake analysis include -

- Equivalent Static Analysis
- Response Spectrum Analysis
- Time History Analysis

2.Equivalent Static Analysis:

An elastic design approach is basically the same as the corresponding static analysis process. In contrast to the multi-model response technique this one is easier to implement and its assumptions about simplification are more in line with those used throughout the design process.

Following these procedures will result in a comparable static analysis:

- Use the design response spectra to estimate the building's first mode response period.
- Verify that the building's total lateral base shear matches the expected amount of post-elastic (ductility) response using the specified design response spectra.
- Apply 90% of the base shear to the lower levels of the lumped mass with 10% applied to the upper level to account for higher mode effects; this distribution is typically based on an inverted triangle shear.

3. Response Spectrum Analysis: This method makes it possible to consider a building's many reaction modes. With the exception of very basic or extremely complicated buildings this is mandated by several construction regulations. A number of modalities come together to form the structural response. To find these modes for a building one may employ computer analysis. A response is estimated for the structure as a whole by taking the modal mass and modal frequency values from the design spectrum and applying them to each mode individually. In this the building's impact are determined by calculating the magnitude of forces in all directions. You may classify the various combination techniques as follows:

- Absolute - peak values are added together
- Square root of the sum of the squares (SRSS)
- Complete quadratic combination (CQC) - a method that is an improvement on SRSS for closely spaced modes

Due to the loss of phase information the result of an RSM analysis derived from a ground motion's response spectrum is usually different from that of a linear dynamic analysis utilising the same ground motion directly.
The reaction spectrum technique is no longer suitable for buildings with major irregularities are excessively tall or are significant to a community in disaster response. Instead more complicated analysis such as non-linear static or dynamic analysis is typically necessary.

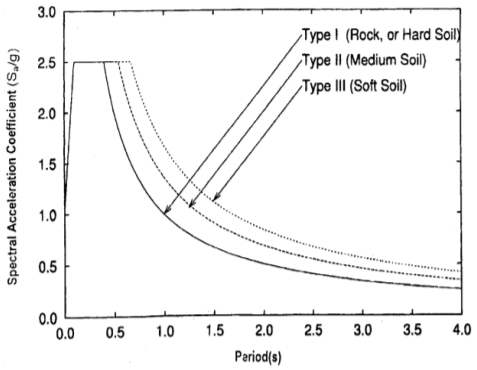


Figure 1.3: Response Spectrum Curve

5. Design Criteria

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There are four seismic zones in India (I III IV and V) that are used to determine the design seismic forces. Zones I and II were combined into Zone II in the fifth code revision from a total of five zones. Using the following formula, one may get a structure's design horizontal seismic forces coefficient (Ah).

$$A_h = ZIS_a / 2Rg$$

Z = Zone coefficient for the maximum credible earthquake (MCE) and the lifespan of the building within a designated area. The factor of 2 in the denominator serves to diminish the maximum credible earthquake (MCE) to the design basis earthquake (DBE).

I = Significance factor contingent upon the building's intended function defined by the perilous repercussions of its collapse post-seismic operational requirements historical significance or financial value.

R = Deformations in the structure may be either ductile or brittle and the response reduction factor (I/R) can't be more than 1 depending on how the structure is thought to behave in the event of seismic damage.

S_a/g = Average response acceleration coefficient.

For Rocky or hard soil sites;

$$S_a / g = \begin{cases} 1+15T & (0.00 \le T \le 0.10) \\ 2.50 & (0.10 \le T \le 0.40) \\ 1.00/T & (0.4 \le T \le 4.00) \end{cases}$$

For medium soil sites

$$S_a / g = \begin{cases} 1+15T & (0.00 \le T \le 0.10) \\ 2.50 & (0.10 \le T \le 0.55) \\ 1.36/T & (0.55 \le T \le 4.00) \end{cases}$$

For soft soil sites

$$S_a / g = \begin{cases} 1+15T & (0.00 \le T \le 0.10) \\ 2.50 & (0.10 \le T \le 0.67) \\ 1.67/T & (0.67 \le T \le 4.00) \end{cases}$$

6. Design Lateral Force

What follows is an equation that may be used to get the overall design lateral force or design seismic base shear (V) beside any major building direction.

$$V_b = A_h W$$

Where A_h is the "horizontal seismic forces coefficient"

W is the "seismic weight of building"

7. Seismic Weight

Every level's seismic weight is equal to its dead load plus the stated amount of forced load. The seismic load of a floor is determined by distributing the weight of its columns and walls evenly across the floors above and below it. The total seismic load of a building is equal to the sum of its individual floor loads. The load bearing capacity of each floor is directly proportional to the inverse of the distance between them therefore any load sustained between storeys will be evenly distributed.

8. Fundamental Natural Period

In clause 7.6 of IS1893 (part 1): 2002 it is stated that the essential natural time duration for moment resisting RC frame buildings without brick infill walls and moment resisting steel frame buildings without brick infill walls is supplied by

$$Ta = 0.075h^{0.75}$$

$$Ta = 0.085h^{0.75}$$

where h = "height of the building in 'm' excluding basement storey if it is connected with the ground floor decks or fitted in between the building column."

If there is brick filling then the "fundamental natural period of vibration may be taken as"

$$T_a = 0.09h/d^{0.5}$$

where h= "height of the building" in m as defined above and d = "base dimension of the
building at the plinth level" in meter along the considered direction of the lateral force.

9. Distribution of Design Force

The following equation will be used to distribute the design base shear V determined above along the building's height:

$$Q_i = W_i h_i^2 / \sum_{j=1}^{n} W_j h_j^2$$

where

Q_i = Design lateral force at it floor

W_i = Seismic weight of it' floor

H_i = height of i^{th} floor measured from base and

n = numbers of stories in the building (is the number of the levels) at which the masses
are located.

Assuming the floors are infinitely rigid in the horizontal plane the total shear in any horizontal plane must be distributed to the various vertical parts of the lateral force resisting system in buildings whose floors are capable of producing rigid horizontal diaphragm action.

In buildings where the floor diaphragms are not perfectly flat the lateral shear at each level must be allocated to the vertical elements that resist the lateral stresses taking into account the diaphragms' flexibility in the plane of the structure.

10.Time History Analysis:

Methods for time history analysis include solving one step at a time the multi-degree-of-freedom equations of motion that describe the real reaction of a structure. As far as structural engineers are concerned it is the pinnacle of analytical tools. The input parameter for a particular building's seismic ground motion determines its solution. In most cases this kind of study is not used to assign lateral pressures directly but rather to verify that the assumptions made while designing significant structures were reasonable. Here are the steps to take while doing a time series analysis:

- Calculation of Modal matrix

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- Calculation of effective force vector
- Obtaining of Displacement response in normal coordinate
- Obtaining of Displacement response in physical coordinate
- Calculation of effective earthquake response forces at each storey.
- Calculation of maximum response

Equations of motion

11. Classification of Ground Motion:

Three groups are established for the ground motion recordings according to their frequency content which is the ratio of PGA/PGV.

- High-frequency content - PGA/PGV > 1.2
- Intermediate-frequency content - 0.8≤ PGA/PGV≤ 1.2
- Low- frequency content - PGA/PGV< 0.8

The frequency content of ground motion is defined as the ratio of peak ground acceleration in units of acceleration of gravity (g) to peak ground velocity in units of (m/s). How reinforced concrete structures react to ground vibrations with low medium and high frequencies is shown in this study.

Definitions:

Base Shear:

You may use the static or analogous lateral force method to find the lateral forces that ground vibrations put on the building. Seismic base shear is a measure of the highest lateral force that a structure may reasonably be anticipated to experience at its base. Seismic zone soil type and lateral force formulae from the building code are used to compute it. The formula for base shear is

Base shear value (V) is determined by combining the following physical factors:

- Soil conditions at the site
- Proximity to potential sources of seismic activity (such as geological faults)
- Probability of significant seismic ground motion
- Level of ductility and over strength associated with various structural configurations and total weight
- Fundamental (Natural) period of vibration of the structure when subjected to dynamic loading

Story Drift:-

When designing buildings to withstand seismic loading it is crucial to keep in mind that there should be no more than an acceptable amount of lateral displacement due to earthquake shaking. One way to measure the movement of a floor in relation to the floor below is by measuring its storey drift. The storey drift ratio is calculated by dividing the storey drift by the storey height. One helpful metric to compare with the criteria of seismic loading code IS 1893 Part I is the storey drift ratio which normally restricts storey drift as a percentage of the storey height. If you look at the storey drift ratio graph you can see which floors are drifting the most and if they may need to be stiffened.

According to Article 7.11.1.1 of IS 1893 Part 1 the maximum allowable inter-story drift is 0.004 times the storey height meaning that the drift must be less than 0.4% of the story height.

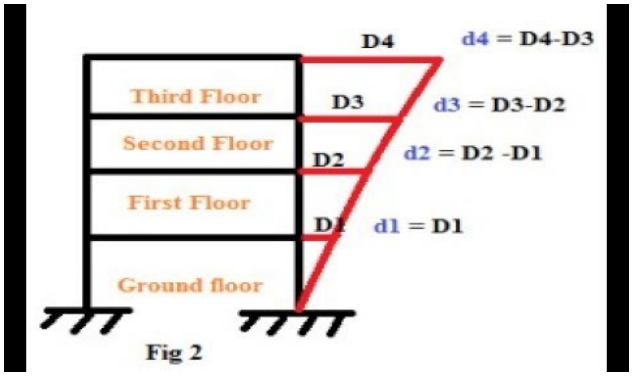


Fig 1.4: Story Drift

Story Displacement:

When one narrative moves laterally with respect to the base this is called story displacement. To prevent the structure from being too displaced laterally the lateral force-resisting system is in place. In most buildings the story drift ratio is more important at the middle level compared to the top level.

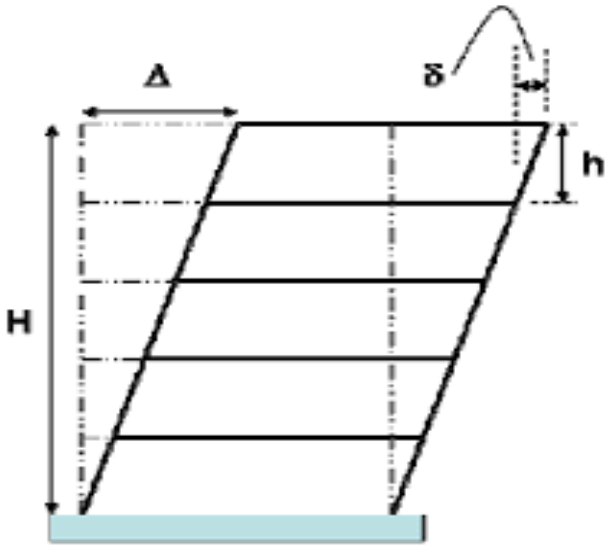


Fig 1.5: Story Displacement

Objectives

- To compare the regular and irregular building types in terms of seismic response variance (base shear time period storey drift and storey displacements).

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- To investigate how RC building seismic responses vary with building height.
- To investigate how the structure acts at various frequencies.
- Seismic zones affect the reactions of both regular and irregular structures which should be studied.

Research Aim

- This project's overarching objective is to conduct seismic analyses of both regular and irregular RC structures.
- Various building heights will be included and compared in this effort.
- Various earthquake frequencies are introduced and compared in this paper.

III. LITERATURE REVIEW

General:

In this chapter we provide the literature review of several buildings that have been examined for earthquakes with different frequencies. Also covered in this chapter are the requirements of the code that are necessary for the research and the reviews of the loads under consideration.

Review Of Resources:

Sravani et. al (2019) have studied that Structural analysis and design software (ETABS) does linear time history analysis. Researching how reinforced concrete structures of varying heights react to ground movements of varying frequencies is the suggested approach. Research is conducted on two- six- and twenty-story RC structures that are both regular and irregular in three dimensions. The buildings are subjected to six ground movements with identical duration and peak ground acceleration (PGA) ranging from low to high frequency contents. To sum up the influence of low-frequency content ground motion on the responses of both regular and irregular RC structures is substantial. The reactions of both regular and irregular RC structures are little affected by high-frequency content ground motion. The results show that RC structures are more affected by ground motion with high frequency content than by ground motion with low frequency content and that intermediate frequency content has a less impact.

Kori et. al (2019) analysed that Structures' responses to seismic stresses are affected by two crucial earthquake dynamic properties: Peak Ground Acceleration (PGA) and Peak Ground Velocity (PGV). The ratio of PGA to PGV is called frequency content and it is used to quantify the intensity of ground motion. The PGA/PGV ratio is larger than 1.2 for high frequency contents and less than 0.8 for low frequency items. In contrast the PGA/PGV ratio which represents intermediate frequency content falls somewhere in the middle of these two extremes. With this research we want to better understand how frequency content influences the seismic performance of symmetric and asymmetric RC structures. Because symmetric structures show the lowest levels of displacements and drifts in our research they should be seriously considered for use in future building projects.

Rajesh et. al (2016) have studied the Regular R.C.C. structures situated on level land subjected to ground vibrations of varied frequencies demonstrate seismic behaviour. The results show that the 3-storey and 6-storey regular RC buildings were most affected by low-frequency content ground motion in the X and Y directions while the 3-storey and 6-storey regular RC buildings were least affected by high-frequency content ground motion in those directions and the 3-storey and 6-storey regular RC buildings were subject to medium-floor displacement from intermediate-frequency content ground motion in those directions.

Monish et. al (2015) conducted this research to model and analyse structures with square shapes diaphragm discontinuities in the shapes of 'H' 'C' and '+' and re-entrant corners in the form of an L with X-direction projections of 40% 60% and 80% and Y-direction projections of 40%. Model C which has more projections (80% in the X direction and 40% in the Y direction) is the most susceptible to displacement as the number of stories rises and when compared to ordinary re-entrant models this is clearly the case. Since the reaction spectrum approach relies only on empirical formulas the findings it produces are accurate when compared to those of the corresponding static method. Models D1 (H-shaped) and C-shaped performed worse during earthquakes compared to the other models.

Kusuma (2017) conducted a study on the results of the seismic analysis showed that regular structures with RC moment resistant frames and masonry walls performed better than irregular structures when subjected to seismic loads. Seismic excitation has the greatest effect on re-entrant corner structures and other types of irregular structures while it has the least effect on mass irregular stiffness irregular and vertical geometric irregular structures. If the building is vertically uneven has re-entrant corners or is stiffness erratic the lateral displacement will grow from the storey where the irregularity is introduced. In structures with vertical irregularities re-entrant corners and uneven stiffness the structural stiffness is decreased.

Sunil et. al (2018) objective is aimed at comprehending the torsional response of asymmetric structures via the modelling and examination of a 14-story edifice using three-dimensional dynamic analysis (Response Spectrum Method) with ETABS. They determined that the inconsistencies in structural plans substantially affect the seismic response of the structure particularly regarding displacement and base shear. The findings indicate a rise in shear forces inside columns particularly in irregular structures as a consequence of torsion. Structures with atypical architectural layouts

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inflict more destruction than conventional buildings during seismic events in high-risk zones attributed to heightened drifts and displacements. A special moment resisting frame is more appropriate for severe earthquake zones compared to an ordinary moment resisting frame.

Naveen (2019) addresses the Seismic behaviour of reinforced concrete edifices exhibiting diverse configurations of imperfections. A nine-story regular framework is altered by introducing irregularities in several forms in both the plan and elevation resulting in 34 configurations with a single irregularity and 20 instances with combinations of abnormalities. In addition to the standard setup 54 atypical variants are examined and contrasted. All frames endure seismic forces and the structural responses are calculated computationally with finite element software ETABS. Irregularity significantly influences the earthquake response. Among the several categories of single irregularities examined stiffness irregularity is determined to have the most impact on the response. Among the instances exhibiting a blend of imperfections the arrangement including mass stiffness and vertical geometric abnormalities has shown the greatest reaction. The findings of this research might facilitate the prudent design of unconventional buildings without sacrificing their efficacy.

Rajalakshmi (2019) have made A concise overview of the research conducted about the seismic behaviour of irregular building frameworks. An examination of literature concerning asymmetric structures indicates that abnormalities stemming from uneven mass stiffness and strength distribution lead to significant damage owing to the resultant floor rotations and floor translations. A prevalent kind of vertical irregularity occurs when the lateral dimension of a structure diminishes as its height increases and these structures are referred to as stepped buildings. This architectural style is gaining prominence in contemporary multi-storey construction mostly because to its practical and visual appeal. This tiered design ensures sufficient natural light and airflow at the lower levels of an urban area characterised by densely positioned high-rise structures. Innovative design techniques are required to enhance the performance of these structures under anticipated seismic activity.

Srishti and Parikshit (Sept 2019) have Conducted analysis and design of RCC (G+3) structures both regular and irregular using manual methods and the Structural Engineering software ETABS. They determined that the center of mass and the center of stiffness align in regular structures whereas irregular buildings exhibit some degree of eccentricity. The torsional forces in the standard structure resulting from seismic activity in both the X and Y directions were determined to be 0 kN-m. The torsion was induced in the irregular 18 building as a result of an earthquake along the X-axis. In conventional structures no torsion was detected in the columns however in atypical structures every column experienced torsion. The sectional demands of an irregular structure are comparatively greater than those of conventional structures. A variation in the base shear value in both directions was seen in the regular and irregular models.

Critical Appraisal of Literature Review:

According to the research reviewed in the current literature irregular structures have shown superior outcomes relative to regular structures. When plan irregularity is seen as a '+' form it has shown superior outcomes relative to other irregular configurations (H L C etc.). The current study examines the response of structures under non-linear time history analysis. Plan irregularity is defined as a '+' configuration for G+9 and G+19 edifices. The variables under examination in the current research include base shear time period narrative drift and story displacement which will be compared across various zone kinds.

IV. METHODOLOGY

General

The examination of both regular and irregular structures is conducted by ETABS 2017. Non-linear time history analysis is used for the examination of G+9 and G+19 structures. The evaluation is conducted with IS codes.

Overview Of Software

The analytical framework for the case study structure was developed using Extended 3D Analysis of Building Systems (ETABS) version 17.0.1. (Computers and Structures Inc 2017). ETABS is a finite element analysis program particularly tailored for the evaluation of high-rise structures. The original design of the structure is provided by Tyrens followed by alterations to the model. The TABS software uses the finite element analysis approach to do both static and dynamic analyses. The finite element method (FEM) is a computational approach used to derive approximate solutions for boundary value issues associated with differential equations. It employs variational techniques to reduce an error function and yields a consistent solution.

The finite element approach in structural engineering analysis involves partitioning structural components into smaller elements and linking them via nodes. Each fundamental component will be addressed using separate equations and subsequently all parts from each subdomain will be used to estimate a more intricate equation to be resolved over a broader domain. The quantity of elements is established based on the required precision and the resemblance to the actual performance of the components.

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The outcomes derived from the finite element analysis just serve as approximations of the true findings.
In the ETABS software the components used in the finite element analysis process are characterised by the 'meshing' of structural elements. The mesh feature inside the software allows for the specification of element size quantity and geometric configuration to ensure that the analysis accurately represents the structural behaviour with enough precision. The software has a 'Auto mesh' feature that autonomously creates the mesh based on the provided input.

Models

The current research examines G+9 and G+19 regular and irregular reinforced concrete structures exposed to two frequency contents: Elcentro and Corralit. All these models are evaluated across various regions.

Model 1 : G+9 Regular Structure for Elcentro Data Zone - II
Model 2 : G+9 Irregular Structure for Elcentro Data Zone - II
Model 3 : G+9 Regular Structure for Corralit Data Zone - II
Model 4 : G+9 Irregular Structure for Corralit Data Zone – II
Model 5 : G+9 Regular Structure for Altadena Data Zone - II
Model 6 : G+9 Irregular Structure for Altadena Data Zone – II
Model 7 : G+19 Regular Structure for Elcentro Data Zone - II
Model 8 : G+19 Irregular Structure for Elcentro Data Zone - II
Model 9 : G+19 Regular Structure for Corralit Data Zone - II
Model 10 : G+19 Irregular Structure for Corralit Data Zone – II
Model 11 : G+19 Regular Structure for Altadena Data Zone - II
Model 12 : G+19 Irregular Structure for Altadena Data Zone – II
Model 13 : G+9 Regular Structure for Elcentro Data Zone - III
Model 14 : G+9 Irregular Structure for Elcentro Data Zone - III
Model 15 : G+9 Regular Structure for Corralit Data Zone - III
Model 16 : G+9 Irregular Structure for Corralit Data Zone – III
Model 17 : G+9 Regular Structure for Altadena Data Zone - III
Model 18 : G+9 Irregular Structure for Altadena Data Zone - III
Model 19 : G+19 Regular Structure for Elcentro Data Zone - III
Model 20 : G+19 Irregular Structure for Elcentro Data Zone - III
Model 21 : G+19 Regular Structure for Corralit Data Zone - III
Model 22 : G+19 Irregular Structure for Corralit Data Zone – III
Model 23 : G+19 Regular Structure for Altadena Data Zone - III
Model 24 : G+19 Irregular Structure for Altadena Data Zone - III
Model 25 : G+9 Regular Structure for Elcentro Data Zone - IV
Model 26 : G+9 Irregular Structure for Elcentro Data Zone - IV
Model 27 : G+9 Regular Structure for Corralit Data Zone - IV
Model 28 : G+9 Irregular Structure for Corralit Data Zone – IV
Model 29 : G+9 Regular Structure for Altadena Data Zone - IV
Model 30 : G+9 Irregular Structure for Altadena Data Zone - IV
Model 31 : G+19 Regular Structure for Elcentro Data Zone - IV
Model 32 : G+19 Irregular Structure for Elcentro Data Zone - IV
Model 33 : G+19 Regular Structure for Corralit Data Zone - IV
Model 34 : G+19 Irregular Structure for Corralit Data Zone – IV
Model 35 : G+19 Regular Structure for Altadena Data Zone - IV
Model 36 : G+19 Irregular Structure for Altadena Data Zone - IV
Model 37 : G+9 Regular Structure for Elcentro Data Zone - V
Model 38 : G+9 Irregular Structure for Elcentro Data Zone - V
Model 39 : G+9 Regular Structure for Corralit Data Zone - V
Model 40 : G+9 Irregular Structure for Corralit Data Zone – V
Model 41 : G+9 Regular Structure for Altadena Data Zone - V
Model 42 : G+9 Irregular Structure for Altadena Data Zone - V
Model 43 : G+19 Regular Structure for Elcentro Data Zone - V
Model 44 : G+19 Irregular Structure for Elcentro Data Zone - V
Model 45 : G+19 Regular Structure for Corralit Data Zone - V
Model 46 : G+19 Irregular Structure for Corralit Data Zone – V

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Model 47 : G+19 Regular Structure for Altadena Data Zone - V
Model 48 : G+19 Irregular Structure for Altadena Data Zone - V

Properties

Grade Of Concrete

Section	Grade of concrete
Column	M30
Beam	M25
Slab	M25

Table 3.1: Table showing Grade of concrete

Other Properties

- Grade of steel = Fe415
- Density of concrete = 25 kN/m^3

Section Properties

Building Type	Beam	Column
G+9 Building	450x300	450x450
G+19 Building	450x700	700x700

Table 3.2: Table showing Section Properties

Design Data:

Storey height : 3m
Slab thickness : 125mm

Live load : 2kN/m^2
Floor Finish : 1kN/m^2
Damping : 5%
External Wall load :
2.7*0.23*18=11.178=12kN (Approx)
Internal Wall load : 6kN

Classification	Station	PGA (g)	PGV (m/s)	PGA/PGV
High	Corralit	0.4395	0.186	2.36
Intermediate	El Centro	0.3484	0.3345	1.04
Low	Altadena	0.01264	0.02	0.6

Table 3.3: Ground motion characteristics of selected earthquakes Frequency content

The relationship between peak ground acceleration expressed as a fraction of gravitational acceleration (g) and peak ground velocity measured in meters per second (m/s) is characterised as the frequency content of the ground motion.

Modelling Of Structure In Etabs:

Step - 1: Establishment of Standard Codes and Country Codes. The prescribed codes for design were duly implemented.

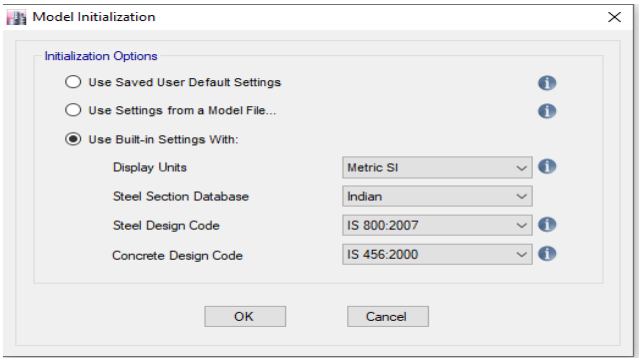


Fig 3.1: "Defining codes"

Step - 2: Establishment of grid points and structural generation; upon launching ETABS we choose a new model prompting a window to emerge where we input the grid and story dimensions of our edifice.

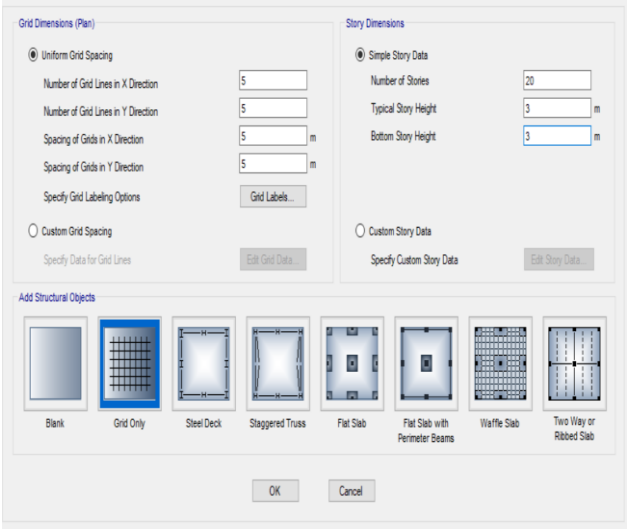


Fig 3.2: "Grid Data"

Step - 3: Defining of property

Initially we established the material property by choosing the define option for material properties. We include new materials for our structural elements (beams columns slabs) by providing the requisite specifications in the definition. Subsequently we establish the section dimensions by choosing frame segments and include the necessary sections for beams columns and so on.

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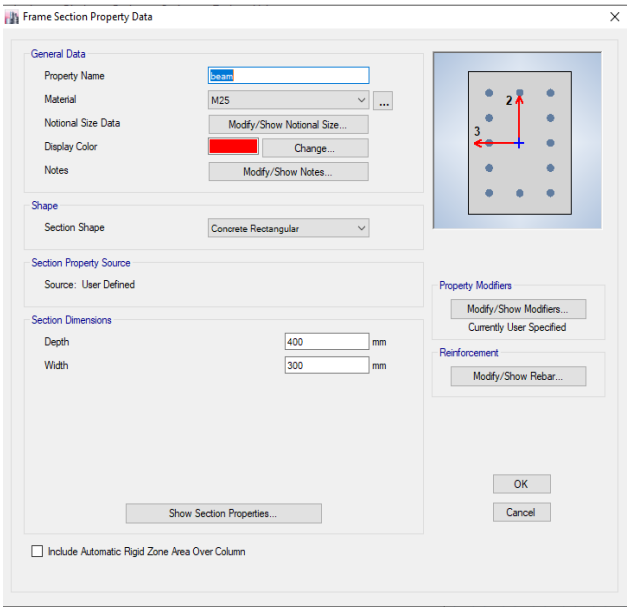


Fig 3.3: "Section properties"

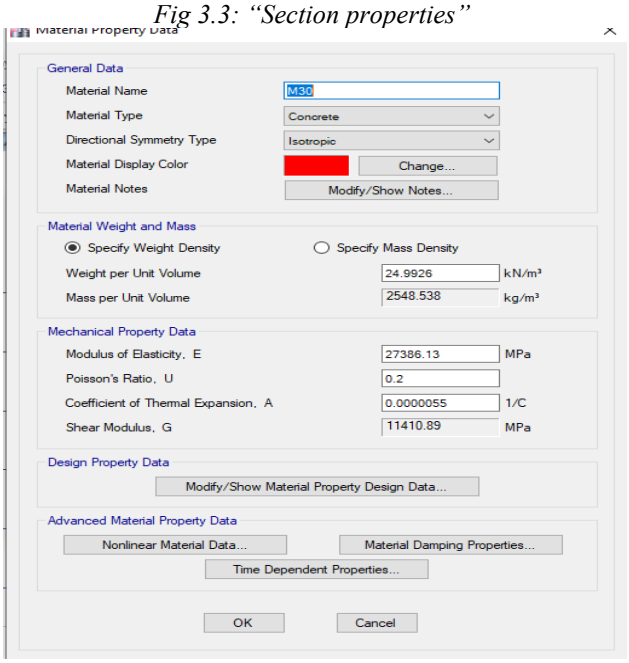


Fig 3.4: "Material property"

Step - 4: Assigning of Property

Upon delineating the property, we use the command menu to illustrate the structural elements. Illustrate a line for beams and establish columns in the designated area for columns so finalising property assignment for both beams and columns.

Step - 5: Assigning of Supports

By maintaining the selection at the foundation of the structure and choosing all the columns we designated supports by navigating to the assign menu joint\frame Restraints (supports) fixed.

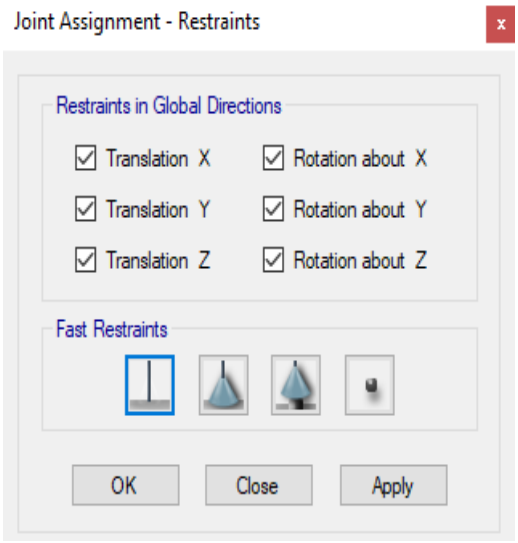


Fig 3.5: "Defining support"

Step - 6: Allocation of Static Loads Subsequent to delineating all the loads. Dead loads for exterior walls and interior walls are automatically managed by the E-Tabs software.

Step - 7: Allocation of live loads Live loads for the roof and floor are designated independently for the whole structure.

Step -8: Seismic loads are designated and allocated according to IS 1893: 2016 by specifying the zone soil classification and response reduction factor in both X and Y axes.

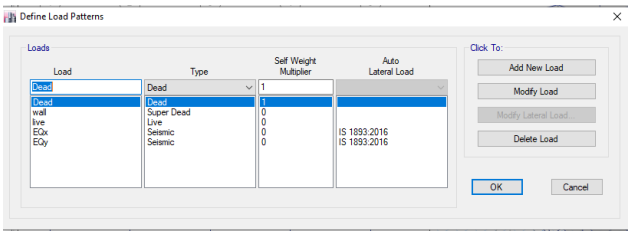


Fig 3.6: "Load patterns data"

Step -9: Defining mass source by giving a multiplication factor of 1 and 0.25 for dead and live loads respectively.

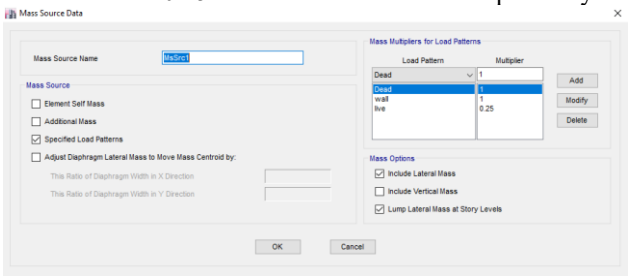


Fig 3.7: "Defining Mass source"

Step -10: Define TIME HISTORY FUNCTION

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- Define > Functions > Time history > select function from file >add new function >browse >locate EL CENTRO data

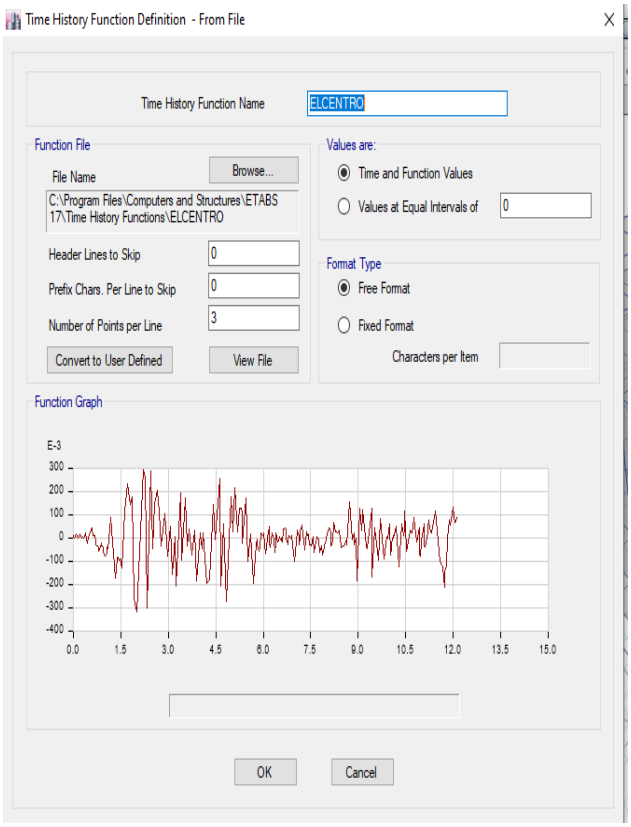


Fig 3.8: "Time History Data"

Step -11: Defining Time history load case

- Define > Load cases > select Time history>nonlinear
- Give scale factor base on the formula $\frac{IG}{R}$

Step -12: Analysing Analysis > Run analysis

Step -13: Click on unlock model

- Go to load case>time history
- Change the scale factor by a multiplication factor i.e. $\frac{Vx}{\overline{Vx}}$

  Where Vx = Base shear obtained by fundamental mode

  $\overline{Vx}$= Base shear obtained by time history data

Step -14: Analysing Analysis > Run analysis.

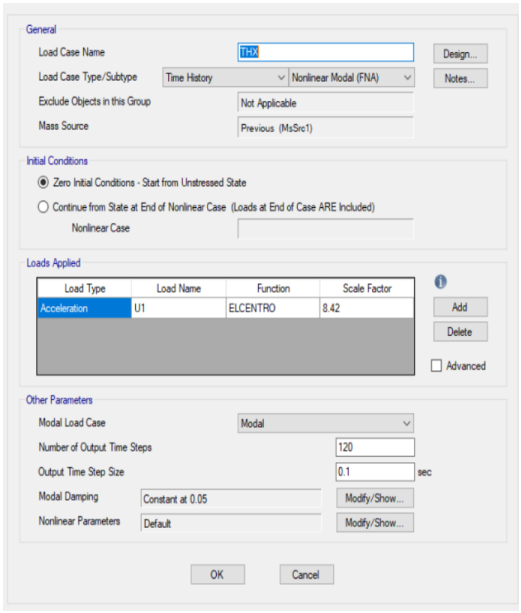


Fig 3.9: "Time history load case data"

Plan And Elevation

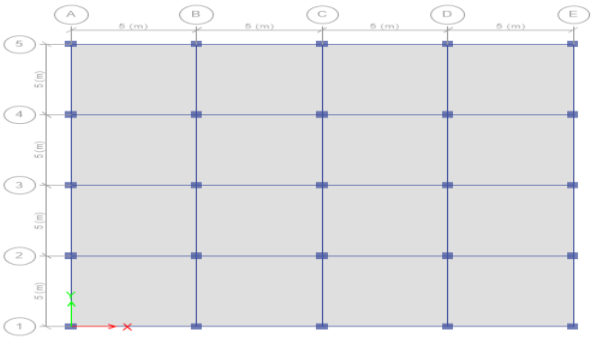


Fig 3.10: "Plan view"

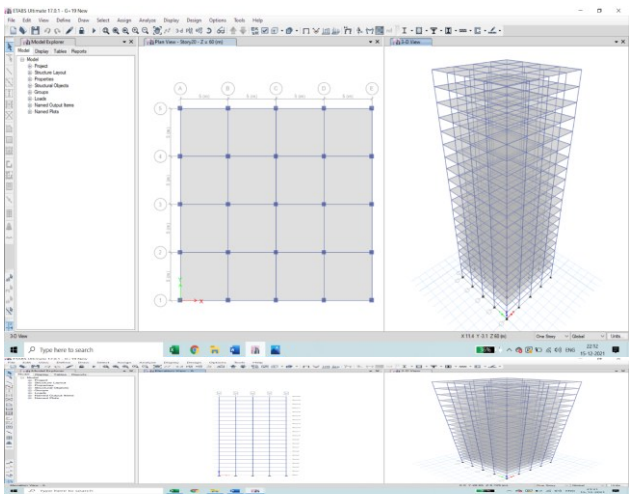


Fig 3.11: "Plan & Elevation of G+19 Regular Building"

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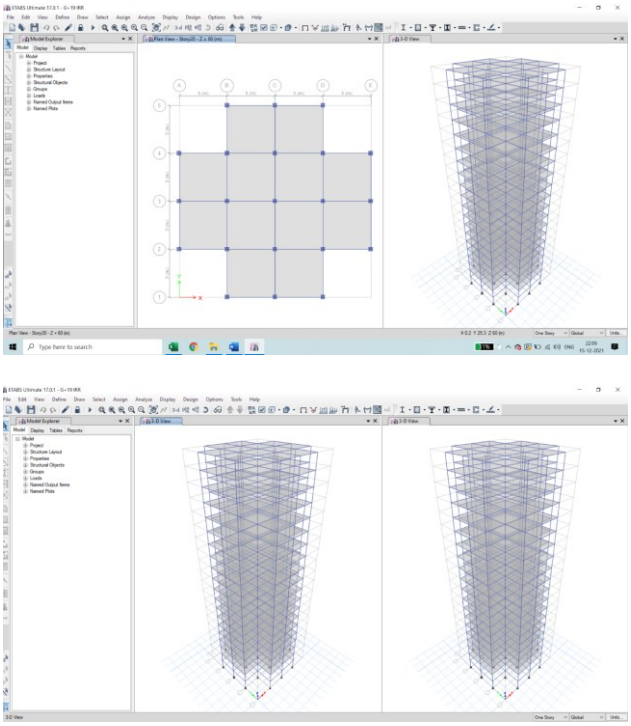


Fig 3.12: "Elevation & 3D view of G+19 Irregular Building"

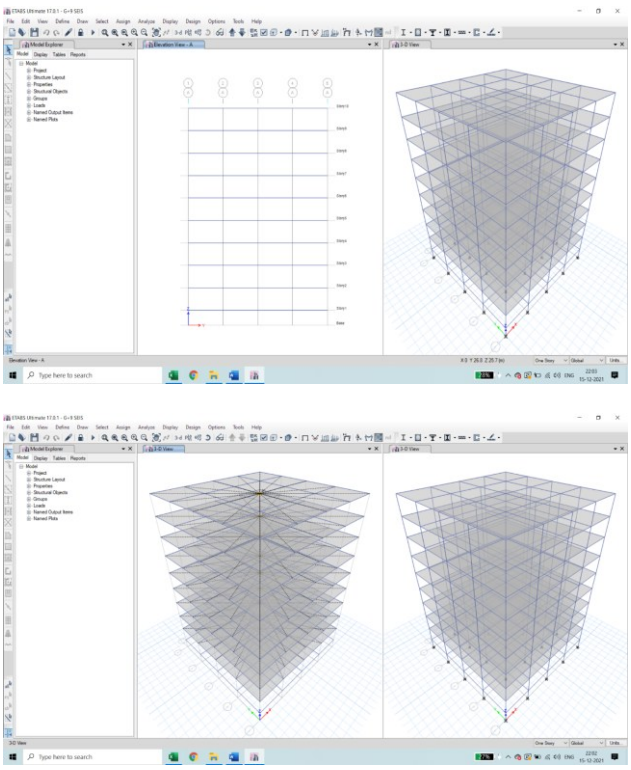


Fig 3.13: "Elevation and 3D view of G+9 Regular Building"

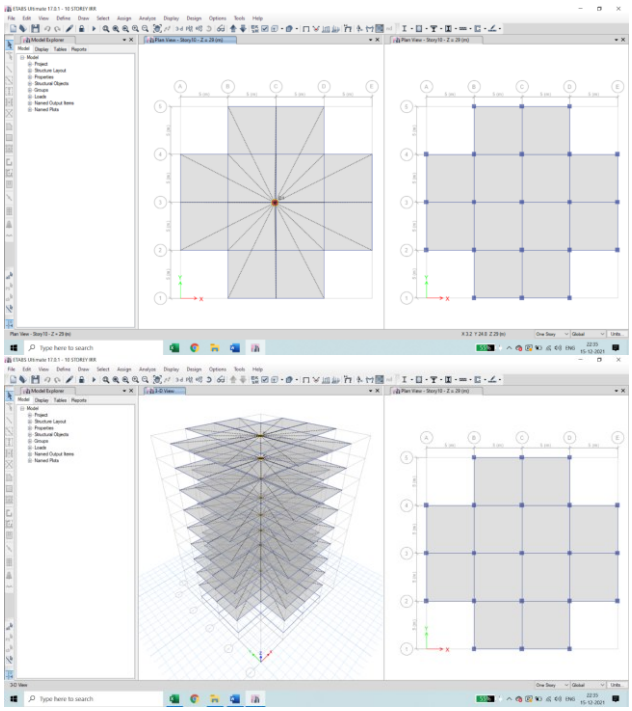


Fig 3.14: "Elevation & 3D view of G+9 Irregular Building"

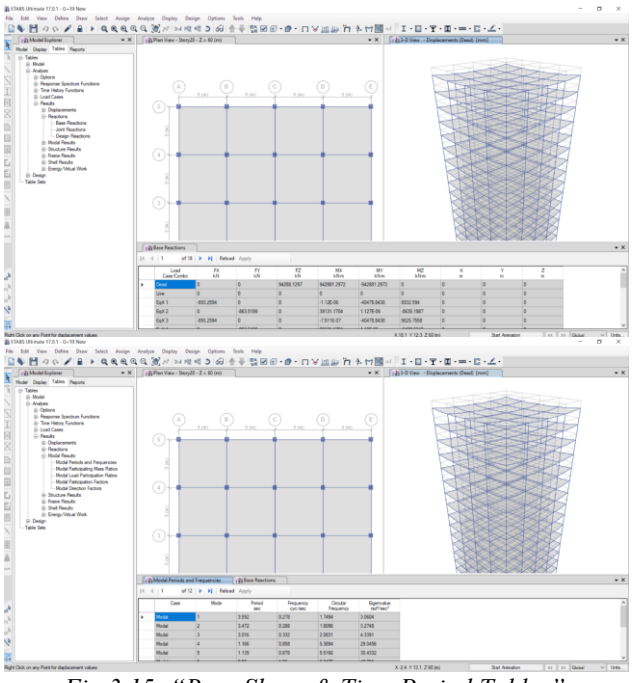


Fig 3.15: "Base Shear & Time Period Tables"

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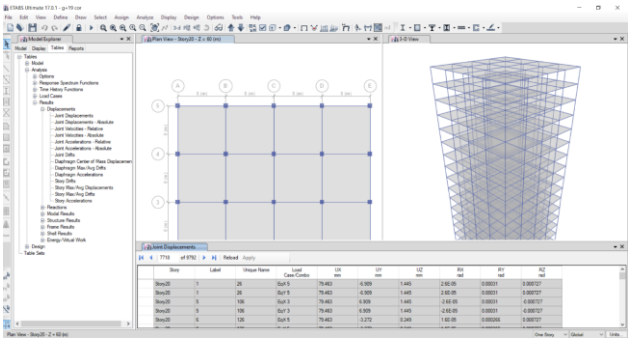


Fig 3.16: "Story Displacement Tables"

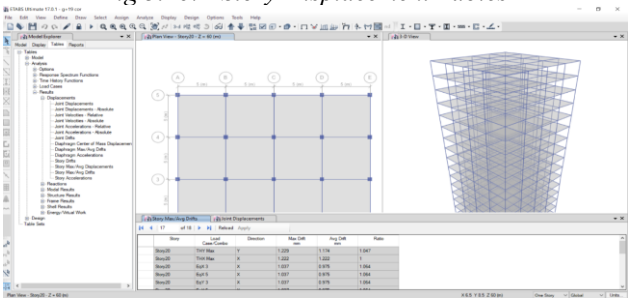


Fig 3.17: "Story Drift Tables"

Summary:
In This Chapter different models required for analysis material properties sectional properties and other properties are discussed. Step by step procedure involved in the analysis is also discussed. The following chapter includes the observations and results derived from the analysis.

V. RESULTS AND DISCUSSION

1. Adopted Method For Analysis:
The Present Work Aims At Assessing The Performance Of Regular And Irregular Buildings. The Method Adopted For Analysis Of The Structure Is Time History Analysis. Analysis Is Carried Out On 32 Different Type Of Models And The Results (Output) Are Presented And Discussed.

Results:
Base Shear:

BASE SHEAR

BUILDING HEIGHT	ZONE 2		ZONE 3		ZONE 4		ZONE 5	
	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULAR
	EL CENTRO	CORRALIT	EL CENTRO	CORRALIT	EL CENTRO	CORRALIT	EL CENTRO	CORRALIT
G+9	403.4048	320.1703	558.4277	464.6163	976.6644	704.1841	1260.966	1099.8825
G+19	535.3119	406.2455	856.4991	649.9927	1284.749	974.9891	1927	1502.6912

Table4.1: "Variation Of Base Shear For G+9 And G+19 Regular And Irregular Building For Different Zones In Kn"

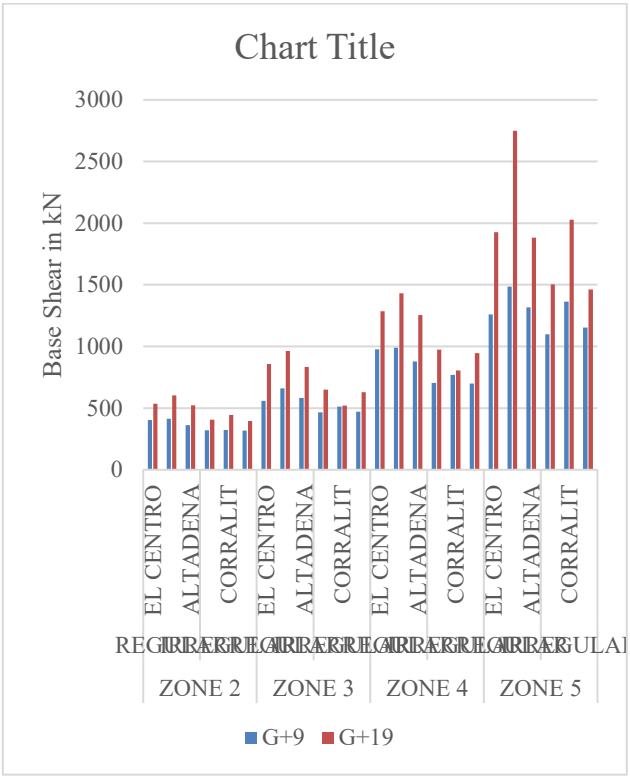


Fig 4.1 "Base Shear For G+9 And G+19 Regular And Irregular Building For Different Zones"

ELCENTRO

BUILDING HEIGHT	ZONE 2		ZONE 3		ZONE 4		ZONE 5	
	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULAR
G+9	403.4048	320.1703	558.4277	464.6163	976.6644	704.1841	1260.966	1099.8825
G+19	535.3119	406.2455	856.4991	649.9927	1284.749	974.9891	1927	1502.6912

Table4.2: "Variation Of Base Shear For El Centro Earthquake For Different Zones In Kn"

ELCENTRO

	ZONE 2	ZONE 3	ZONE 4	ZONE 5
BUILDING HEIGHT	REGULAR	REGULAR	REGULAR	REGULAR
G+9	403.4048	558.4277	976.6644	1260.9658
G+19	535.3119	856.4991	1284.749	1927.0004

Table4.3: "Variation Of Base Shear For Different Zones Of Elcentro For Regular Building In Kn"

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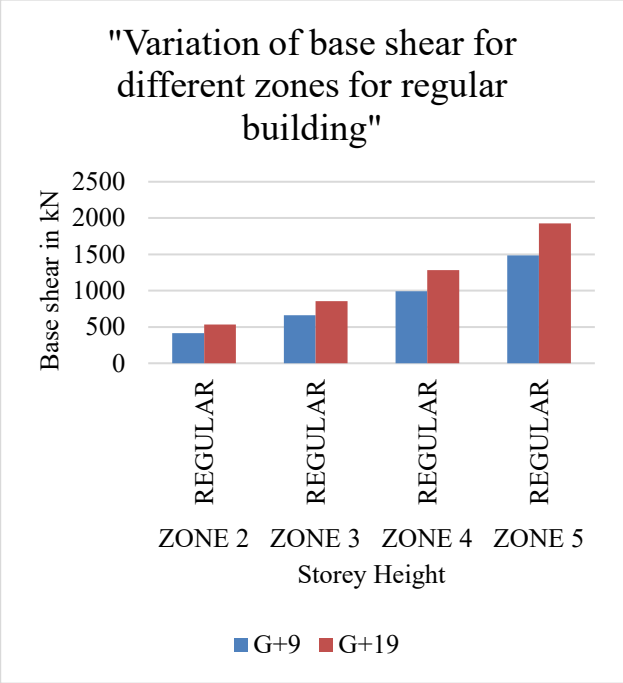


Fig 4.2: "Variation Of Base Shear For Different Zones For Regular Building"

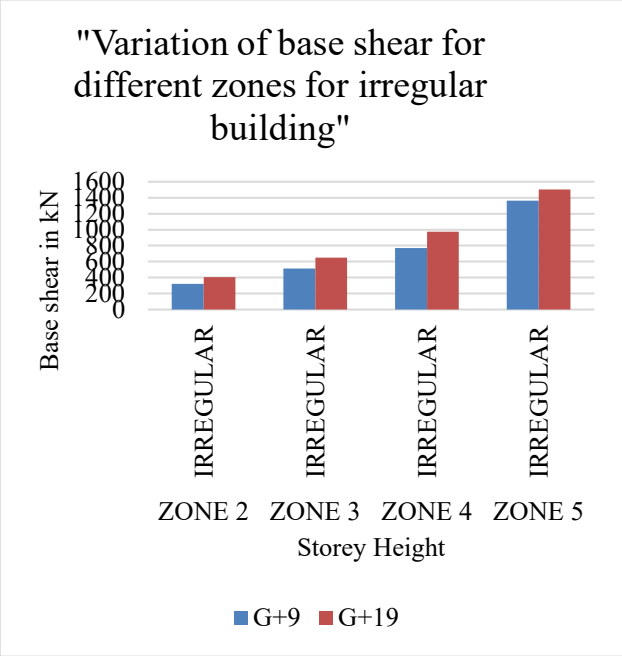


Fig 4.3: "Variation Of Base Shear For Different Zones For Irregular Building"

ELCENTRO				
	ZONE 2	ZONE 3	ZONE 4	ZONE 5
BUILDING HEIGHT	IRREGULA	IRREGULA	IRREGULA	IRREGULA
G+9	320.1703	464.6163	704.1841	1099.8825
G+19	406.2455	649.9927	974.9891	1502.6912

Table4.4: "Variation Of Base Shear For Different Zones Of Elcentro For Irregular Building In Kn"

ZONE 2					
	G+9			G+19	
	EL CENTR	CORRALIT	ALTADENA	EL CENTR	CORRALIT	ALTADENA
REGULAI	403.4048	412.7516	363.0513	535.3119	604.2786	521.5236
IRREGUL	320.1703	322.1084	318.4495	406.2455	445.8561	394.6536

Table4.5: "Variation Of Base Shear For Regular & Irregular Building
(Zone – 2) In Kn"

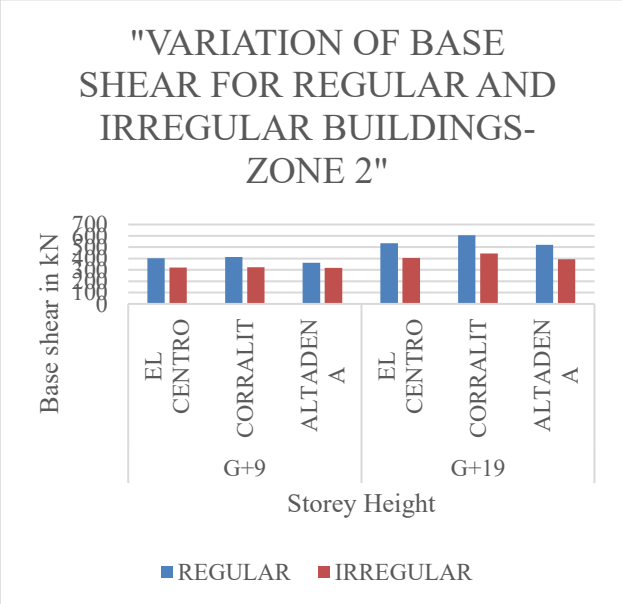


Fig 4.4: "Variation Of Base Shear For Regular & Irregular Building"
(Zone – 2)

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ZONE 3						
	G+9			G+19		
	EL CENTR	CORRALIT	ALTADENA	EL CENTR	CORRALIT	ALTADENA
REGULAI	558.4277	660.4026	581.7073	856.4991	963.5794	835.4036
IRREGUL	512.2724	464.6163	470.0963	649.9927	521.1163	629.7663

Table4.6: "Variation Of Base Shear For Regular & Irregular Buildings
(Zone – 3) In Kn"

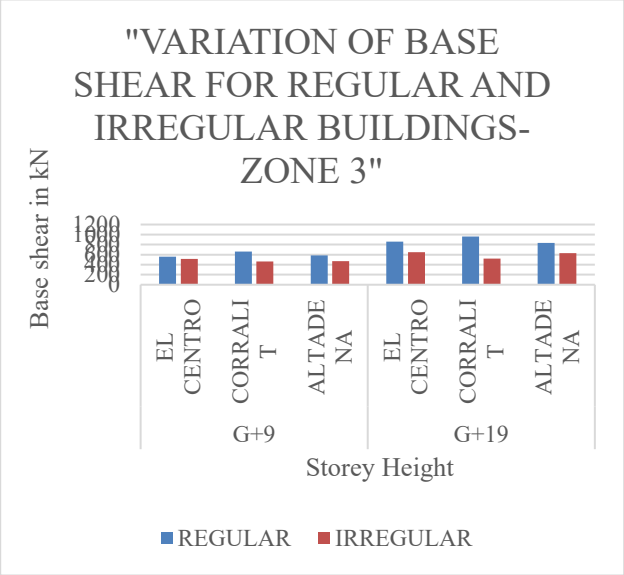


Fig 4.5: "Variation Of Base Shear For Regular & Irregular Buildings"
(Zone – 3)

ZONE 4						
	G+9			G+19		
	EL CENTR	CORRALIT	ALTADENA	EL CENTR	CORRALIT	ALTADENA
REGULAI	976.6644	990.6039	878.7493	1284.7486	1430.6704	1255.5199
IRREGUL	704.1841	768.4087	700.2814	974.9891	806.6322	945.2493

Table4.7: "Variation Of Base Shear For Regular & Irregular Buildings
(Zone – 4) In Kn"



Fige4.6: "Variation Of Base Shear For Regular & Irregular Buildings"
(Zone – 4)

ZONE 5						
	G+9			G+19		
	EL CENTR	CORRALIT	ALTADENA	EL CENTR	CORRALIT	ALTADENA
REGULAI	1260.9658	1485.7453	1316.0611	1927.0004	2750.2842	1883.2798
IRREGUL	1099.8825	1364.3659	1152.613	1502.6912	2029.2479	1462.4837

Table4.8: "Variation Of Base Shear For Regular & Irregular Buildings
(Zone – 5) In Kn"

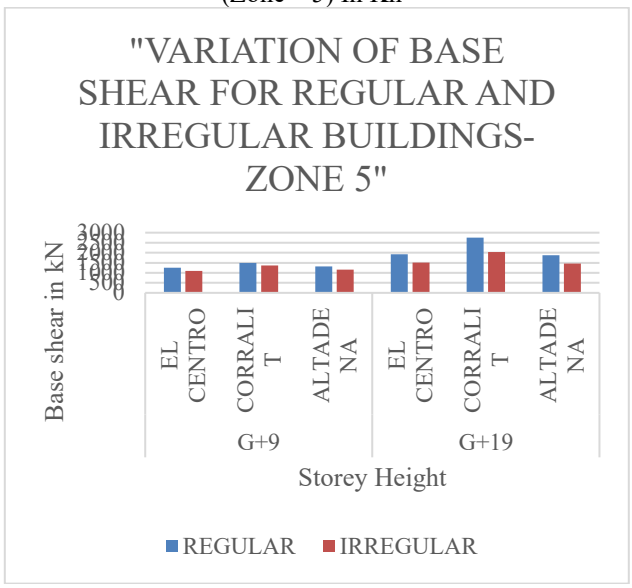


Fig4.7: "Variation Of Base Shear For Regular & Irregular Buildings"
(Zone – 5)

Discussion About Base Shear:

G+9:

- The Data Presented In Table 4.1 Indicates That The Base Shear Decreases By 21% 22% 22% And 10% For Irregular Structures In Comparison To Regular Structures Over Zones 2 3 4 And 5 Respectively.
- According To Table 4.1 The Fundamental Shear Force For The G+19 Structure Has Risen By 20% Relative To The G+9 Structure.
- Structures Exposed To The Corralit Earthquake Had Base Shear Values That Were 1.10% 15% 5% And 21% More In Comparison To The Elcentro Earthquake And 8% 9% 13% And 18% Higher When Juxtaposed With The Altadena Earthquake For Zones 2 3 4 And 5 Respectively.

G+19:

- The Data Presented In Table 4.1 Indicates That The Base Shear Decreases By 24% 24% 24% And 26% For Irregular Structures In Comparison To Regular Structures Over Zones 2 3 4 And 5 Respectively.

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- Buildings Exposed To The Corralit Earthquake Had Base Shear Values That Were 12% 13% 12% And 35% More In Comparison To The Elcentro Earthquake And 16% 15% 14% And 46% Higher When Juxtaposed With The Altadena Earthquake Throughout Zones 2 3 4 And 5 Correspondingly.

Time Period:

BUILDING HEIGHT	REGULAR	IRREGULAR
G+9	1.881	1.857
G+19	5.675	5.616

Table4.9: "Variation Of Time Period In Seconds"

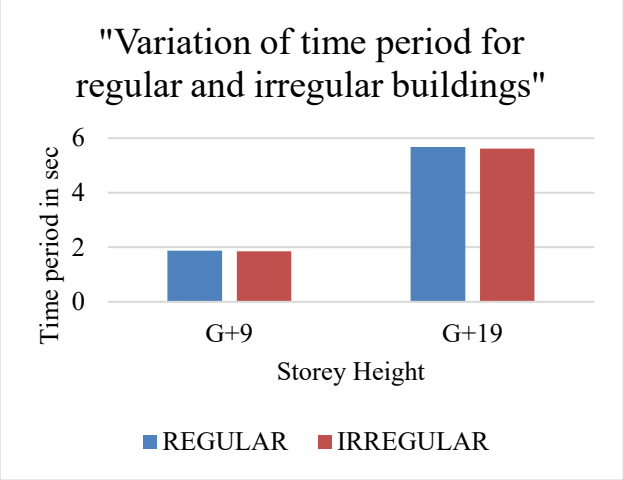


Fig 4.8: "Variation Of Time Period"

Discussion About Time Period:

- It Is Seen From The Table: 4.9 Time Period Is Reduced By 1.21% & 1.03% For Irregular Building When Compared To The Regular Building For G+9 & G+19 Building Respectively.
- From Table 4.9 The Time Period Has Increased By Thrice For G+19 Building When Compared To G+9 Building.

Storey Displacements:

STOREY DISPLACEMENT

BUILDING	ZONE 2		ZONE 3		ZONE 4		ZONE 5	
	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULAR
HEIGHT	EL CENTRO	CORRALITALTADENA	CENTRO	CORRALITALTADENA	CENTRO	CORRALITALTADENA	CENTRO	CORRALITALTADENA
G+9	7.743 6.937 6.654	7.942 7.443 6.985	12.618 11.318 10.661	12.776 11.619 11.253	18.928 16.795 16.106	19.337 17.61 16.782	28.678 25.557 24.121	34.53 25.416 25.222
G+19	20.18 20.145 11.227	20.046 27.086 11.329	45.925 44.877 17.904	44.666 39.541 18.078	68.806 66.622 27.026	66.48 60.094 27.154	104.571 120.091 40.542	103.874 126.918 41.597

Table 4.10: "Maximum Storey Displacement Of G+9 And G+19 Regular And Irregular Building For Different Zones"

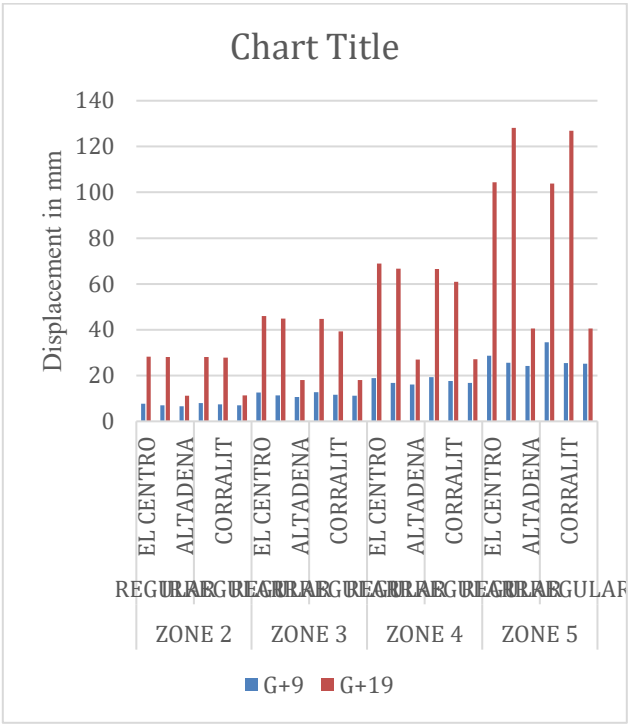


Fig 4.9: "Maximum Storey Displacement Of G+9 And G+19 Regular And Irregular Building For Different Zones"

For G+9:

Table 4.11: "Variation In Storey Displacement For G+9 Regular & Irregular Building For Different Zones In Mm"

EL CENTRO

BUILDING	ZONE 2		ZONE 3		ZONE 4		ZONE 5	
G HEIGHT	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULAR
base	0	0	0	0	0	0	0	0
storey 1	0.703	0.76	1.146	1.223	1.719	1.851	2.604	3.306
storey 2	1.812	1.891	2.952	3.041	4.429	4.603	6.71	8.22
storey 3	2.871	2.942	4.679	4.732	7.018	7.162	10.633	12.789
storey 4	3.79	3.851	6.176	6.195	9.264	9.376	14.036	16.743
storey 5	4.55	4.642	7.415	7.468	11.123	11.303	16.853	20.183
storey 6	5.521	5.607	8.996	9.021	13.495	13.653	20.447	24.38
storey 7	6.355	6.456	10.357	10.386	15.535	15.719	23.538	28.07
storey 8	7.015	7.147	11.431	11.497	17.147	17.401	25.98	31.073
storey 9	7.477	7.646	12.184	12.3	18.277	18.617	27.692	33.244
storey 10	7.743	7.942	12.618	12.776	18.928	19.337	28.678	34.53

Table 4.12: "Variation In Storey Displacement For G+9 Regular & Irregular Building For Different Zones (El Centro) In Mm"

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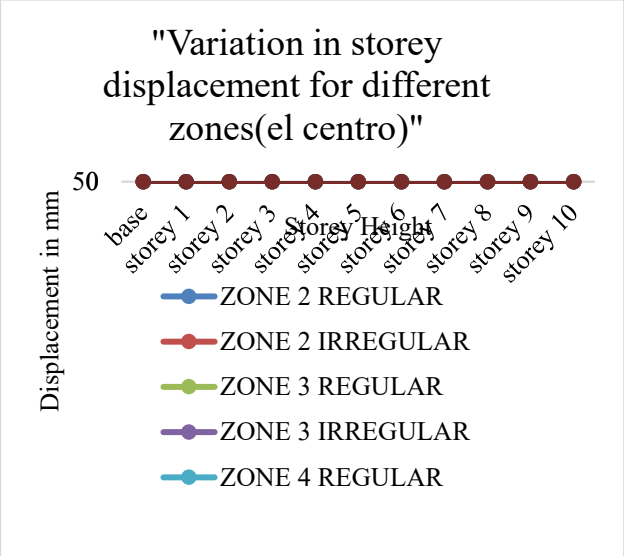


Fig 4.10: "Variation In Storey Displacement For Different Zones (El Centro)"

CORRALIT

BUILDING HEIGHT	ZONE 2		ZONE 3		ZONE 4		ZONE
	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR
base	0	0	0	0	0	0	0
storey 1	0.71	0.811	1.158	1.266	1.718	1.919	2.615
storey 2	1.803	1.976	2.942	3.084	4.366	4.675	6.644
storey 3	2.754	3.007	4.494	4.694	6.668	7.115	10.147
storey 4	3.549	3.911	5.79	6.105	8.591	9.252	13.074
storey 5	4.182	4.665	6.824	7.282	10.125	11.036	15.408
storey 6	4.653	5.007	7.591	7.815	11.264	11.845	17.142
storey 7	5.164	5.547	8.425	8.659	12.502	13.124	19.025
storey 8	5.744	6.111	9.372	9.539	13.907	14.457	21.163
storey 9	6.487	6.939	10.585	10.832	15.706	16.417	23.901
storey 10	6.937	7.443	11.318	11.619	16.795	17.61	25.557

Table 4.13: "Variation In Storey Displacement For G+9 Regular & Irregular Building For Different Zones (Corralit) In Mm"

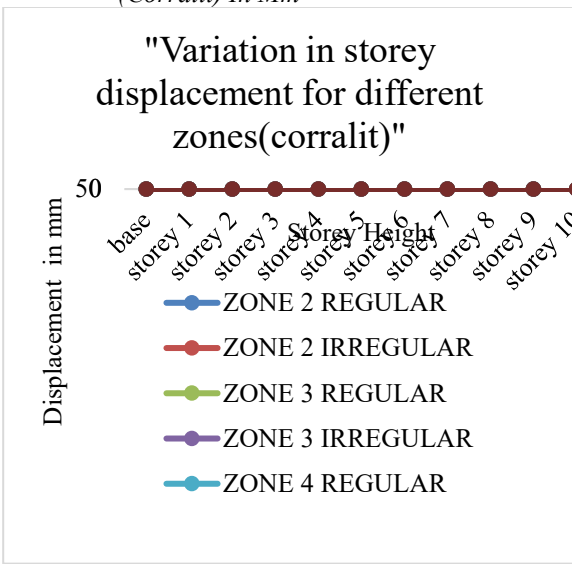


Fig 4.11: "Variation In Storey Displacement For Different Zones (Corralit)"

ALTADENA

BUILDING HEIGHT	ZONE 2		ZONE 3		ZONE 4		ZONE 5	
	REGULAR	RREGULAR	REGULAR	RREGULAR	REGULAR	RREGULAR	REGULAR	RREGULAR
base	0	0	0	0	0	0	0	0
storey 1	0.764	0.74	1.224	1.193	1.849	1.777	2.77	2.674
storey 2	1.67	1.675	2.676	2.698	4.043	4.019	6.055	6.047
storey 3	2.496	2.767	4	4.458	6.042	6.641	9.049	9.991
storey 4	4.216	4.527	6.755	7.294	10.204	10.866	15.282	16.349
storey 5	5.895	6.19	9.445	9.973	14.268	14.857	21.369	22.354
storey 6	7.037	7.279	11.275	11.728	17.033	17.47	25.51	26.286
storey 7	7.365	7.56	11.801	12.18	17.827	18.145	26.699	27.301
storey 8	6.975	7.162	11.175	11.538	16.882	17.188	25.283	25.862
storey 9	6.351	6.608	10.176	10.646	15.372	15.859	23.022	23.862
storey 10	6.654	6.985	10.661	11.253	16.106	16.763	24.121	25.223

Table 4.14: "Variation In Storey Displacement For G+9 Regular & Irregular Building For Different Zones (Altadena) In Mm"

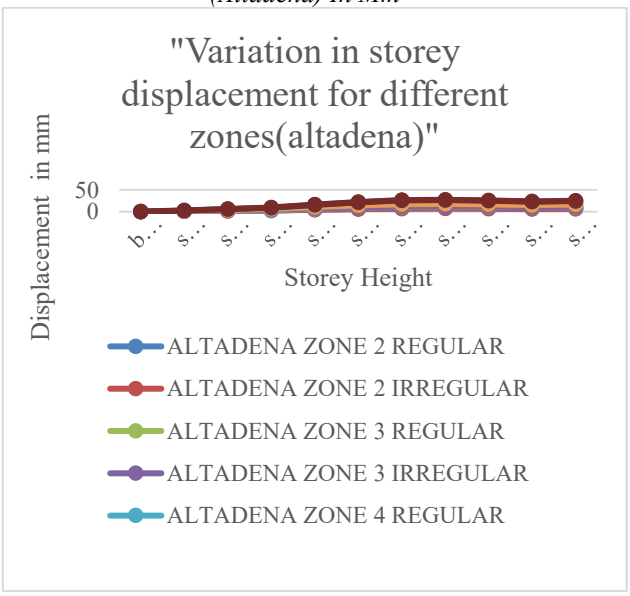


Fig 4.12: "Variation In Storey Displacement For Different Zones (Altadena)"

BUILDING HEIGHT	ZONE 2					
	REGULAR			IRREGULAR		
	L CENTR	CORRALIT	LTADEN	L CENTR	CORRALIT	LTADEN
base	0	0	0	0	0	0
storey 1	0.703	0.71	0.764	0.76	0.811	0.74
storey 2	1.812	1.803	1.67	1.891	1.976	1.675
storey 3	2.871	2.754	2.496	2.942	3.007	2.767
storey 4	3.79	3.549	4.216	3.851	3.911	4.527
storey 5	4.55	4.182	5.895	4.642	4.665	6.19
storey 6	5.521	4.653	7.037	5.607	5.007	7.279
storey 7	6.355	5.164	7.365	6.456	5.547	7.56
storey 8	7.015	5.744	6.975	7.147	6.111	7.162
storey 9	7.477	6.487	6.351	7.646	6.939	6.608
storey 10	7.743	6.937	6.654	7.942	7.443	6.985

Table4.15: "Variation In Storey Displacement For Different Earthquakes
(Zone – 2) In Mm"

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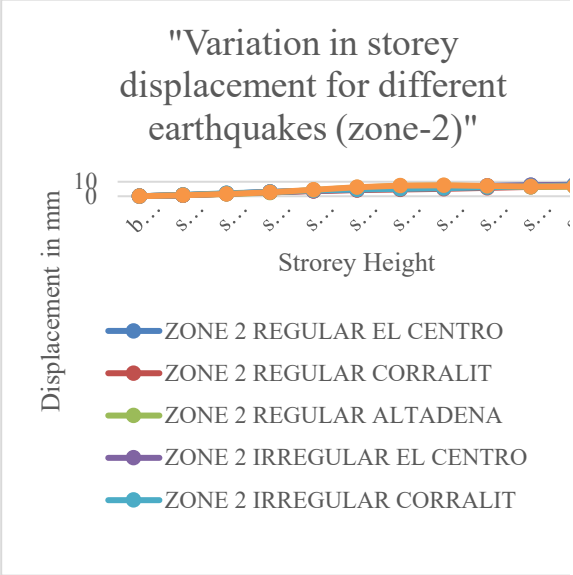


Fig 4.13: "Variation In Storey Displacement For Different Earthquakes (Zone - 2)"

BUILDING HEIGHT	ZONE 3					
	REGULAR			IRREGULAR		
	L CENTR	CORRALIT	LTADEN.	L CENTR	CORRALIT	LT
base	0	0	0	0	0	
storey 1	1.146	1.158	1.224	1.223	1.266	
storey 2	2.952	2.942	2.676	3.041	3.084	
storey 3	4.679	4.494	4	4.732	4.694	
storey 4	6.176	5.79	6.755	6.195	6.105	
storey 5	7.415	6.824	9.445	7.468	7.282	
storey 6	8.996	7.591	11.275	9.021	7.815	
storey 7	10.357	8.425	11.801	10.386	8.659	
storey 8	11.431	9.372	11.175	11.497	9.539	
storey 9	12.184	10.585	10.176	12.3	10.832	
storey 10	12.618	11.318	10.661	12.776	11.619	

Table4.16: "Variation In Storey Displacement For Different Earthquakes (Zone – 3) In Mm"

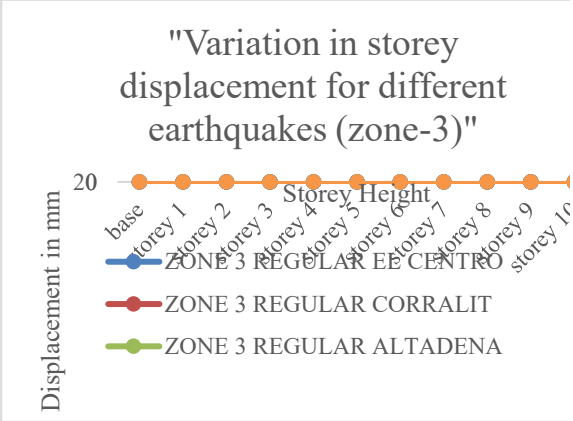


Fig 4.14: "Variation In Storey Displacement For Different Earthquakes (Zone - 3)"

BUILDING HEIGHT	ZONE 4					
	REGULAR			IRREGULAR		
	L CENTR	CORRALIT	LTADEN.	L CENTR	CORRALIT	LTADEN.
base	0	0	0	0	0	0
storey 1	1.146	1.158	1.849	1.223	1.266	1.777
storey 2	2.952	2.942	4.043	3.041	3.084	4.019
storey 3	4.679	4.494	6.042	4.732	4.694	6.641
storey 4	6.176	5.79	10.204	6.195	6.105	10.866
storey 5	7.415	6.824	14.268	7.468	7.282	14.857
storey 6	8.996	7.591	17.033	9.021	7.815	17.47
storey 7	10.357	8.425	17.827	10.386	8.659	18.145
storey 8	11.431	9.372	16.882	11.497	9.539	17.188
storey 9	12.184	10.585	15.372	12.3	10.832	15.859
storey 10	12.618	11.318	16.106	12.776	11.619	16.763

Table4.17: "Variation In Storey Displacement For Different Earthquakes (Zone – 4) In Mm"

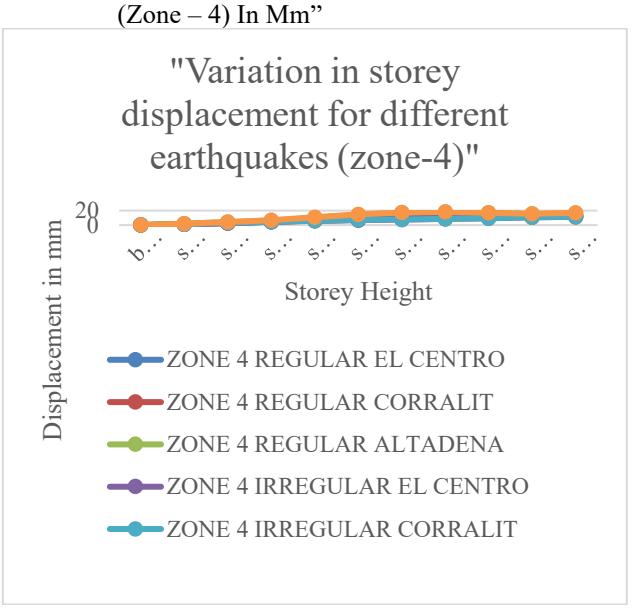


Fig 4.15: "Variation In Storey Displacement For Different Earthquakes (Zone - 4)"

BUILDING HEIGHT	ZONE 5					
	REGULAR			IRREGULAR		
	L CENTR	CORRALIT	LTADEN.	L CENTR	CORRALIT	LTADEN.
base	0	0	0	0	0	0
storey 1	1.146	1.158	2.77	1.223	1.266	2.674
storey 2	2.952	2.942	6.055	3.041	3.084	6.047
storey 3	4.679	4.494	9.049	4.732	4.694	9.991
storey 4	6.176	5.79	15.282	6.195	6.105	16.349
storey 5	7.415	6.824	21.369	7.468	7.282	22.354
storey 6	8.996	7.591	25.51	9.021	7.815	26.286
storey 7	10.357	8.425	26.699	10.386	8.659	27.301
storey 8	11.431	9.372	25.283	11.497	9.539	25.862
storey 9	12.184	10.585	23.022	12.3	10.832	23.862
storey 10	12.618	11.318	24.121	12.776	11.619	25.223

Table4.18: "Variation In Storey Displacement For Different Earthquakes (Zone – 5) In Mm"

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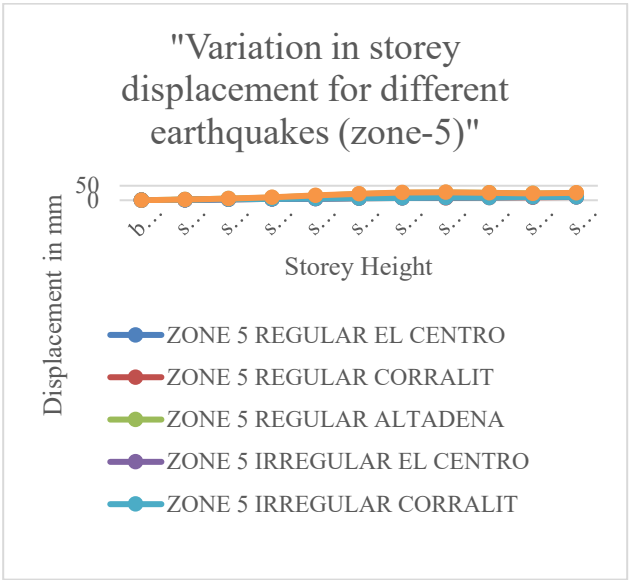


Fig 4.16: "Variation In Storey Displacement For Different Earthquakes (Zone - 5)"

For G+19:

BUILDING	STOREY DISPLACEMENT															
	ZONE 2				ZONE 3				ZONE 4				ZONE 5			
	REGULAR		IRREGULAR		REGULAR		IRREGULAR		REGULAR		IRREGULAR		REGULAR		IRREGULAR	
HEIGHT	EL CENTRO	CORRALIT	EL CENTRO	ALTADENA	EL CENTRO	CORRALIT	EL CENTRO	ALTADENA	EL CENTRO	CORRALIT	EL CENTRO	ALTADENA	EL CENTRO	CORRALIT	EL CENTRO	ALTADENA
base	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
storey 1	4.25	5.83	5.596	4.546	6.455	6.931	6.925	9.667	8.963	7.24	9.107	9.624	10.388	14.353	13.471	10.777
storey 2	7.059	10.02	9.245	7.203	10.333	9.49	11.503	15.977	14.81	11.472	14.579	15.144	17.255	23.722	22.237	17.074
storey 3	8.692	12.416	11.218	8.814	12.972	11.417	14.166	19.798	17.97	14.037	18.301	18.219	21.248	29.396	27.066	20.892
storey 4	9.906	14.874	12.458	10.021	15.3	12.607	16.144	23.718	19.957	15.959	21.586	20.117	24.216	35.215	29.892	23.753
storey 5	10.907	17.148	13.091	10.951	17.381	13.197	17.775	27.344	20.969	17.44	24.522	21.06	26.662	40.598	31.514	25.958
storey 6	11.804	19.094	13.156	11.813	19.107	13.24	19.236	30.447	21.078	18.813	26.957	21.126	28.855	45.206	31.676	28.001
storey 7	12.561	20.553	12.731	12.57	20.357	12.808	20.47	32.773	20.394	20.019	28.719	20.438	30.705	48.66	30.65	29.796
storey 8	13.516	21.406	11.996	13.506	21.045	11.995	22.027	34.134	19.071	21.509	29.691	19.141	33.04	50.681	28.662	32.014
storey 9	14.486	21.612	10.792	14.586	21.154	10.906	23.607	34.463	17.287	23.229	29.845	17.406	35.411	51.169	25.98	34.573
storey 10	15.789	21.221	9.501	15.864	20.742	9.65	25.731	33.839	15.22	25.265	29.262	15.399	38.597	50.242	22.874	37.604
storey 11	17.242	20.367	8.137	17.23	19.933	8.314	28.098	32.477	13.034	27.44	28.122	13.287	42.147	48.22	19.589	40.841
storey 12	18.885	20.451	6.783	18.855	20.223	6.976	30.776	32.61	10.866	30.028	28.53	11.132	46.163	48.418	16.33	44.693
storey 13	20.449	21.488	5.612	20.405	21.166	5.692	33.324	34.264	8.99	32.496	29.861	9.083	49.986	50.874	13.51	48.367
storey 14	21.852	22.495	5.851	21.781	22.116	5.78	35.611	35.87	9.373	34.688	31.201	9.223	53.416	53.258	14.086	51.628
storey 15	23.239	23.426	5.826	23.144	23.043	5.871	37.871	37.355	9.335	36.859	32.51	9.364	56.807	55.462	14.03	54.86
storey 16	24.477	24.243	5.537	24.337	23.912	5.607	39.888	38.658	8.837	38.759	33.736	9.091	59.832	57.398	13.28	57.688
storey 17	25.775	25.196	7.077	25.626	24.936	7.129	42.003	40.177	11.337	40.813	35.179	11.376	63.005	59.653	17.038	60.744
storey 18	26.854	26.499	8.895	26.704	26.231	9.023	43.761	42.255	14.248	42.529	37.007	14.398	65.642	62.738	21.413	63.3
storey 19	27.649	27.492	10.336	27.505	27.225	10.441	45.058	43.839	16.557	43.804	38.409	16.661	67.587	65.09	24.884	65.197
storey 20	28.18	28.143	11.227	28.046	27.886	11.329	45.923	44.877	17.984	44.666	39.341	18.078	68.885	66.632	27.028	66.48

Table 4.19: "Variation In Storey Displacement For G+19 Regular & Irregular Building For Different Zones In Mm"

EL CENTRO								
BUILDING	ZONE 2		ZONE 3		ZONE 4		ZONE 5	
HEIGHT	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULAR
base	0	0	0	0	0	0	0	0
storey 1	4.25	4.546	6.925	7.24	10.388	10.777	15.739	16.838
storey 2	7.059	7.203	11.503	11.472	17.255	17.074	26.144	26.679
storey 3	8.692	8.814	14.166	14.037	21.248	20.892	32.194	32.644
storey 4	9.906	10.021	16.144	15.959	24.216	23.753	36.69	37.114
storey 5	10.907	10.951	17.775	17.44	26.662	25.958	40.397	40.559
storey 6	11.804	11.813	19.236	18.813	28.855	28.001	43.719	43.752
storey 7	12.561	12.57	20.47	20.019	30.705	29.796	46.522	46.556
storey 8	13.516	13.506	22.027	21.509	33.04	32.014	50.061	50.022
storey 9	14.486	14.586	23.607	23.229	35.411	34.573	53.653	54.021
storey 10	15.789	15.864	25.731	25.265	38.597	37.604	58.48	58.756
storey 11	17.242	17.23	28.098	27.44	42.147	40.841	63.86	63.814
storey 12	18.885	18.855	30.776	30.028	46.163	44.693	69.945	69.833
storey 13	20.449	20.405	33.324	32.496	49.986	48.367	75.736	75.573
storey 14	21.852	21.781	35.611	34.688	53.416	51.628	80.933	80.669
storey 15	23.239	23.144	37.871	36.859	56.807	54.86	86.071	85.718
storey 16	24.477	24.337	39.888	38.759	59.832	57.688	90.655	90.137
storey 17	25.775	25.626	42.003	40.813	63.005	60.744	95.462	94.913
storey 18	26.854	26.704	43.761	42.529	65.642	63.3	99.458	98.906
storey 19	27.649	27.505	45.058	43.804	67.587	65.197	102.405	101.87
storey 20	28.18	28.046	45.923	44.666	68.885	66.48	104.371	103.874

Table 4.20: "Variation In Storey Displacement For G+19 Regular & Irregular Building For Different Zones (El Centro) In Mm"

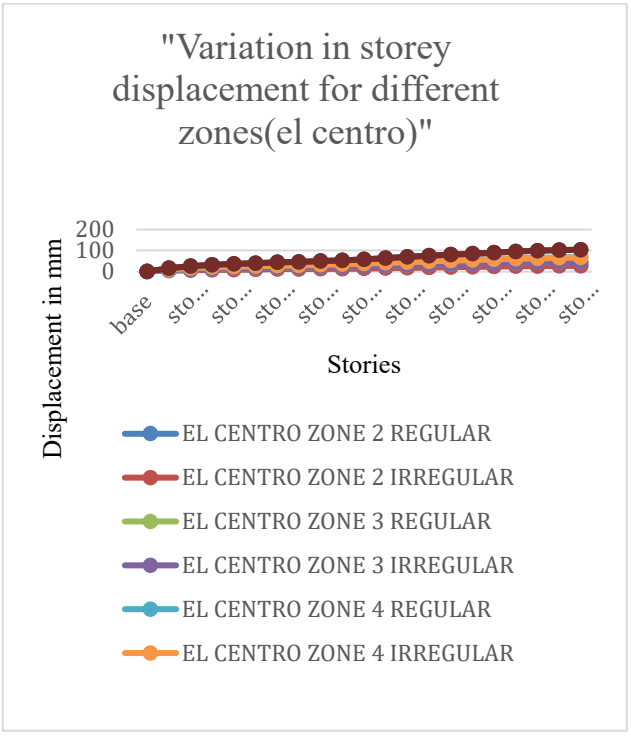


Fig 4.17: "Variation In Storey Displacement For Dt Ifferenzones (El Centro)"

CORRALIT								
BUILDING	ZONE 2		ZONE 3		ZONE 4		ZONE 5	
HEIGHT	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULAR
base	0	0	0	0	0	0	0	0
storey 1	5.83	6.455	9.667	9.107	14.353	14.097	27.591	29.38
storey 2	10.02	10.333	15.977	14.579	23.722	22.566	45.603	47.031
storey 3	12.416	12.972	19.798	18.301	29.396	28.329	56.51	59.041
storey 4	14.874	15.3	23.718	21.586	35.215	33.412	67.696	69.636
storey 5	17.148	17.381	27.344	24.522	40.598	37.957	78.045	79.109
storey 6	19.094	19.107	30.447	26.957	45.206	41.726	86.903	86.965
storey 7	20.553	20.357	32.773	28.719	48.66	44.454	93.543	92.65
storey 8	21.406	21.045	34.134	29.691	50.681	45.958	97.428	95.783
storey 9	21.612	21.154	34.463	29.845	51.169	46.196	98.366	96.28
storey 10	21.221	20.742	33.839	29.262	50.242	45.295	96.584	94.402
storey 11	20.367	19.933	32.477	28.122	48.22	43.53	92.697	90.723
storey 12	20.451	20.223	32.61	28.53	48.418	44.162	93.077	92.04
storey 13	21.488	21.166	34.264	29.861	50.874	46.222	97.799	96.335
storey 14	22.495	22.116	35.87	31.201	53.258	48.296	102.382	100.656
storey 15	23.426	23.043	37.355	32.51	55.462	50.321	106.619	104.877
storey 16	24.243	23.912	38.658	33.736	57.398	52.219	110.34	108.834
storey 17	25.196	24.936	40.177	35.179	59.653	54.454	114.676	113.49
storey 18	26.499	26.231	42.255	37.007	62.738	57.284	120.607	119.388
storey 19	27.492	27.225	43.839	38.409	65.09	59.453	125.128	123.91
storey 20	28.143	27.886	44.877	39.341	66.632	60.896	128.091	126.918

Table 4.21: "Variation In Storey Displacement For G+19 Regular & Irregular Building For Different Zones (Corralit) In Mm"

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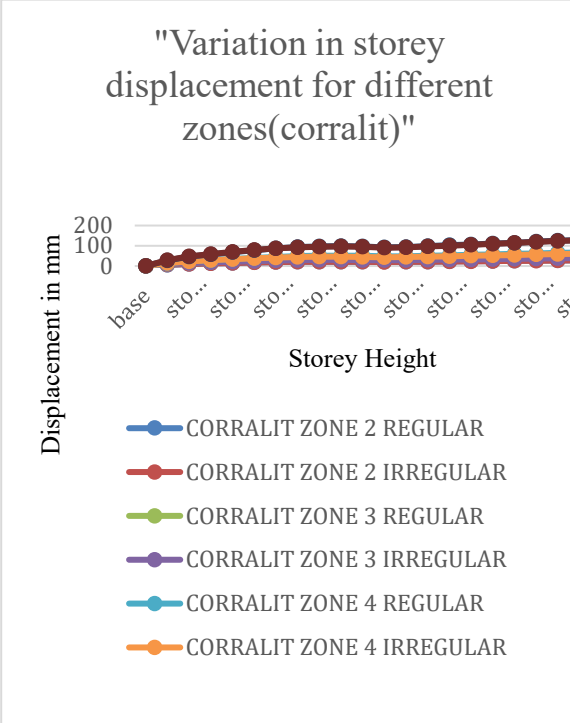


Fig 4.18: "Variation In Storey Displacement For Different Zones (Corralit)"

ALTADENA							
BUILDING HEIGHT	ZONE 2		ZONE 3		ZONE 4		ZONE
	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR
base	0	0	0	0	0	0	0
storey 1	5.596	6.031	8.963	9.624	13.471	14.446	20.206
storey 2	9.245	9.49	14.81	15.144	22.257	22.73	33.386
storey 3	11.218	11.417	17.97	18.219	27.006	27.345	40.51
storey 4	12.458	12.607	19.957	20.117	29.992	30.195	44.989
storey 5	13.091	13.197	20.969	21.06	31.514	31.609	47.271
storey 6	13.158	13.24	21.078	21.128	31.678	31.712	47.517
storey 7	12.731	12.808	20.394	20.438	30.65	30.677	45.975
storey 8	11.906	11.995	19.071	19.141	28.662	28.73	42.993
storey 9	10.792	10.908	17.287	17.406	25.98	26.125	38.97
storey 10	9.501	9.65	15.22	15.399	22.874	23.113	34.311
storey 11	8.137	8.314	13.034	13.267	19.589	19.913	29.384
storey 12	6.783	6.976	10.866	11.132	16.33	16.708	24.495
storey 13	5.612	5.692	8.99	9.083	13.51	13.633	20.265
storey 14	5.851	5.78	9.373	9.223	14.086	13.844	21.13
storey 15	5.828	5.871	9.335	9.368	14.03	14.061	21.045
storey 16	5.517	5.697	8.837	9.091	13.28	13.645	19.921
storey 17	7.077	7.129	11.337	11.376	17.038	17.074	25.558
storey 18	8.895	9.023	14.248	14.398	21.413	21.61	32.12
storey 19	10.336	10.441	16.557	16.661	24.884	25.007	37.326
storey 20	11.227	11.329	17.984	18.078	27.028	27.134	40.542

Table 4.22: "Variation In Storey Displacement For G+19 Regular & Irregular Building For Different Zones (Altadena) In Mm"

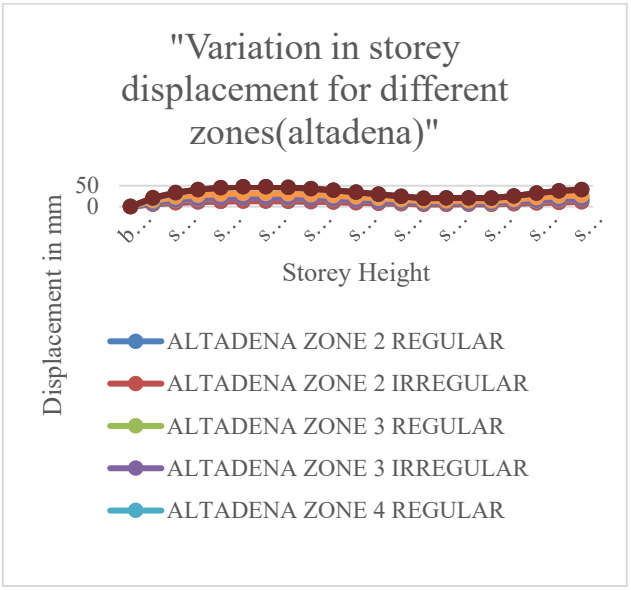


Fig 4.19: "Variation In Storey Displacement For Different Zones (Altadena)"

BUILDING HEIGHT	ZONE 2					
	REGULAR			IRREGULAR		
	L CENTR	CORRALIT	LTADEN	L CENTR	CORRALIT	LTADEN
base	0	0	0	0	0	0
storey 1	4.25	5.83	5.596	4.546	6.455	6.031
storey 2	7.059	10.02	9.245	7.203	10.333	9.49
storey 3	8.692	12.416	11.218	8.814	12.972	11.417
storey 4	9.906	14.874	12.458	10.021	15.3	12.607
storey 5	10.907	17.148	13.091	10.951	17.381	13.197
storey 6	11.804	19.094	13.158	11.813	19.107	13.24
storey 7	12.561	20.553	12.731	12.57	20.357	12.808
storey 8	13.516	21.406	11.906	13.506	21.045	11.995
storey 9	14.486	21.612	10.792	14.586	21.154	10.908
storey 10	15.789	21.221	9.501	15.864	20.742	9.65
storey 11	17.242	20.367	8.137	17.23	19.933	8.314
storey 12	18.885	20.451	6.783	18.855	20.223	6.976
storey 13	20.449	21.488	5.612	20.405	21.166	5.692
storey 14	21.852	22.495	5.851	21.781	22.116	5.78
storey 15	23.239	23.426	5.828	23.144	23.043	5.871
storey 16	24.477	24.243	5.517	24.337	23.912	5.697
storey 17	25.775	25.196	7.077	25.626	24.936	7.129
storey 18	26.854	26.499	8.895	26.704	26.231	9.023
storey 19	27.649	27.492	10.336	27.505	27.225	10.441
storey 20	28.18	28.143	11.227	28.046	27.886	11.329

Table4.23: "Variation In Storey Displacement For Different Earthquakes (Zone – 2)"

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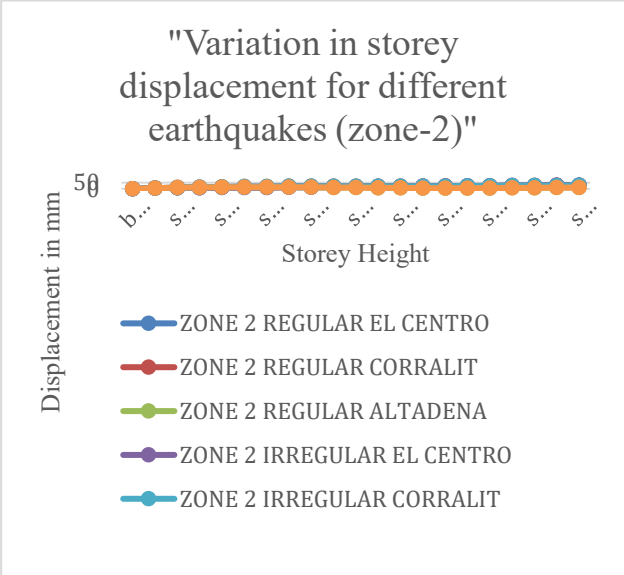


Fig 4.20: "Variation In Storey Displacement For Different Earthquakes (Zone - 2)"

BUILDING HEIGHT	ZONE 3					
	REGULAR			IRREGULAR		
	L CENTR	CORRALIT	LTADEN	L CENTR	CORRALIT	LTADEN
base	0	0	0	0	0	0
storey 1	6.925	9.667	8.963	7.24	9.107	9.624
storey 2	11.503	15.977	14.81	11.472	14.579	15.144
storey 3	14.166	19.798	17.97	14.037	18.301	18.219
storey 4	16.144	23.718	19.957	15.959	21.586	20.117
storey 5	17.775	27.344	20.969	17.44	24.522	21.06
storey 6	19.236	30.447	21.078	18.813	26.957	21.128
storey 7	20.47	32.773	20.394	20.019	28.719	20.438
storey 8	22.027	34.134	19.071	21.509	29.691	19.141
storey 9	23.607	34.463	17.287	23.229	29.845	17.406
storey 10	25.731	33.839	15.22	25.265	29.262	15.399
storey 11	28.098	32.477	13.034	27.44	28.122	13.267
storey 12	30.776	32.61	10.866	30.028	28.53	11.132
storey 13	33.324	34.264	8.99	32.496	29.861	9.083
storey 14	35.611	35.87	9.373	34.688	31.201	9.223
storey 15	37.871	37.355	9.335	36.859	32.51	9.368
storey 16	39.888	38.658	8.837	38.759	33.736	9.091
storey 17	42.003	40.177	11.337	40.813	35.179	11.376
storey 18	43.761	42.255	14.248	42.529	37.007	14.398
storey 19	45.058	43.839	16.557	43.804	38.409	16.661
storey 20	45.923	44.877	17.984	44.666	39.341	18.078

Table4.24: "Variation In Storey Displacement For Different Earthquakes
(Zone – 3)"

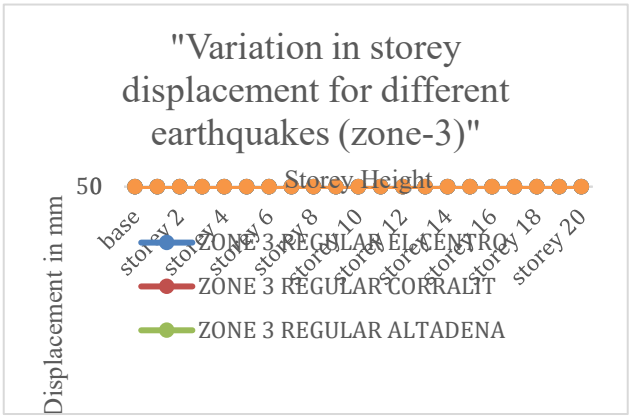


Fig 4.21: "Variation In Storey Displacement For Different Earthquakes (Zone - 3)"

Table4.25: "Variation In Storey Displacement For Different Earthquakes
(Zone – 4)"

BUILDING HEIGHT	ZONE 4					
	REGULAR			IRREGULAR		
	L CENTR	CORRALIT	LTADEN	L CENTR	CORRALIT	LTADEN
base	0	0	0	0	0	0
storey 1	10.388	14.353	13.471	10.777	14.097	14.446
storey 2	17.255	23.722	22.257	17.074	22.566	22.73
storey 3	21.248	29.396	27.006	20.892	28.329	27.345
storey 4	24.216	35.215	29.992	23.753	33.412	30.195
storey 5	26.662	40.598	31.514	25.958	37.957	31.609
storey 6	28.855	45.206	31.678	28.001	41.726	31.712
storey 7	30.705	48.66	30.65	29.796	44.454	30.677
storey 8	33.04	50.681	28.662	32.014	45.958	28.73
storey 9	35.411	51.169	25.98	34.573	46.196	26.125
storey 10	38.597	50.242	22.874	37.604	45.295	23.113
storey 11	42.147	48.22	19.589	40.841	43.53	19.913
storey 12	46.163	48.418	16.33	44.693	44.162	16.708
storey 13	49.986	50.874	13.51	48.367	46.222	13.633
storey 14	53.416	53.258	14.086	51.628	48.296	13.844
storey 15	56.807	55.462	14.03	54.86	50.321	14.061
storey 16	59.832	57.398	13.28	57.688	52.219	13.645
storey 17	63.005	59.653	17.038	60.744	54.454	17.074
storey 18	65.642	62.738	21.413	63.3	57.284	21.61
storey 19	67.587	65.09	24.884	65.197	59.453	25.007
storey 20	68.885	66.632	27.028	66.48	60.896	27.134

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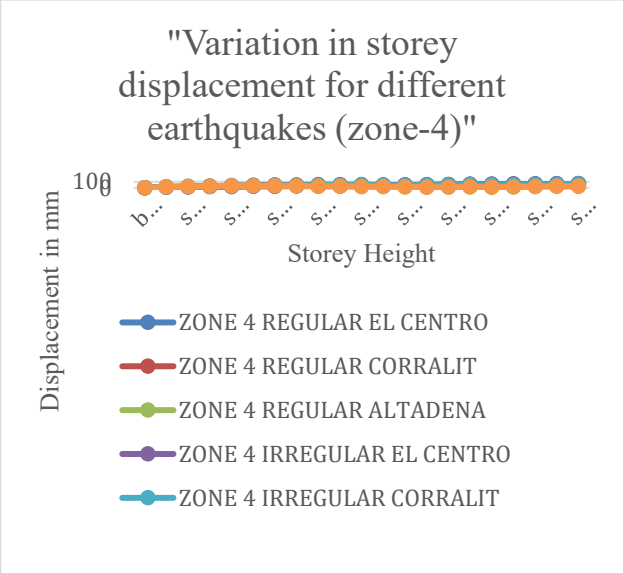


Fig 4.22: "Variation In Storey Displacement For Different Earthquakes (Zone - 4)"

Table4.26: "Variation In Storey Displacement For Different Earthquakes
(Zone – 5)"

BUILDING HEIGHT	ZONE 5					
	REGULAR			IRREGULAR		
	L CENTR	CORRALIT	LTADEN	L CENTR	CORRALIT	LTADEN
base	0	0	0	0	0	0
storey 1	15.739	27.591	20.206	16.838	29.38	21.613
storey 2	26.144	45.603	33.386	26.679	47.031	34.009
storey 3	32.194	56.51	40.51	32.644	59.041	40.914
storey 4	36.69	67.696	44.989	37.114	69.636	45.178
storey 5	40.397	78.045	47.271	40.559	79.109	47.294
storey 6	43.719	86.903	47.517	43.752	86.965	47.448
storey 7	46.522	93.543	45.975	46.556	92.65	45.898
storey 8	50.061	97.428	42.993	50.022	95.783	42.985
storey 9	53.653	98.366	38.97	54.021	96.28	39.089
storey 10	58.48	96.584	34.311	58.756	94.402	34.581
storey 11	63.86	92.697	29.384	63.814	90.723	29.794
storey 12	69.945	93.077	24.495	69.833	92.04	24.999
storey 13	75.736	97.799	20.265	75.573	96.335	20.398
storey 14	80.933	102.382	21.13	80.669	100.656	20.713
storey 15	86.071	106.619	21.045	85.718	104.877	21.038
storey 16	90.655	110.34	19.921	90.137	108.834	20.415
storey 17	95.462	114.676	25.558	94.913	113.49	25.547
storey 18	99.458	120.607	32.12	98.906	119.388	32.333
storey 19	102.405	125.128	37.326	101.87	123.91	37.416
storey 20	104.371	128.091	40.542	103.874	126.918	40.597

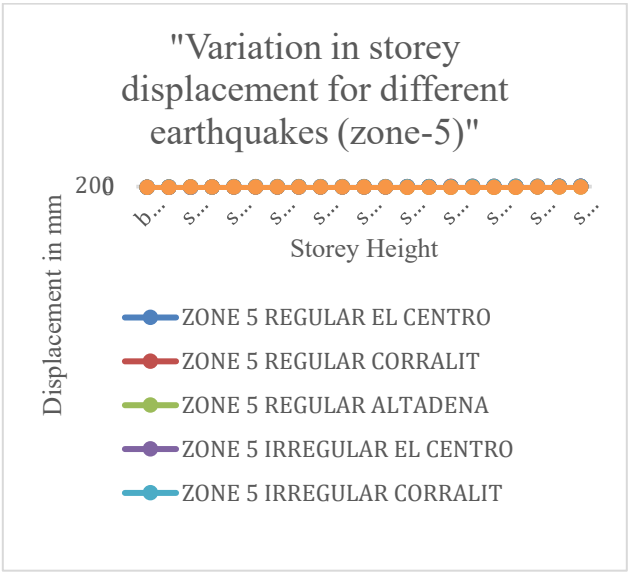


Fig 4.23: "Variation In Storey Displacement For Different Earthquakes (Zone - 5)"

Discussion About Storey Displacement:

Storey Displacements Are Found Smaller At The Base And Bottom Floors And Have Increased As It Goes Towards The Top. The Same Pattern Is Seen For All The Models For All Zones

G+9:

- It Is Seen From The Table: 4.10 Storey Displacements Have Increased By An Average Of 8%6.7%7.6% And 26% For Irregular Building When Compared To The Regular Building For Zone2 Zone3 Zone4 & Zone 5 Respectively.
- Buildings Subjected To Elcentro Earthquake Have Shown Higher Storey Displacements Of About 13%11%10%&12% When Compared To Corralit Earthquake And 15%19%17%& 37% Higher Values When Compared To Altadena Earthquake For Zone2 Zone3 Zone4 & Zone 5 Respectively.

G+19:

- It Is Seen From The Table: 4.17 Storey Displacements Have Increased By An Average Of 6.9%4.5%3.7% And 7% For Irregular Building When Compared To The Regular Building For Zone2 Zone3 Zone4 & Zone 5 Respectively.
- Buildings Subjected To Elcentro Earthquake Have Shown Higher Storey Displacements Of About 4%3%4%23% When Compared To Corralit Earthquake And 148% 150% 152%& 160% Higher Values When Compared To Altadena Earthquake For Zone2 Zone3 Zone4 & Zone 5 Respectively.

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Storey Drifts:

STOREY DRIFT																				
BUILDING	ZONE 2						ZONE 3						ZONE 4						ZONE 5					
	REGULAR			IRREGULAR			REGULAR			IRREGULAR			REGULAR			IRREGULAR			REGULAR			IRREGULAR		
HEIGHT	EL CENTRO	CORRALIT	ALTADENA	EL CENTRO	CORRALIT	ALTADENA	EL CENTRO	CORRALIT	ALTADENA	EL CENTRO	CORRALIT	ALTADENA	EL CENTRO	CORRALIT	ALTADENA	EL CENTRO	CORRALIT	ALTADENA	EL CENTRO	CORRALIT	ALTADENA	EL CENTRO	CORRALIT	ALTADENA
G+9	0.458	0.668	0.772	0.453	0.754	0.769	0.732	1.089	1.208	0.725	1.177	1.246	1.099	1.616	1.824	1.088	1.785	1.847	1.648	2.46	2.732	1.904	2.574	2.778
G+19	0.72	1.452	0.891	0.707	1.376	0.888	1.175	2.224	1.456	1.126	1.941	1.457	1.76	3.591	2.144	1.676	3.082	2.126	2.666	6.518	3.216	2.619	6.825	3.101

Table 4.27: "Maximum Storey Drift Of G+9 And G+19 Regular And Irregular Building For Different Zones"

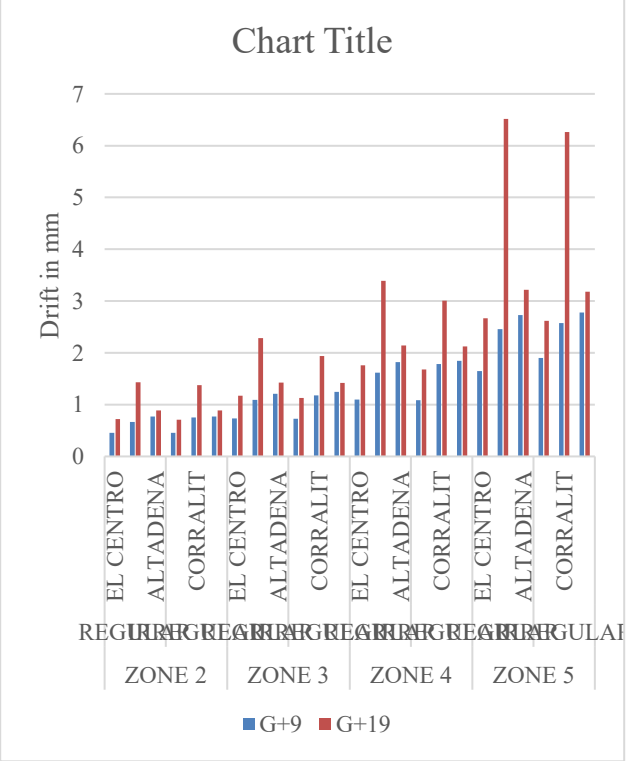


Fig 4.24: "Maximum Storey Drift Of G+9 And G+19 Regular And Irregular Building For Different Zones"

For G+9:

STOREY DRIFT																				
BUILDING	ZONE 2						ZONE 3						ZONE 4						ZONE 5					
	REGULAR			IRREGULAR			REGULAR			IRREGULAR			REGULAR			IRREGULAR			REGULAR			IRREGULAR		
HEIGHT	EL CENTRO	CORRALIT	ALTADENA	EL CENTRO	CORRALIT	ALTADENA	EL CENTRO	CORRALIT	ALTADENA	EL CENTRO	CORRALIT	ALTADENA	EL CENTRO	CORRALIT	ALTADENA	EL CENTRO	CORRALIT	ALTADENA	EL CENTRO	CORRALIT	ALTADENA	EL CENTRO	CORRALIT	ALTADENA
base	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
storey 1	1.241	1.241	1.241	1.349	1.312	0.74	2.012	1.986	1.224	2.17	2.1	2.1	3.018	2.979	1.849	3.285	3.15	1.777	4.572	4.468	2.77	5.865	4.725	2.674
storey 2	1.582	1.582	1.582	1.588	1.588	1.027	2.531	2.531	1.618	2.54	2.54	2.54	3.796	3.796	2.444	3.81	3.81	2.464	5.694	5.694	3.66	6.522	5.715	3.707
storey 3	1.521	1.521	1.521	1.488	1.488	1.421	2.434	2.434	2.141	2.381	2.381	2.381	3.651	3.651	3.254	3.572	3.572	3.409	5.476	5.476	4.844	5.358	5.358	5.13
storey 4	1.502	1.502	1.722	1.463	1.463	1.763	2.404	2.404	2.759	2.34	2.34	2.84	3.606	3.606	4.168	3.51	3.51	4.231	5.408	5.408	6.241	5.266	5.266	6.366
storey 5	1.448	1.448	1.679	1.41	1.41	1.663	2.317	2.317	2.691	2.256	2.256	2.679	3.475	3.475	4.065	3.385	3.385	3.991	5.213	5.213	6.087	5.231	5.077	6.005
storey 6	1.354	1.354	1.354	1.319	1.319	1.089	2.166	2.166	1.83	2.111	2.111	2.111	3.25	3.25	2.765	3.167	3.167	2.613	4.874	4.874	4.141	5.044	4.75	3.932
storey 7	1.212	1.212	1.212	1.182	1.2	1.105	1.939	1.939	1.745	1.891	1.891	1.891	2.908	2.908	2.655	2.836	2.839	2.653	4.362	4.362	3.947	4.72	4.254	3.992
storey 8	1.014	1.16	1.41	0.99	1.264	1.36	1.622	1.892	2.217	1.583	1.973	2.244	2.433	2.807	3.349	2.375	2.99	3.264	3.649	4.272	5.016	4.04	4.316	4.911
storey 9	0.755	1.04	1.248	0.739	1.149	1.191	1.208	1.697	1.956	1.183	1.793	1.987	1.812	2.518	2.955	1.775	2.718	2.858	2.718	3.832	4.426	3.153	3.923	4.3
storey 10	0.458	0.668	0.772	0.453	0.754	0.769	0.732	1.089	1.208	0.725	1.177	1.246	1.099	1.616	1.824	1.088	1.785	1.847	1.648	2.46	2.732	1.904	2.574	2.778

Table 4.28: "Variation In Storey Drift For G+9 Regular & Irregular Building For Different Zones In Mm"

EL CENTRO								
BUILDING HEIGHT	ZONE 2		ZONE 3		ZONE 4		ZONE 5	
	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULAR
base	0	0	0	0	0	0	0	0
storey 1	1.241	1.349	2.012	2.17	3.018	3.285	4.572	5.865
storey 2	1.582	1.588	2.531	2.54	3.796	3.81	5.694	6.522
storey 3	1.521	1.488	2.434	2.381	3.651	3.572	5.476	5.358
storey 4	1.502	1.463	2.404	2.34	3.606	3.51	5.408	5.266
storey 5	1.448	1.41	2.317	2.256	3.475	3.385	5.213	5.231
storey 6	1.354	1.319	2.166	2.111	3.25	3.167	4.874	5.044
storey 7	1.212	1.182	1.939	1.891	2.908	2.836	4.362	4.72
storey 8	1.014	0.99	1.622	1.583	2.433	2.375	3.649	4.04
storey 9	0.755	0.739	1.208	1.183	1.812	1.775	2.718	3.153
storey 10	0.458	0.453	0.732	0.725	1.099	1.088	1.648	1.904

Table 4.29: "Variation In Storey Drift For G+9 Regular & Irregular Building For Different Zones (El Centro) In Mm"

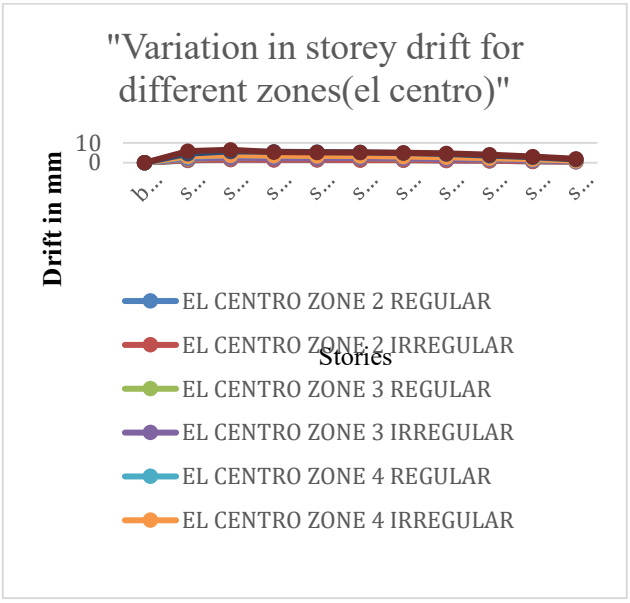


Fig 4.25: "Variation In Storey Drifts For Different Zones (El Centro)"

CORRALIT								
BUILDING HEIGHT	ZONE 2		ZONE 3		ZONE 4		ZONE 5	
	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULAR
base	0	0	0	0	0	0	0	0
storey 1	1.241	1.312	1.986	2.1	2.979	3.15	4.468	4.725
storey 2	1.582	1.588	2.531	2.54	3.796	3.81	5.694	5.715
storey 3	1.521	1.488	2.434	2.381	3.651	3.572	5.476	5.358
storey 4	1.502	1.463	2.404	2.34	3.606	3.51	5.408	5.266
storey 5	1.448	1.41	2.317	2.256	3.475	3.385	5.213	5.077
storey 6	1.354	1.319	2.166	2.111	3.25	3.167	4.874	4.75
storey 7	1.212	1.2	1.939	1.891	2.908	2.839	4.362	4.254
storey 8	1.16	1.264	1.892	1.973	2.807	2.99	4.272	4.316
storey 9	1.04	1.149	1.697	1.793	2.518	2.718	3.832	3.923
storey 10	0.668	0.754	1.089	1.177	1.616	1.783	2.46	2.574

Table 4.30: "Variation In Storey Drift For G+9 Regular & Irregular Building For Different Zones (Corralit) In Mm"

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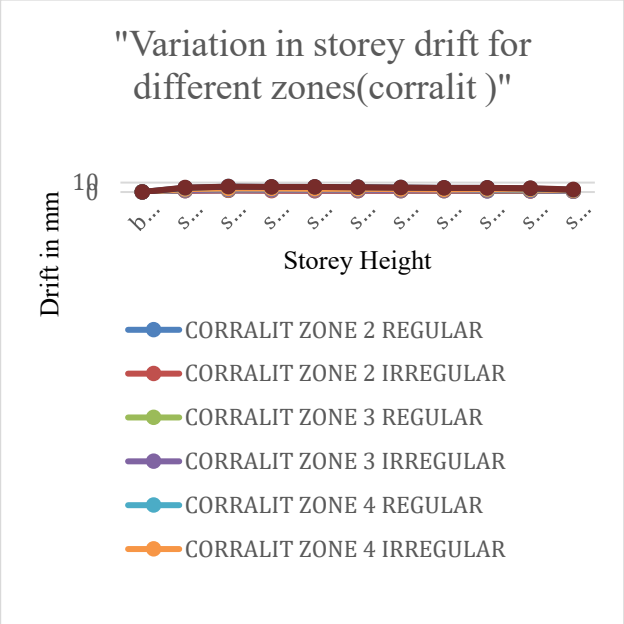


Fig 4.26: "Variation In Storey Drift For Different Zones (Corralit)"

ALTADENA								
BUILDING HEIGHT	ZONE 2		ZONE 3		ZONE 4		ZONE 5	
	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULA
base	0	0	0	0	0	0	0	0
storey 1	1.241	0.74	1.224	2.1	1.849	1.777	2.77	2.674
storey 2	1.582	1.027	1.618	2.54	2.444	2.464	3.66	3.707
storey 3	1.521	1.421	2.141	2.381	3.234	3.409	4.844	5.13
storey 4	1.722	1.763	2.759	2.84	4.168	4.231	6.241	6.366
storey 5	1.679	1.663	2.691	2.679	4.065	3.991	6.087	6.005
storey 6	1.354	1.089	1.83	2.111	2.765	2.613	4.141	3.932
storey 7	1.212	1.105	1.745	1.891	2.635	2.653	3.947	3.992
storey 8	1.41	1.36	2.217	2.244	3.349	3.264	5.016	4.911
storey 9	1.248	1.191	1.956	1.987	2.955	2.858	4.426	4.3
storey 10	0.772	0.769	1.208	1.246	1.824	1.847	2.732	2.778

Table 4.31: "Variation In Storey Drift For G+9 Regular & Irregular Building For Different Zones (Altadena) In Mm"

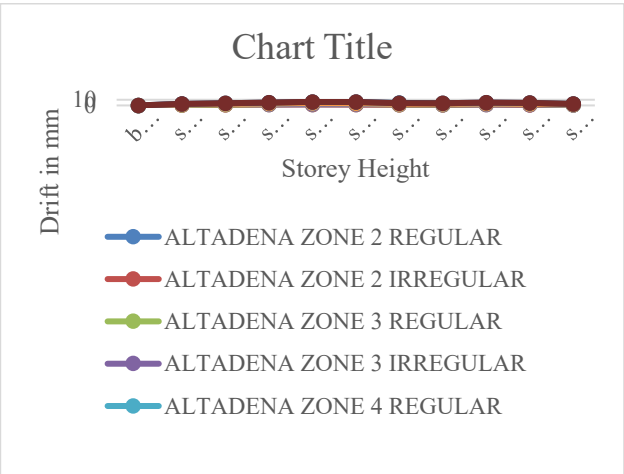


Fig 4.27: "Variation In Storey Drift For Different Zones (Altadena)"

Table4.32: "Variation In Storey Drift For Different Earthquakes (Zone – 2) In Mm"

BUILDING HEIGHT	ZONE 2					
	REGULAR			IRREGULAR		
	L CENTR	CORRALI	LTADEN	L CENTR	CORRALI	LTADEN
base	0	0	0	0	0	0
storey 1	1.241	1.241	1.241	1.349	1.312	0.74
storey 2	1.582	1.582	1.582	1.588	1.588	1.027
storey 3	1.521	1.521	1.521	1.488	1.488	1.421
storey 4	1.502	1.502	1.722	1.463	1.463	1.763
storey 5	1.448	1.448	1.679	1.41	1.41	1.663
storey 6	1.354	1.354	1.354	1.319	1.319	1.089
storey 7	1.212	1.212	1.212	1.182	1.2	1.105
storey 8	1.014	1.16	1.41	0.99	1.264	1.36
storey 9	0.755	1.04	1.248	0.739	1.149	1.191
storey 10	0.458	0.668	0.772	0.453	0.754	0.769

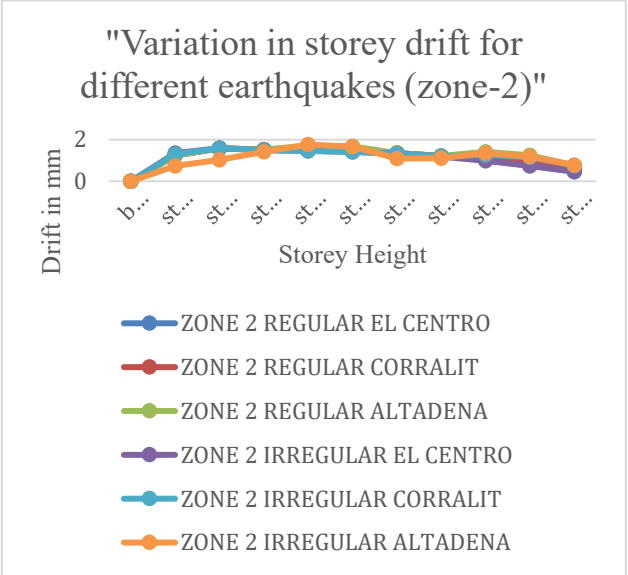


Fig 4.28: "Variation In Storey Drift For Different Earthquakes (Zone - 2)"

BUILDING HEIGHT	ZONE 3					
	REGULAR			IRREGULAR		
	L CENTR	CORRALI	LTADEN	L CENTR	CORRALI	LTADEN
base	0	0	0	0	0	0
storey 1	2.012	1.986	1.224	2.17	2.1	2.1
storey 2	2.531	2.531	1.618	2.54	2.54	2.54
storey 3	2.434	2.434	2.141	2.381	2.381	2.381
storey 4	2.404	2.404	2.759	2.34	2.34	2.84
storey 5	2.317	2.317	2.691	2.256	2.256	2.679
storey 6	2.166	2.166	1.83	2.111	2.111	2.111
storey 7	1.939	1.939	1.745	1.891	1.891	1.891
storey 8	1.622	1.892	2.217	1.583	1.973	2.244
storey 9	1.208	1.697	1.956	1.183	1.793	1.987
storey 10	0.732	1.089	1.208	0.725	1.177	1.246

Table4.33: "Variation In Storey Drift For Different Earthquakes (Zone – 3) In Mm"

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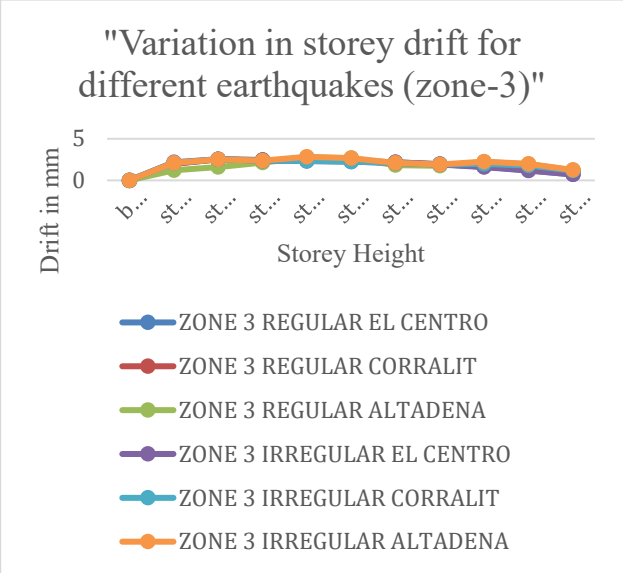


Fig 4.29: "Variation In Storey Drift For Different Earthquakes (Zone - 3)"

BUILDING HEIGHT	ZONE 4					
	REGULAR			IRREGULAR		
	L CENTR	CORRALIT	LTADEN	L CENTR	CORRALIT	LTADEN
base	0	0	0	0	0	0
storey 1	3.018	2.979	1.849	3.285	3.15	1.777
storey 2	3.796	3.796	2.444	3.81	3.81	2.464
storey 3	3.651	3.651	3.234	3.572	3.572	3.409
storey 4	3.606	3.606	4.168	3.51	3.51	4.231
storey 5	3.475	3.475	4.065	3.385	3.385	3.991
storey 6	3.25	3.25	2.765	3.167	3.167	2.613
storey 7	2.908	2.908	2.635	2.836	2.839	2.653
storey 8	2.433	2.807	3.349	2.375	2.99	3.264
storey 9	1.812	2.518	2.955	1.775	2.718	2.858
storey 10	1.099	1.616	1.824	1.088	1.783	1.847

Table4.34: "Variation In Storey Drift For Different Earthquakes (Zone – 4) In Mm"

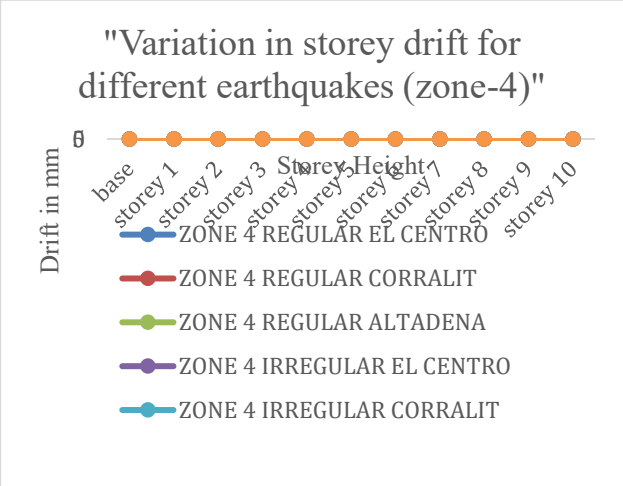


Fig 4.30: "Variation In Storey Drift For Different Earthquakes (Zone - 4)"

BUILDING HEIGHT	ZONE 5					
	REGULAR			IRREGULAR		
	L CENTR	CORRALIT	LTADEN	L CENTR	CORRALIT	LTADEN
base	0	0	0	0	0	0
storey 1	4.572	4.468	2.77	5.865	4.725	2.674
storey 2	5.694	5.694	3.66	6.522	5.715	3.707
storey 3	5.476	5.476	4.844	5.358	5.358	5.13
storey 4	5.408	5.408	6.241	5.266	5.266	6.366
storey 5	5.213	5.213	6.087	5.231	5.077	6.005
storey 6	4.874	4.874	4.141	5.044	4.75	3.932
storey 7	4.362	4.362	3.947	4.72	4.254	3.992
storey 8	3.649	4.272	5.016	4.04	4.316	4.911
storey 9	2.718	3.832	4.426	3.153	3.923	4.3
storey 10	1.648	2.46	2.732	1.904	2.574	2.778

Table4.35: "Variation In Storey Drift For Different Earthquakes (Zone – 5) In Mm"

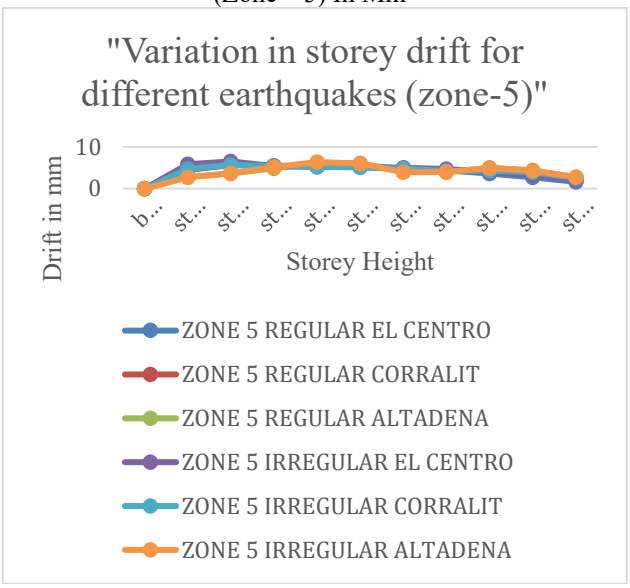


Fig 4.31: "Variation In Storey Drift For Different Earthquakes (Zone - 5)"

For G+19:

	STOREY DRIFT																							
BUILDING	ZONE 2						ZONE 3						ZONE 4						ZONE 5					
	REGULAR			IRREGULAR			REGULAR			IRREGULAR			REGULAR			IRREGULAR			REGULAR			IRREGULAR		
HEIGHT	L CENTR	CORRALIT	LTADEN	L CENTR	CORRALIT	LTADEN	L CENTR	CORRALIT	LTADEN	L CENTR	CORRALIT	LTADEN	L CENTR	CORRALIT	LTADEN	L CENTR	CORRALIT	LTADEN	L CENTR	CORRALIT	LTADEN	L CENTR	CORRALIT	LTADEN
base	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
storey 1	8.899	9.388	5.596	9.029	9.069	6.031	14.238	14.969	8.963	14.446	13.008	9.624	21.357	22.226	13.471	21.669	19.779	14.446	32.026	42.726	20.206	32.503	41.222	21.613
storey 2	5.28	5.37	3.994	5.465	5.608	4.018	8.448	8.562	6.398	8.744	7.902	6.412	12.673	12.713	9.616	13.115	12.231	9.624	19.009	24.439	14.423	19.673	21.661	14.399
storey 3	2.921	2.73	1.973	2.951	2.705	1.927	4.673	4.353	3.16	4.722	4.162	3.075	7.01	6.463	4.749	7.083	6.243	4.615	10.515	12.425	7.124	10.624	12.312	6.995
storey 4	2.657	2.876	1.24	2.656	2.912	1.19	4.251	4.586	1.987	4.249	4.108	1.899	6.377	6.809	2.986	6.374	6.359	2.85	9.566	13.089	4.479	9.56	13.253	4.264
storey 5	2.638	3.145	1.267	2.627	3.133	1.247	4.218	5.015	2.029	4.204	4.42	1.99	6.327	7.446	3.049	6.305	6.842	2.986	9.49	14.314	4.574	9.458	14.26	4.468
storey 6	2.634	3.248	1.383	2.623	3.162	1.356	4.25	5.18	2.216	4.197	4.461	2.163	6.376	7.69	3.331	6.296	6.905	3.247	9.66	14.784	4.996	9.663	14.392	4.858
storey 7	2.652	3.066	1.28	2.646	2.996	1.251	4.322	4.888	2.05	4.214	4.171	1.996	6.483	7.258	3.081	6.272	6.456	2.995	9.822	13.953	4.621	9.799	13.455	4.482
storey 8	2.607	2.735	1.174	2.593	2.68	1.132	4.248	4.361	1.88	4.139	3.776	1.807	6.372	6.475	2.826	6.206	5.844	2.712	9.655	12.448	4.238	9.685	12.181	4.058
storey 9	2.555	2.926	1.048	2.545	2.94	1.059	4.088	4.666	1.678	4.072	4.143	1.69	6.132	6.928	2.522	6.108	6.413	2.537	9.199	13.319	3.783	9.162	13.365	3.796
storey 10	2.495	3.305	1.17	2.485	3.382	1.2	3.991	5.366	1.874	3.976	4.765	1.916	5.987	7.967	2.817	5.964	7.375	2.675	8.98	15.315	4.225	8.946	15.371	4.302
storey 11	2.414	3.607	1.302	2.405	3.669	1.318	3.862	5.88	2.066	3.848	5.17	2.104	5.793	8.73	3.135	5.772	8.002	3.158	8.689	16.782	4.702	8.658	16.677	4.724
storey 12	2.311	3.776	1.379	2.303	3.7	1.364	3.698	6.021	2.209	3.685	5.213	2.176	5.547	8.94	3.32	5.528	8.069	3.267	8.32	17.186	4.98	8.292	16.817	4.887
storey 13	2.264	3.592	1.525	2.24	3.463	1.512	3.689	5.728	2.443	3.568	4.879	2.413	5.533	8.504	3.672	5.311	7.552	3.621	8.384	16.348	5.508	8.298	15.739	5.418
storey 14	2.295	3.169	1.735	2.258	3.13	1.743	3.74	5.053	2.779	3.597	4.41	2.701	5.609	7.503	4.176	5.353	6.826	4.175	8.499	14.423	6.265	8.364	14.226	6.246
storey 15	2.237	3.095	2.101	2.187	3.052	2.098	3.646	4.955	3.366	3.483	4.305	3.348	5.469	7.327	5.058	5.184	6.664	5.025	8.267	14.085	7.507	8.101	13.889	7.518
storey 16	2.082	3.373	2.365	2.021	3.202	2.281	3.395	5.379	3.692	3.219	4.602	3.641	5.089	7.986	5.549	4.792	7.123	5.464	7.711	15.582	8.323	7.487	14.845	8.176
storey 17	1.828	3.526	2.269	1.765	3.199	2.234	2.979	5.352	3.635	2.811	4.513	3.565	4.468	7.946	5.463	4.183	6.986	5.352	6.77	15.275	9.195	6.536	14.559	8.007
storey 18	1.485	2.964	1.97	1.43	2.805	1.934	2.42	4.727	3.155	2.277	3.954	3.087	3.631	7.018	4.742	3.389	6.12	4.633	5.501	13.492	7.113	5.295	12.756	6.932
storey 19	1.081	2.225	1.442	1.043	2.104	1.418	1.761	3.549	2.309	1.662	2.969	2.263	2.642	5.269	3.471	2.473	4.596	3.397	4.083	10.129	5.266	3.865	9.576	5.083
storey 20	0.72	1.432	0.891	0.707	1.376	0.888	1.173	2.294	1.426	1.126	1.941	1.417	1.76	3.391	2.144	1.676	3.005	2.126	2.666	6.518	3.216	2.619	6.263	3.181

Table 4.36: "Variation In Storey Drift For G+19 Regular & Irregular Building For Different Zones In Mm"

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EL CENTRO								
BUILDIN	ZONE 2		ZONE 3		ZONE 4		ZONE	
G HEIGHT	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRF
base	0	0	0	0	0	0	0	
storey 1	8.899	9.029	14.238	14.446	21.357	21.669	32.036	
storey 2	5.28	5.465	8.448	8.744	12.673	13.115	19.009	
storey 3	2.921	2.951	4.673	4.722	7.01	7.083	10.515	
storey 4	2.657	2.656	4.251	4.249	6.377	6.374	9.566	
storey 5	2.636	2.627	4.218	4.204	6.327	6.305	9.49	
storey 6	2.634	2.623	4.25	4.197	6.376	6.296	9.66	
storey 7	2.652	2.646	4.322	4.214	6.483	6.272	9.822	
storey 8	2.607	2.593	4.248	4.139	6.372	6.208	9.655	
storey 9	2.555	2.545	4.088	4.072	6.132	6.108	9.199	
storey 10	2.495	2.485	3.991	3.976	5.987	5.964	8.98	
storey 11	2.414	2.405	3.862	3.848	5.793	5.772	8.689	
storey 12	2.311	2.303	3.698	3.685	5.547	5.528	8.32	
storey 13	2.264	2.24	3.689	3.568	5.533	5.311	8.384	
storey 14	2.295	2.258	3.74	3.597	5.609	5.353	8.499	
storey 15	2.237	2.187	3.646	3.483	5.469	5.184	8.287	
storey 16	2.082	2.021	3.393	3.219	5.089	4.792	7.711	
storey 17	1.828	1.765	2.979	2.811	4.468	4.183	6.77	
storey 18	1.485	1.43	2.42	2.277	3.631	3.389	5.501	
storey 19	1.081	1.043	1.761	1.662	2.642	2.473	4.003	
storey 20	0.72	0.707	1.173	1.126	1.76	1.676	2.666	

Table 4.37: "Variation In Storey Drift For G+19 Regular & Irregular Building For Different Zones (El Centro) In Mm"

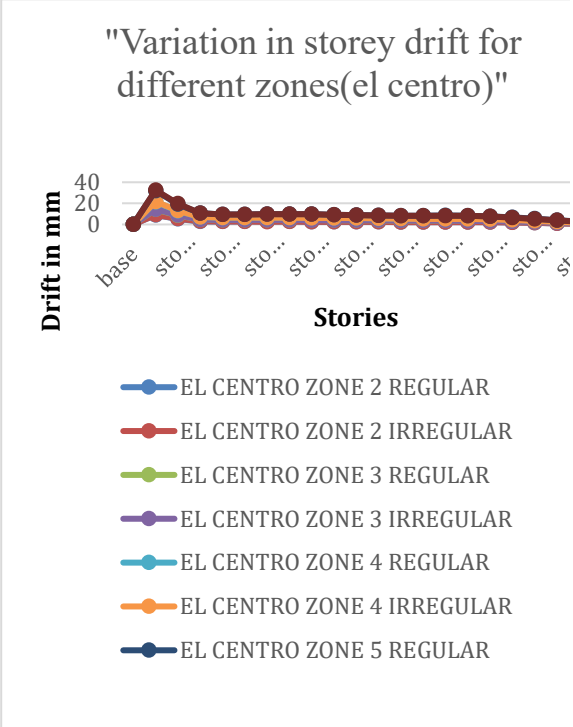


Fig 4.32: "Variation In Storey Drift For Different Zones (El Centro)"

CORRALIT								
BUILDIN	ZONE 2		ZONE 3		ZONE 4		ZONE 5	
G HEIGHT	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULAR	REGULAR	IRREGULAR
base	0	0	0	0	0	0	0	0
storey 1	9.388	9.069	14.969	13.008	22.226	19.779	42.726	41.222
storey 2	5.37	5.608	8.562	7.902	12.713	12.231	24.439	21.661
storey 3	2.73	2.705	4.353	4.162	6.463	6.243	12.425	12.312
storey 4	2.876	2.912	4.586	4.108	6.809	6.359	13.089	13.253
storey 5	3.145	3.133	5.015	4.42	7.446	6.842	14.314	14.26
storey 6	3.248	3.162	5.18	4.461	7.69	6.905	14.784	14.392
storey 7	3.066	2.956	4.888	4.171	7.258	6.456	13.953	13.455
storey 8	2.735	2.68	4.361	3.776	6.475	5.844	12.448	12.181
storey 9	2.926	2.94	4.666	4.143	6.928	6.413	13.319	13.365
storey 10	3.365	3.382	5.366	4.765	7.967	7.375	15.315	15.371
storey 11	3.687	3.669	5.88	5.17	8.73	8.002	16.782	16.677
storey 12	3.776	3.7	6.021	5.213	8.94	8.069	17.186	16.817
storey 13	3.592	3.463	5.728	4.879	8.504	7.552	16.348	15.739
storey 14	3.169	3.13	5.053	4.41	7.503	6.826	14.423	14.226
storey 15	3.095	3.052	4.935	4.305	7.327	6.664	14.085	13.889
storey 16	3.373	3.262	5.379	4.602	7.986	7.123	15.352	14.845
storey 17	3.356	3.199	5.352	4.513	7.946	6.986	15.275	14.559
storey 18	2.964	2.803	4.727	3.954	7.018	6.12	13.492	12.756
storey 19	2.225	2.104	3.549	2.969	5.269	4.596	10.129	9.578
storey 20	1.432	1.376	2.284	1.941	3.391	3.005	6.518	6.263

Table 4.38: "Variation In Storey Drift For G+19 Regular & Irregular Building For Different Zones (Corralit) In Mm"

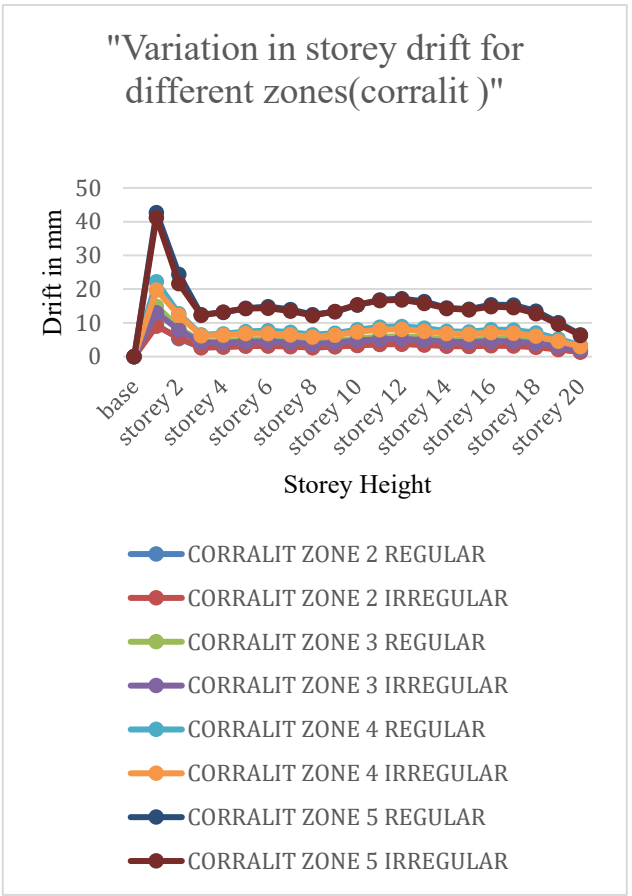


Fig 4.33: "Variation In Storey Drift For Different Zones (Corralit)"

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ALTADENA								
BUILDING HEIGHT	ZONE 2		ZONE 3		ZONE 4		ZONE 5	
	REGULAR	REGULAR	REGULAR	REGULAR	REGULAR	REGULAR	REGULAR	REGULA
base	0	0	0	0	0	0	0	0
storey 1	5.596	6.031	8.963	9.624	13.471	14.446	20.206	21.613
storey 2	3.994	4.018	6.398	6.412	9.616	9.624	14.423	14.399
storey 3	1.973	1.927	3.16	3.075	4.749	4.615	7.124	6.905
storey 4	1.24	1.19	1.987	1.899	2.986	2.85	4.479	4.264
storey 5	1.267	1.247	2.029	1.99	3.049	2.986	4.574	4.468
storey 6	1.383	1.356	2.216	2.163	3.331	3.247	4.996	4.858
storey 7	1.28	1.251	2.05	1.996	3.081	2.995	4.621	4.482
storey 8	1.174	1.132	1.88	1.807	2.826	2.712	4.238	4.058
storey 9	1.048	1.059	1.678	1.69	2.522	2.537	3.783	3.796
storey 10	1.17	1.2	1.874	1.916	2.817	2.875	4.225	4.302
storey 11	1.302	1.318	2.086	2.104	3.135	3.158	4.702	4.724
storey 12	1.379	1.364	2.209	2.176	3.32	3.267	4.98	4.887
storey 13	1.525	1.512	2.443	2.413	3.672	3.621	5.508	5.418
storey 14	1.735	1.743	2.779	2.781	4.176	4.175	6.265	6.246
storey 15	2.101	2.098	3.366	3.348	5.058	5.025	7.587	7.518
storey 16	2.305	2.281	3.692	3.641	5.549	5.464	8.323	8.176
storey 17	2.269	2.234	3.635	3.565	5.463	5.352	8.195	8.007
storey 18	1.97	1.934	3.155	3.087	4.742	4.633	7.113	6.932
storey 19	1.442	1.418	2.309	2.263	3.471	3.397	5.206	5.083
storey 20	0.891	0.888	1.426	1.417	2.144	2.126	3.216	3.181

Table 4.39: "Variation In Storey Drift For G+19 Regular & Irregular Building For Different Zones (Altadena) In Mm"

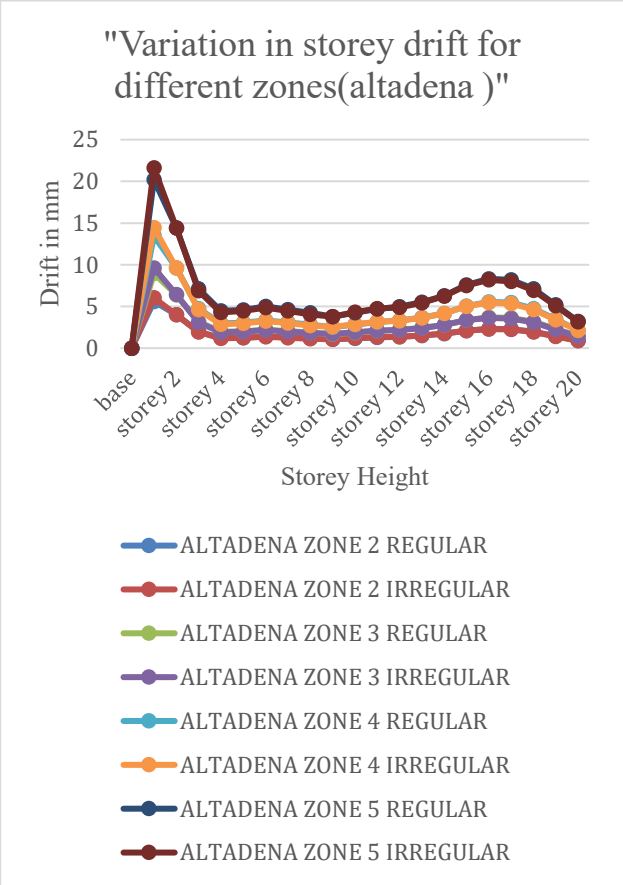


Fig 4.34: "Variation In Storey Drift For Different Zones (Altadena)"

BUILDING HEIGHT	ZONE 2					
	REGULAR			IRREGULAR		
	L CENTR	CORRALIT	LTADEN	L CENTR	CORRALIT	LTADEN
base	0	0	0	0	0	0
storey 1	8.899	9.388	5.596	9.029	9.069	6.031
storey 2	5.28	5.37	3.994	5.465	5.608	4.018
storey 3	2.921	2.73	1.973	2.951	2.705	1.927
storey 4	2.657	2.876	1.24	2.656	2.912	1.19
storey 5	2.636	3.145	1.267	2.627	3.133	1.247
storey 6	2.634	3.248	1.383	2.623	3.162	1.356
storey 7	2.652	3.066	1.28	2.646	2.956	1.251
storey 8	2.607	2.735	1.174	2.593	2.68	1.132
storey 9	2.555	2.926	1.048	2.545	2.94	1.059
storey 10	2.495	3.365	1.17	2.485	3.382	1.2
storey 11	2.414	3.687	1.302	2.405	3.669	1.318
storey 12	2.311	3.776	1.379	2.303	3.7	1.364
storey 13	2.264	3.592	1.525	2.24	3.463	1.512
storey 14	2.295	3.169	1.735	2.258	3.13	1.743
storey 15	2.237	3.095	2.101	2.187	3.052	2.098
storey 16	2.082	3.373	2.305	2.021	3.262	2.281
storey 17	1.828	3.356	2.269	1.765	3.199	2.234
storey 18	1.485	2.964	1.97	1.43	2.803	1.934
storey 19	1.081	2.225	1.442	1.043	2.104	1.418
storey 20	0.72	1.432	0.891	0.707	1.376	0.888

Table4.40: "Variation In Storey Drift For Different Earthquakes (Zone – 2)"

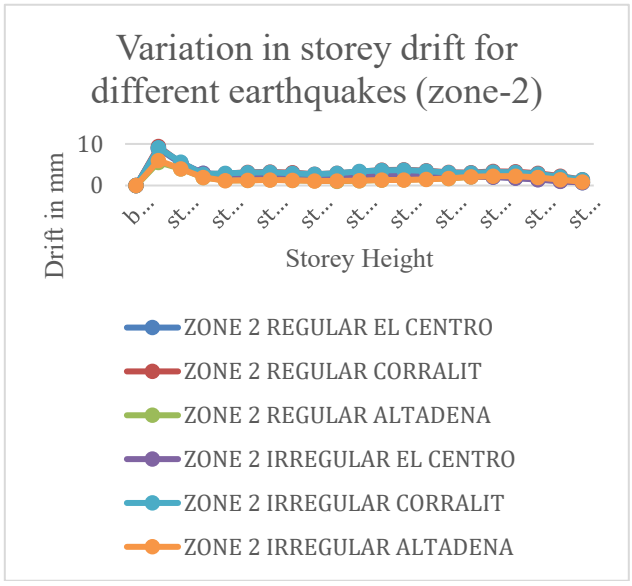


Fig 4.35: "Variation In Storey Drift For Different Earthquakes (Zone - 2)"

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BUILDING HEIGHT	ZONE 3					
	REGULAR			IRREGULAR		
	L CENTRO	CORRALIT	LTADEN	L CENTRO	CORRALIT	LTADEN
base	0	0	0	0	0	0
storey 1	14.238	14.969	8.963	14.446	13.008	9.624
storey 2	8.448	8.562	6.398	8.744	7.902	6.412
storey 3	4.673	4.353	3.16	4.722	4.162	3.075
storey 4	4.251	4.586	1.987	4.249	4.108	1.899
storey 5	4.218	5.015	2.029	4.204	4.42	1.99
storey 6	4.25	5.18	2.216	4.197	4.461	2.163
storey 7	4.322	4.888	2.05	4.214	4.171	1.996
storey 8	4.248	4.361	1.88	4.139	3.776	1.807
storey 9	4.088	4.666	1.678	4.072	4.143	1.69
storey 10	3.991	5.366	1.874	3.976	4.765	1.916
storey 11	3.862	5.88	2.086	3.848	5.17	2.104
storey 12	3.698	6.021	2.209	3.685	5.213	2.176
storey 13	3.689	5.728	2.443	3.568	4.879	2.413
storey 14	3.74	5.053	2.779	3.597	4.41	2.781
storey 15	3.646	4.935	3.366	3.483	4.305	3.348
storey 16	3.393	5.379	3.692	3.219	4.602	3.641
storey 17	2.979	5.352	3.635	2.811	4.513	3.565
storey 18	2.42	4.727	3.155	2.277	3.954	3.087
storey 19	1.761	3.549	2.309	1.662	2.969	2.263
storey 20	1.173	2.284	1.426	1.126	1.941	1.417

Table4.41: "Variation In Storey Drift For Different Earthquakes (Zone – 3)"

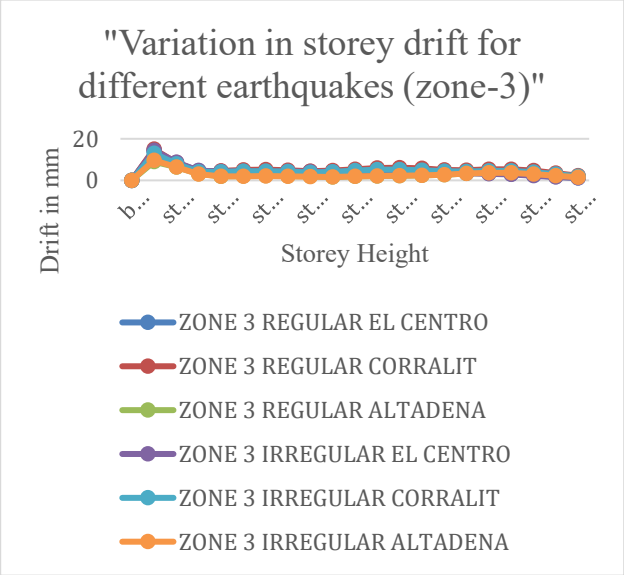


Fig 4.36: "Variation In Storey Drift For Different Earthquakes (Zone - 3)"

BUILDING HEIGHT	ZONE 4					
	REGULAR			IRREGULAR		
	L CENTRO	CORRALIT	LTADEN	L CENTRO	CORRALIT	LTADEN
base	0	0	0	0	0	0
storey 1	21.357	22.226	13.471	21.669	19.779	14.446
storey 2	12.673	12.713	9.616	13.115	12.231	9.624
storey 3	7.01	6.463	4.749	7.083	6.243	4.615
storey 4	6.377	6.809	2.986	6.374	6.359	2.85
storey 5	6.327	7.446	3.049	6.305	6.842	2.986
storey 6	6.376	7.69	3.331	6.296	6.905	3.247
storey 7	6.483	7.258	3.081	6.272	6.456	2.995
storey 8	6.372	6.475	2.826	6.208	5.844	2.712
storey 9	6.132	6.928	2.522	6.108	6.413	2.537
storey 10	5.987	7.967	2.817	5.964	7.375	2.875
storey 11	5.793	8.73	3.135	5.772	8.002	3.158
storey 12	5.547	8.94	3.32	5.528	8.069	3.267
storey 13	5.533	8.504	3.672	5.311	7.552	3.621
storey 14	5.609	7.503	4.176	5.353	6.826	4.175
storey 15	5.469	7.327	5.058	5.184	6.664	5.025
storey 16	5.089	7.986	5.549	4.792	7.123	5.464
storey 17	4.468	7.946	5.463	4.183	6.986	5.352
storey 18	3.631	7.018	4.742	3.389	6.12	4.633
storey 19	2.642	5.269	3.471	2.473	4.596	3.397
storey 20	1.76	3.391	2.144	1.676	3.005	2.126

Table4.42: "Variation In Storey Drift For Different Earthquakes (Zone – 4)"

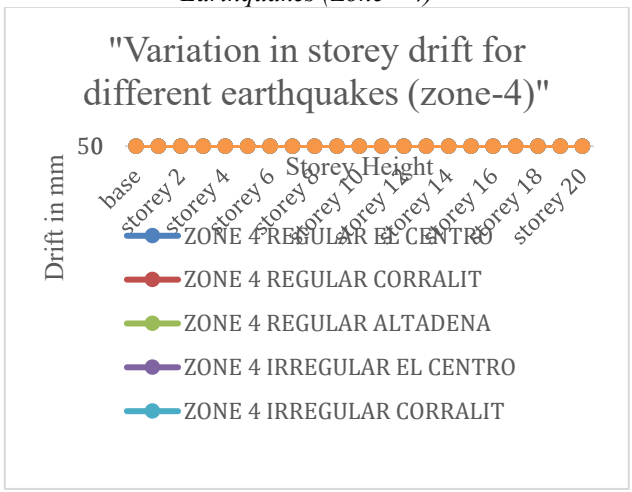


Fig 4.37: "Variation In Storey Drift For Different Earthquakes (Zone - 4)"

BUILDING HEIGHT	ZONE 5					
	REGULAR			IRREGULAR		
	L CENTRO	CORRALIT	LTADEN	L CENTRO	CORRALIT	LTADEN
base	0	0	0	0	0	0
storey 1	32.036	42.726	20.206	32.503	41.222	21.613
storey 2	19.009	24.439	14.423	19.673	21.661	14.399
storey 3	10.515	12.425	7.124	10.624	12.312	6.905
storey 4	9.566	13.089	4.479	9.56	13.253	4.264
storey 5	9.49	14.314	4.574	9.458	14.26	4.468
storey 6	9.66	14.784	4.996	9.663	14.392	4.858
storey 7	9.822	13.953	4.621	9.799	13.455	4.482
storey 8	9.655	12.448	4.238	9.605	12.181	4.058
storey 9	9.199	13.319	3.783	9.162	13.365	3.796
storey 10	8.98	15.315	4.225	8.946	15.371	4.302
storey 11	8.689	16.782	4.702	8.658	16.677	4.724
storey 12	8.32	17.186	4.98	8.292	16.817	4.887
storey 13	8.384	16.348	5.508	8.298	15.739	5.418
storey 14	8.499	14.423	6.265	8.364	14.226	6.246
storey 15	8.287	14.085	7.587	8.101	13.889	7.518
storey 16	7.711	15.352	8.323	7.487	14.845	8.176
storey 17	6.77	15.275	8.195	6.536	14.559	8.007
storey 18	5.501	13.492	7.113	5.295	12.756	6.932
storey 19	4.003	10.129	5.206	3.865	9.578	5.083
storey 20	2.666	6.518	3.216	2.619	6.263	3.181

Table4.43: "Variation In Storey Drift For Different Earthquakes (Zone – 5)"

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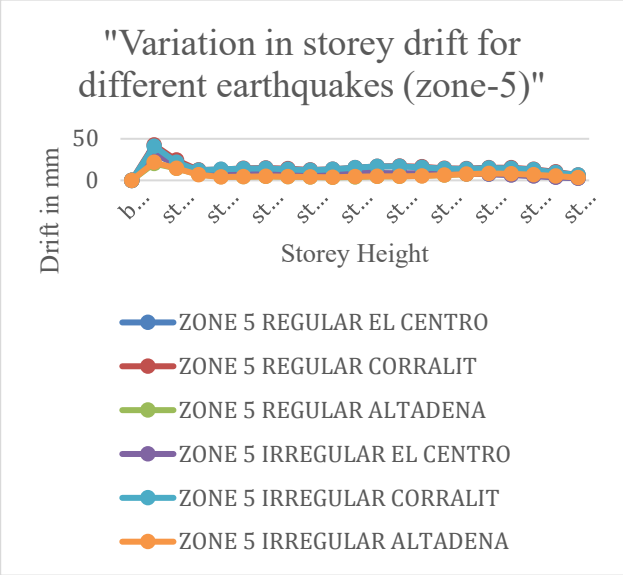


Fig 4.38: "Variation In Storey Drift For Different Earthquakes (Zone - 5)"

Discussion About Storey Drift:

Storey Drifts Are Found Higher At The Base And Bottom Floors And Have Reduced As It Goes Towards The Top. The Same Pattern Is Seen For All Models.

G+9:

- It Is Seen From The Table: 4.24 Storey Drifts Have Decreased By An Average Of 1.09%0.95%1% And 15% For Irregular Building When Compared To The Regular Building For Zone2 Zone3 Zone4 & Zone 5 Respectively.
- Buildings Subjected To Altadena Earthquake Have Shown Higher Storey Displacements Of About 46%71%63%42% When Compared To Elcentro Earthquake And 2% 22% 12.5%& 8% Higher Values When Compared To Corralit Earthquake For Zone2 Zone3 Zone4 & Zone 5 Respectively.

G+19:

- It Is Seen From The Table: 4.31 Storey Displacements Have Increased By An Average Of 3.9%15%11% And 4% For Irregular Building When Compared To The Regular Building For Zone2 Zone3 Zone4 & Zone 5 Respectively.
- Buildings Subjected To Corralit Earthquake Have Shown Higher Storey Displacements Of About 85%88%79%130% When Compared To Elcentro Earthquake And 62% 35% 61%& 103% Higher Values When Compared To Altadena Earthquake For Zone2 Zone3 Zone4 & Zone 5 Respectively.

Discussion Of Results:

Base Shear:

G+9:

- It Is Seen From The Table: 4.1 Base Shear Is Reduced By 21%22%22% And 10% For Irregular Building When Compared To The Regular Building For Zone2 Zone3 Zone4 & Zone 5 Respectively.
- From Table 4.1 The Base Shear Value Has Increased By 20% For G+19 Building When Compared To G+9 Building.
- Building Subjected To Corralit Earthquake Have Shown 1.10% 15% 5% & 21% Higher Base Shear Values When Compared To Elcentro And 8% 9% 13%& 18% Higher Values When Compared To Altadena Earthquake For Zone2 Zone3 Zone4 & Zone 5 Respectively.

G+19:

- It Is Seen From The Table: 4.1 Base Shear Is Reduced By 24%24%24% And 26% For Irregular Building When Compared To The Regular Building For Zone2 Zone3 Zone4 & Zone 5 Respectively.
- Buildings Subjected To Corralit Earthquake Have Shown 12%13%12% And 35% Higher Base Shear Values When Compared To Elcentro And 16% 15% 14%& 46% Higher Values When Compared To Altadena Earthquake For Zone2 Zone3 Zone4 & Zone 5 Respectively.

Time Period:

- It Is Seen From The Table: 4.9 Time Period Is Reduced By 1.21% & 1.03% For Irregular Building When Compared To The Regular Building For G+9 & G+19 Building Respectively.
- From Table 4.9 The Time Period Has Increased By Thrice For G+19 Building When Compared To G+9 Building.

Storey Displacement:

Storey Displacements Are Found Smaller At The Base And Bottom Floors And Have Increased As It Goes Towards The Top. The Same Pattern Is Seen For All The Models For All Zones

G+9:

- It Is Seen From The Table: 4.10 Storey Displacements Have Increased By An Average Of 8%6.7%7.6% And 26% For Irregular Building When Compared To The Regular Building For Zone2 Zone3 Zone4 & Zone 5 Respectively.
- Buildings Subjected To Corralit Earthquake Have Shown Higher Storey Displacements Of About 13%11%10%&12% When Compared To Elcentro Earthquake And 15%19%17%& 37% Higher Values When Compared To Altadena Earthquake For Zone2 Zone3 Zone4 & Zone 5 Respectively.

G+19:

- It Is Seen From The Table: 4.17 Storey Displacements Have Increased By An Average Of 6.9%4.5%3.7% And 7% For Irregular Building

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When Compared To The Regular Building For Zone2 Zone3 Zone4 & Zone 5 Respectively.

- Buildings Subjected To Corralit Earthquake Have Shown Higher Storey Displacements Of About 4%3%4%23% When Compared To Elcentro Earthquake And 148% 150% 152%& 160% Higher Values When Compared To Altadena Earthquake For Zone2 Zone3 Zone4 & Zone 5 Respectively.

Storey Drift:

Storey Drifts Are Found Higher At The Base And Bottom Floors And Have Reduced As It Goes Towards The Top. The Same Pattern Is Seen For All Models.

G+9:

- It Is Seen From The Table: 4.24 Storey Drifts Have Decreased By An Average Of 1.09%0.95%1% And 15% For Irregular Building When Compared To The Regular Building For Zone2 Zone3 Zone4 & Zone 5 Respectively.
- Buildings Subjected To Corralit Earthquake Have Shown Higher Storey Displacements Of About 46%71%63%42% When Compared To Elcentro Earthquake And 2% 22% 12.5%& 8% Higher Values When Compared To Altadena Earthquake For Zone2 Zone3 Zone4 & Zone 5 Respectively.

G+19:

- It Is Seen From The Table: 4.31 Storey Displacements Have Increased By An Average Of 3.9%15%11% And 4% For Irregular Building When Compared To The Regular Building For Zone2 Zone3 Zone4 & Zone 5 Respectively.
- Buildings Subjected To Corralit Earthquake Have Shown Higher Storey Displacements Of About 85%88%79%130% When Compared To Elcentro Earthquake And 62% 35% 61%& 103% Higher Values When Compared To Altadena Earthquake For Zone2 Zone3 Zone4 & Zone 5 Respectively.

VI. CONCLUSIONS

In This Study Rc Framed Structures Have Been Examined Using Both Regular And Irregular Configurations At Varying Heights Namely G+9 And G+19. The Structure's Performance Was Examined By Time History Analysis And A Comparison Research Was Conducted. Based On The Research Conducted In This Dissertation The Following Findings Are Formulated.

Effect On Base Shear:

The Irregularity In The Building Design Has Led To A 20% Decrease In The Base Shear For A G+9 Structure With A More Pronounced Impact Seen In Taller Buildings Where A 25% Reduction Is Noted In A G+19 Structure Attributed To The Extended Time Periods Of High-Rise Constructions.

Effect On Time Period:

Irregularity Has Decreased The Vibration Period Of The Structure By As Much As 1.5%. The Duration Has Been Shown To Extend When The Rigidity Of The Structure Diminishes. As The Rigidity Of The Isolator Diminishes The Structure Exhibits More Flexibility Resulting In A Noticeable Rise In The Time Period.

Effect On Storey Drift And Storey Displacements:

Storey Drift Is Also Reduced By A Percentage Of 5% Highest Being Towards The Top Storey. Storey Drifts Are Seen Higher At The Base Due To The Lateral Movement And Reduction In Drifts Is Observed While Moving Towards The Top Floors.

Storey Displacements Are Seen Higher At The Top There Is An Increase Of 5% In Storey Displacements For Irregular Building. An Increase Of About 50% And 80% Is Seen In Storey Displacements And Storey Drifts For Corallit Earthquake When Compared To The Elcentro And Altadena Earthquake.

Futther Scope Of Work:

- This Project Dealt With Introduction Of Plain Irregularities To The Structure. Further Vertical Irregularities Can Be Introduced For Better Study Of Structure.
- Ssi (Soil Structure Interaction) Can Be Introduced For More Realistic Approach.
- It Would Be Useful To Examine The Seismic Behaviour Of Irregular Structures With Dampers Shear Walls & Bracings And Optimum Placement Of These Frames.

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