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Analysis and Design of RCC hospital building subjected to seismic forces by using different zone factor

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INTRODUCTION:-

An earthquake is the vibration of the earth's surface that follows a sudden release of energy in the crust. During an earthquake, the ground surface moves in all directions. The most damaging effects on buildings are caused by lateral movements which disturb the stability of the structure, causing it to topple or to collapse sideways. Since buildings are normally constructed to resist gravity, many traditional systems of construction are not inherently resistant to horizontal forces. Thus design for earthquakes consists largely of solving the problem of building vibrations. The design of buildings is fundamentally concerned with ensuring that the components of buildings, e.g. lateral force-resisting system, can adequately serve their intended functions. In the case of seismic design of the lateral force-resisting system, the design problem can be reduced simply to the problem of providing adequate force and deformation capacity to resist the seismic demands.

Seismic Analysis is a subset of structural analysis and is the calculation of the response of a building structure to earthquakes. It is a part of the process of structural design, earthquake engineering or structural assessment and retrofit in regions where earthquakes are prevalent. Seismic structural analysis methods can be divided into two main categories, static analysis and dynamic analysis. These two main categories can be divided into two main types of analysis, the linear and non-linear analysis. The studied building in this paper is a typical six-story model of a hospital building. The building is comprised of a reinforced concrete structural frame. The overall plan dimension is 69m × 26.99 m with 24.5 m in height. designed RC structure retrofitted with RC jacketing intervention is a strength-ductility based rehabilitation system: it provided a ductility increase equal to about 76% and a strength increase equal to about 43% with an elastic period decrease of about 25%; it allowed reducing the torsional behaviour of the structure by a factor of about 56%. This scheme was strongly effective in mitigating the torsional effects and increasing the seismic performance of the "as-built" structure.

IS 1893(Part-1)-2016

Design the building by using IS 1893(part 1)-2016 as per seismic analysis by following criteria:-

The earthquake load is considered as per IS:1893 (Part I):2016,for the zone IV and medium soil with importance factor 1.5 and Reduction factor 5.

Seismic zone factor Z for Zone IV =0.24

Scale factor = (Z/2)*(I/R)*g

The seismic load is calculated as per IS 1893(Part 1):2016.The building is analysed in two principal horizontal directions.

Fundamental time period of building are calculated as per IS 1893(Part 1):2016 by using Response spectra method.

1.Seismic coefficient :-

$$A_h = \frac{ZI}{2R}\left(\frac{S_a}{g}\right)$$

Base shear $V_B = A_h * W$

For medium soil sites

$S_a/g = 1+15*T \quad 0.00 \leq T \leq 0.10$

$= 2.5 \quad 0.10 \leq T \leq 0.55$

$= 1.36/T \quad 0.55 \leq T \leq 4.00$

2.Story lateral drift demand in existing building shall be 0.4% of the height of building.

3.Lateral force for NSE_S :-

$$Q_1 = V_B \frac{W_1 h_1^2}{\sum_{j=1}^{j=n} W_1 h_1^2}$$

Where,

$Q_i =$ design lateral force at floor i

W_i = seismic weight of floor i

h_i = height of floor i measured from base

n = number of storeys in building, that is, number of levels at which masses are located

COMPARISON:-

Existing hospital building	By IS:1893(part-1)-2016	
Seismic coefficient	$A_h = \frac{ZI}{2R}\left(\frac{S_a}{g}\right)$	
Story lateral drift	0.4% of height	
Lateral force for NSEs	$Q_1 = V_B \frac{W_1 h_1^2}{\sum_{j=1}^{j=n} W_1 h_1^2}$	

AIM AND OBJECTIVES:-

AIM:-

To analyse and design of RCC hospital building subjected to seismic forces by using different zone factor.

OBJECTIVES:-

- To study provisions of IS:1893(part 1)-2016 ,IS:456-2000
- To analyse G+6 RCC building by commercially available software
- To analyse G+6 RCC building by using different zone factor
- To compare the analysis and results

LITERATURE REVIEW:-

- **J. Sankar et.al.[1],** analyzed RC plane frames of G+3 story building for four earthquake zones. Story drift, story displacement, bending moment and shear force variation for different zones was carried out. Story drift is increased from zone II to zone V in force is required in order to design with supporting elements, from which the forces get transferred to the framework. The construction period of a structure is much than its expected life. Therefore, return period of 50 years may be considered for arriving at the both the directions X and Z. They concluded the Amount of story drift depends up on the amount of earthquake effect and also on the displacement of the story. For buildings, Earthquake zone factor for construction stages/period of a structure depending on its importance. The stability of a structure shall be checked both with and without the earthquake loads.

  - **M.I.Adiyanto et.al.[2],** designed the three story hospital building by considering seismic forces. The values of seismic load in this study are higher where the coefficient for importance factor was taken as 1.25 for hospital building. So, the value of shear base, *V* is higher than residential buildings by 20 percent. High seismic load requires the highest cross sectional area of steel reinforcement compared to other loads. They concluded that higher load will produce higher bending moment and shear force.
  - **A.E.Hassaballa et.al.[3],** designed the reinforced concrete columns of a hospital building considering two load case, one is the design load including combinations of dead, live and wind loads and case two includes dead, live and seismic loads. This paper suggested two solutions for this problem based on strengthening the weak columns by inserting reinforced concrete shear walls in the direction of y axis affected by seismic load and shear walls of length 4.5 m and 15 cm width. They conclude the seismic load effect is found to be more significant than the wind load When the seismic load is applied, most of the building columns are found to be inadequate and unsafe particularly in y-direction.
  - **Md. Abul Hasan et.al.[4],** proposed the existing hospital building has capacity to sustain for earthquake load having peak ground acceleration (PGA) of 0.15g which is suggested in Bangladesh National Building Code (BNBC)-1993. So to avoid devastating situation the existing Hospital Building is needed to retrofit immediately using base isolation devices for keeping functioning all time even after major earthquake. They concluded Hospital Building is needed to retrofit immediately using base isolation devices for keeping functioning all time even after major earthquake.

- **C. Sahin et.al.[5],** analyzed performance-based design aims to utilize performance objectives to determine acceptable levels of damage for a given earthquake hazard for new buildings or upgrade of existing buildings. It also describes how the linear analysis may be followed by the pushover analysis in order to estimate the seismic resistance of structure. They concluded the structural retrofit improved the seismic resistance of the building and it can be considered in the retrofit of moment frame structures to prevent the risk of structural collapse under the design load with much more confidence.
- **V.P. Selvam et.al.[6],** studied a seven story RC building to investigate the structural seismic response. Then the designed structure is evaluated for the seismic performance under the old and the revised code of practice using Pushover Analysis. The Displacement controlled Pushover Analysis was carried out and the Pushover Curve was obtained for the building in both X and Y directions. From the analysis it is understood that, the frame is capable of withstanding the presumed seismic force with some significant yielding at several beams. The results obtained in terms of demand, capacity and plastic hinges gave an insight into the real behavior of structure. Pushover analysis is performed on the existing building for both zones (II & III) and Target displacement of the building was 80 mm but the building is analyzed for the displacement up to 200 mm. Pushover parameters were evaluated and compared for both zones. From the analysis it is understood that, the frame is capable of withstanding the presumed seismic force with some significant yielding at several beams. The results obtained in terms of demand, capacity and plastic hinges gave an insight into the real behavior of structure.
- **A. E. Hassaballa et.al.[7],** analyzed the frame using the response spectrum method to calculate the seismic displacements and stresses. The results obtained, clearly, show that the nodal displacements caused drifts in excess of approximately 2 to 3 times the allowable drifts. The horizontal motion has a greater effect on the axial compression loads of the exterior columns compared to the interior columns and the compressive stresses in ground floor columns were about 1.2 to 2 times the tensile stresses. They concluded moments in beams and columns due to seismic excitation showed much larger values compared to that due to static loads.
- **S.M.Z. Ali et.al.[8],** studied the effect of masonry wall on high rise building is essential to consider the effect of masonry infill for the seismic evaluation of moment resistant reinforced concrete frame. On structural capacity under earthquake effect displacement and

relative story displacement are affected by the structural irregularities. Regarding with the result, the following are very important effect on structural behaviour Base Shear, Displacement and Story drift. Story drifts are found within the limit as specified by code (IS 1893-2002 Part-1) in both static and dynamic analysis. The presence of concrete core wall at the center has not affected much on the overall behavior of the structure when subjected to lateral forces, as compared to other models. They concluded that Bare frame structures are having highest response reduction factor as compared to infill frame structures. It indicates that bare frame structures are capable of resisting the forces still after first hinge.

- **F. Harmawan et.al.[9],** analyzed the impact of implementing and retrofitting a new earthquake resisting standard in public hospital building in middle project execution. The structure stimulation is conducted using structural analysis programed (SAP) by 3D frame analysis. They concluded the design method for concrete structure is used as load resistant factor design, the safety factor used in the form of load factor and strength reduction factor of material.
- **D. Bhavar et.al.[10],** analyzed in earthquakes many R.C.C buildings have also collapsed and are found unsafe due to faulty workmanship. It was then decided to implement RCC column jacketing technique due to its feasibility and ease for execution. All the columns on both the floors are now suitably jacketed, the loose pockets of concrete that were investigated during the test are re-concreted, the faulty slabs are completely opened and the rusted reinforcement is replaced with new reinforcement as per the design requirement. They concluded the building was proposed to have been constructed as six storied building and was designed as per requirements, but was constructed only up to two story, it should have worked or served for a period more than the designed life span And recommended the strengthening at early stage due to minor effects of disaster, uplift pressure of ground water table, bad workmanships, hence had to be retrofitted.
- **S. Sugano et.al.[11],** proposed the tension braces provided good ductility properties while compression braces and steel panel did not develop their yield strength due to the failure of existing column and connection. When adequate connection was provided infill wall exhibited almost the same strength as monolithic wall. Multiple precast panel provided good ductility properties however as expected, much less strength was attained. The predominance of bending behaviour in three story frame was observed in contrast to shear dominance in

one story frames. They concluded the Brace frame is used to increase of strength and ductility.

- **S. Otani et.al.[12],** designed earthquake forces were specified by story shear rather than horizontal floor forces and a function of the fundamental period of a structure. The dominant earthquake forces were specified-period of subsoil at the construction site. Stresses in structural members must not exceed the allowable stresses of materials under design earthquake forces corresponding to a standard base shear coefficient Co of 0.20; the story drift angle under the design earthquake forces (Co=0.20) must Not exceed 1/200 of the story height.
- **P. Sudharasanamurty et.al.[13],** studied according to response spectra method the story shear force was found to be maximum for first story and it decrease to a minimum in the top story in all case. In response spectra method, it was found that mass irregular building frame experience larger base shear than similar regular building frames. They concluded in response spectra method the stiffness irregular building experienced lesser base shear and larger inter story drift.
- **G. Oliveto et.al.[14],** studied few specific procedures which may improve the state-of-the-art practice for the evaluation of seismic vulnerability of existing reinforced concrete buildings and for their seismic retrofitting by means of innovative techniques such as base isolation and energy dissipation. They concluded the traditional methods of seismic retrofitting fall essentially into two categories-one based on the classical principles of structural design which requires an increase of strength and stiffness and the other based on mass reduction.
- **S. Kono et.al.[15],** proposed prestressed brace system was proposed to retrofit existing buildings vulnerable to seismic damage by basically increasing strength. The current system has ductility, re-location ability and easier construction using advanced material. They concluded the prestressed brace system resist the external lateral force by placing prestressed diagonal braces in existing frame, brace resist the lateral force mainly when it is subjected to compression but to some extent when it is subjected to minor tension as indicated.

SUMMARY OF LITERATURE REVIEW:-

- It is observed that the values of seismic load in this study are higher where the coefficient for importance factor was taken as 1.25 for hospital building. So, the value of shear base *V,* is higher than residential buildings by 20 percent.

- It is observed that higher load will produce higher bending moment and shear force.
- High seismic load requires the highest cross sectional area of steel reinforcement compared to other loads.
- Performance-based design aims to utilize performance objectives to determine acceptable levels of damage for a given earthquake hazard for new buildings or upgrade of existing buildings.
- It is also described by various researchers that how the linear analysis may be followed by the pushover analysis in order to estimate the seismic resistance of structure.
- The structural retrofit improved the seismic resistance of the building and it can be considered in the retrofit of moment frame structures to prevent the risk of structural collapse under the design load with much more confidence.

STUDY OF RELEVANT IS CODES:-

A detailed study of the IS codes related to general consideration modelling procedure for earthquake analysis and guidelines for seismic rehabilitation of building is presented. IS codes required to analyse multi-storey building are given below:

IS: 1893 (Part 1) 2016 Criteria for Earthquake Resistant Design Of Structures:-

Assumptions-

The following assumptions shall be made in the earthquake resistant design of structures:

a) Earthquake causes impulsive ground motions, which are complex and irregular in character, changing in period and amplitude each lasting for a small duration. Therefore, resonance of the type as visualized under steady-state sinusoidal excitations will not occur as it would need time to build up such amplitudes.

NOTE— however, there are exceptions where resonance-like conditions have been seen to occur between long distance waves and tall structures founded on deep soft soils.

b) Earthquake is not likely to occur simultaneously with wind or maximum flood or maximum sea waves,

c) The value of elastic modulus of materials, wherever required, may be taken as for static analysis unless a more definite value is available for use in such condition (see IS 456, IS 1343 and IS 800)

Terminology

a) Design Horizontal Acceleration Coefficient *(Ah)*

It is a horizontal acceleration coefficient that shall be used for design of structures.

b) Design Lateral Force

It is the horizontal seismic force prescribed by this standard that shall be used to design a structure.

c) Ductility

Ductility of a structure, or its members, is the capacity to undergo large inelastic deformations without significant loss of strength or stiffness.

d) Importance Factor (I)

It is a factor used to obtain the design seismic force depending on the functional use of the structure, characterized by hazardous consequences of its failure, its post-earthquake functional need, historic value, or economic importance.

e) Natural Period (T)

Natural period of a structure is its time period of undammed free vibration.

f) Fundamental Natural Period (T1)

It is the first (longest) modal time period of vibration.

g) Response Reduction Factor (R)

It is the factor by which the actual base shear force that would be generated if the structure were to remain elastic during its response to the Design Basis Earthquake (DBE) shaking, shall be reduced to obtain the design lateral force.

h) Response Spectrum The representation of the maximum response of idealized single degree freedom systems having certain period and damping, during earthquake ground motion. The maximum response is plotted against the undammed natural period and for various damping values, and can be expressed in terms of maximum absolute acceleration, maximum relative velocity, or maximum relative displacement.

I) Seismic Mass: It is the seismic weight divided by acceleration due to gravity.

j) Seismic Weight (W)

It is the total dead load plus appropriate amounts of specified imposed load.

k) Structural Response Factors (Sa/g)

It is a factor denoting the acceleration response spectrum of the structure subjected to earthquake ground vibrations, and depends on natural period of vibration and damping of the structure.

l) Zone Factor (Z)

It is a factor to obtain the design spectrum depending on the perceived maximum seismic risk characterized by Maximum Considered Earthquake (MCE) in the zone in which the structure is located. The basic zone Factors included in this standard are reasonable estimate of effective peak ground acceleration.

m) Design Seismic Base Shear (VB)

It is the total design lateral force at the base of a structure.

n) Diaphragm

It is a horizontal or nearly horizontal system, which transmits lateral forces to the vertical resisting elements, for example, reinforced concrete floors and horizontal bracing systems.

o) Dual System

Buildings with dual system consist of shear walls (or braced frames) and moment resisting frames such that:

i. The two systems are designed to resist the total design lateral force in proportion to their lateral stiffness considering the interaction of the dual system at all floor levels; and

ii. The moment resisting frames are designed to independently resist at least 25 percent of the design base shear.

Load Combinations

When earthquake forces are considered on a structure, where the terms *DL, IL* and *EL* stand for the response quantities due to dead load, imposed load and designated earthquake load respectively.

a) Load factors for plastic design of steel structures- In the plastic design of steel structures, the following load combinations shall be accounted for:

1) 1.7(DL±*IL)*

2) 1.7(DL±EL)

3) 1.3(DL±lL±EL)

b) Partial safety factors for limit state design of reinforced concrete and pre-stressed concrete structures- In the limit state design of reinforced and prestressed concrete structures, the following load combinations shall be accounted for*:*

1) 1.5(DL±IL)

2) 1.2(DL±IL±EL)

3) 1.5(DL±EL)

4) 0.9DL±1.5EL

2.4.2.4 Design Horizontal Earthquake Load

A) When the lateral load resisting elements are oriented along orthogonal horizontal direction, the structure shall be designed for the effects due to till design earthquake load in one horizontal direction at time.

B) When the lateral load resisting elements are not oriented along the orthogonal horizontal directions, the structure shall be designed for the effects due to foil design earthquake load in one horizontal direction plus 30 percent of the design earthquake load in the other direction.

NOTE — For instance, the building should be designed for (± *ELx* ±0.3 *ELy)* as well as (±0.3 *ELx* ± *ELy),* where x and y are two orthogonal horizontal directions, *EL* in 6.3.1.1 and 6.3.1, 2 shall be replaced by (ELx ±0.3 *ELy)* or (ELy ± *0.3 ELx).*

Design Spectrum

a) For the purpose of determining seismic forces, the country is classified into four seismic zones.

b) The design horizontal seismic coefficient Ah for a structure shall be determined by the following expression:

$$Ah = Z\ I\ Sa/2\ R\ g$$

Provided that for any structure with T <0.1 s, the value of Ah will not be taken less than Z/2 whatever be the value of ***I/R.***

Z= Zone factor given in Table 2, is for the Maximum Considered Earthquake (MCE) and service life of structure in a zone. The factor 2 in the denominator of Z is used so as to reduce the Maximum Considered Earthquake (MCE) zone factor to the factor for Design Basis Earthquake (DBE).

Table2 zone factor, Z

Seismic Zone	**II**	**III**	**IV**	**V**
Seismic Intensity	Low	Moderate	Severe	Very Severe
Z	0.10	0.16	0.24	0.36

I= Importance factor, depending upon the functional use of the structures, characterized by Hazardous consequences of its failure, post-earthquake functional needs, historical value, or economic importance (Table)

R= Response reduction factor, depending on the perceived seismic damage performance of the structure, characterized by ductile or brittle deformations. However, the ratio (I/R) shall not greaterthan1.0

Table 8 Importance Factor (I)

(Clause 7.2.3)

Sr. No	**Structure**	**Importance factor**
i)	Important service and community buildings, such as hospitals; schools; monumental structures; emergency buildings like telephone exchange, television stations, radio stations, railway stations, fire station buildings; large community halls like cinemas, assembly halls and subway stations, power stations .	**1.5**
ii)	Residential or commercial buildings [other than those listed in Sl No. (i)] with occupancy more than 200 persons	**1.2**
iii)	All other buildings	**1.0**

b) For use in response spectrum method [*see* Fig. 2(b)]

$$\frac{S_a}{g} = \begin{cases} \text{For rocky or hard soil sites} & \begin{cases} 1+15T & T < 0.10\text{ s} \\ 2.5 & 0.10\text{ s} < T < 0.40\text{ s} \\ \frac{1}{T} & 0.40\text{ s} < T < 4.00\text{ s} \\ 0.25 & T > 4.00\text{ s} \end{cases} \\ \text{For medium stiff soil sites} & \begin{cases} 1+15T & T < 0.10\text{ s} \\ 2.5 & 0.10\text{ s} < T < 0.55\text{ s} \\ \frac{1.36}{T} & 0.55\text{ s} < T < 4.00\text{ s} \\ 0.34 & T > 4.00\text{ s} \end{cases} \\ \text{For soft soil sites} & \begin{cases} 1+15T & T < 0.10\text{ s} \\ 2.5 & 0.10\text{ s} < T < 0.67\text{ s} \\ \frac{1.67}{T} & 0.67\text{ s} < T < 4.00\text{ s} \\ 0.42 & T > 4.00\text{ s} \end{cases} \end{cases}$$

7.6.1Design Seismic Base Shear

The total design lateral force or design seismic base shear (VB) along any principal direction shall be determined by the following expression:

$$V_B = A_h W$$

Ah- Design horizontal acceleration spectrum.

W- Seismic weight of the building.

7.6.2Fundamental Natural Period

1. The approximate fundamental natural period of vibration (T,), in seconds, of a moment-resisting frame building without brick infill panels.

$$T_a = \begin{cases} 0.075h^{0.75} & \text{(for RC MRF building)} \\ 0.080h^{0.75} & \text{(for RC-Steel Composite MRF building)} \\ 0.085h^{0.75} & \text{(for steel MRF building)} \end{cases}$$

h = Height of building, in m.

b) Buildings with RC structural walls:

$$T_a = \frac{0.075h^{0.75}}{\sqrt{A_w}} \geq \frac{0.09h}{\sqrt{d}}$$

where A_w is total effective area (m^2) of walls in the first storey of the building given by:

$$A_w = \sum_{i=1}^{N_w}\left[A_{wi}\left\{0.2+\left(\frac{L_{wi}}{h}\right)^2\right\}\right]$$

where

h = height of building as defined in **7.6.2**(a), in m;

A_{wi} = effective cross-sectional area of wall i in first storey of building, in m^2;

L_{wi} = length of structural wall i in first storey in the considered direction of lateral forces, in m;

d = base dimension of the building at the plinth level along the considered direction of earthquake shaking, in m; and

N_w = number of walls in the considered direction of earthquake shaking.

The value of L_{wi}/h to be used in this equation shall not exceed 0.9.

7.6.3 Distribution of Design Force

Vertical Distribution of Base Shear to Different Floor Level the design base shear (VB) computed in 7.6.1 shall be distributed along the height of the building as per the following expression:

$$Q_i = \left(\frac{W_i h_i^2}{\sum_{j=1}^{n} W_j h_j^2}\right) V_B$$

.

Where,

Qi = Design lateral force at floor i,

Wi = Seismic weight of floor i,

hi = Height of floor i measured from base, and

Table 9 Response Reduction Factor *R* for Building Systems
(*Clause* 7.2.6)

Sl No. (1)	Lateral Load Resisting System (2)	R (3)
i)	**Moment Frame Systems**	
	a) RC buildings with ordinary moment resisting frame (OMRF) (*see* Note 1)	3.0
	b) RC buildings with special moment resisting frame (SMRF)	5.0
	c) Steel buildings with ordinary moment resisting frame (OMRF) (*see* Note 1)	3.0
	d) Steel buildings with special moment resisting frame (SMRF)	5.0
ii)	**Braced Frame Systems** (*see* Note 2)	
	a) Buildings with ordinary braced frame (OBF) having concentric braces	4.0
	b) Buildings with special braced frame (SBF) having concentric braces	4.5
	c) Buildings with special braced frame (SBF) having eccentric braces	5.0
iii)	**Structural Wall Systems** (*see* Note 3)	
	a) Load bearing masonry buildings	
	1) Unreinforced masonry (designed as per IS 1905) without horizontal RC seismic bands (*see* Note 1)	1.5
	2) Unreinforced masonry (designed as per IS 1905) with horizontal RC seismic bands	2.0
	3) Unreinforced masonry (designed as per IS 1905) with horizontal RC seismic bands and vertical reinforcing bars at corners of rooms and jambs of openings (with reinforcement as per IS 4326)	2.5
	4) Reinforced masonry [*see* SP 7 (Part 6) Section 4]	3.0
	5) Confined masonry	3.0
	b) Buildings with ordinary RC structural walls (*see* Note 1)	3.0
	c) Buildings with ductile RC structural walls	4.0

n = Number of storey in the building is the number of levels at which the masses are located.

iv)	**Dual Systems** (*see* Note 3)		
	a)	Buildings with ordinary RC structural walls and RC OMRFs (*see* Note 1)	3.0
	b)	Buildings with ordinary RC structural walls and RC SMRFs (*see* Note 1)	4.0
	c)	Buildings with ductile RC structural walls with RC OMRFs (*see* Note 1)	4.0
	d)	Buildings with ductile RC structural walls with RC SMRFs	5.0
v)	**Flat Slab – Structural Wall Systems** (*see* Note 4)		
	RC building with the three features given below: a) Ductile RC structural walls (which are designed to resist 100 percent of the design lateral force), b) Perimeter RC SMRFs (which are designed to independently resist 25 percent of the design lateral force), and preferably c) An outrigger and belt truss system connecting the core ductile RC structural walls and the perimeter RC SMRFs (*see* Note 1).		3.0

Table 10 Percentage of Imposed Load to be Considered in Calculation of Seismic Weight
(*Clause* 7.3.1)

Sl No. (1)	Imposed Uniformity Distributed Floor Loads kN/m² (2)	Percentage of Imposed Load (3)
i)	Up to and including 3.0	25
ii)	Above 3.0	50

WORK PROGRESS :

- The relevant study of literature survey was carried out.
- The Critical study the various provisions of.IS:456-2000, IS:1893(part-1)-2016 was carried out.
- G+6 RCC hospital building was modeled with the help of commercially available software ETab by different zone factor.

Activity	Aug-Sept 2020	Oct.-Nov 2020	Dec-Jan 2020-21	Feb-Mar 2021	Apr 2021
Literature Survey					
Critical study the various provisions of.IS:456-2000,IS:1893(part-1)-2016					
Modeling of structure					
Analysis of structure by using IS codes with different zone factors					
comparison of Result					
Preparation of Project Report					

PLAN OF PROJECT WORK:-

METHODOLOGY:-

- To carry out the seismic analysis the provisions of various standards need to study and hence the study of provisions of IS:1893(part 1)-2016, IS:456-2000 will be carried out.
- In this study the analysis of the hospital building will be carried out using different zone factor, hence the detail study of various provisions of structural parameter given in that zone will be carried out
- In the proposed study, available software G+6 RCC hospital building will be analysed by IS 1893-2016 for different zone factor with the help of commercially.
- The analysis results shall be then compared with various zone factor shall be recommended to strengthen the structure.

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DIMENSIONS:-

- Regular frame structure:
- Specification of structure

A. Height of Structure = 24.5m

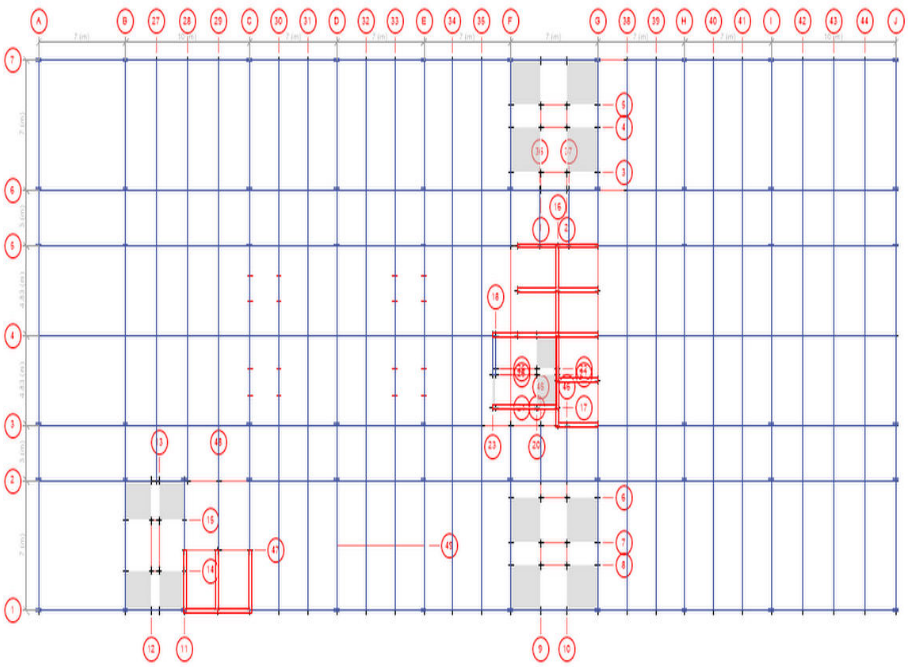
B. No of Stories = G+6

C. Width of structure = m

D. Length of structure = 69m

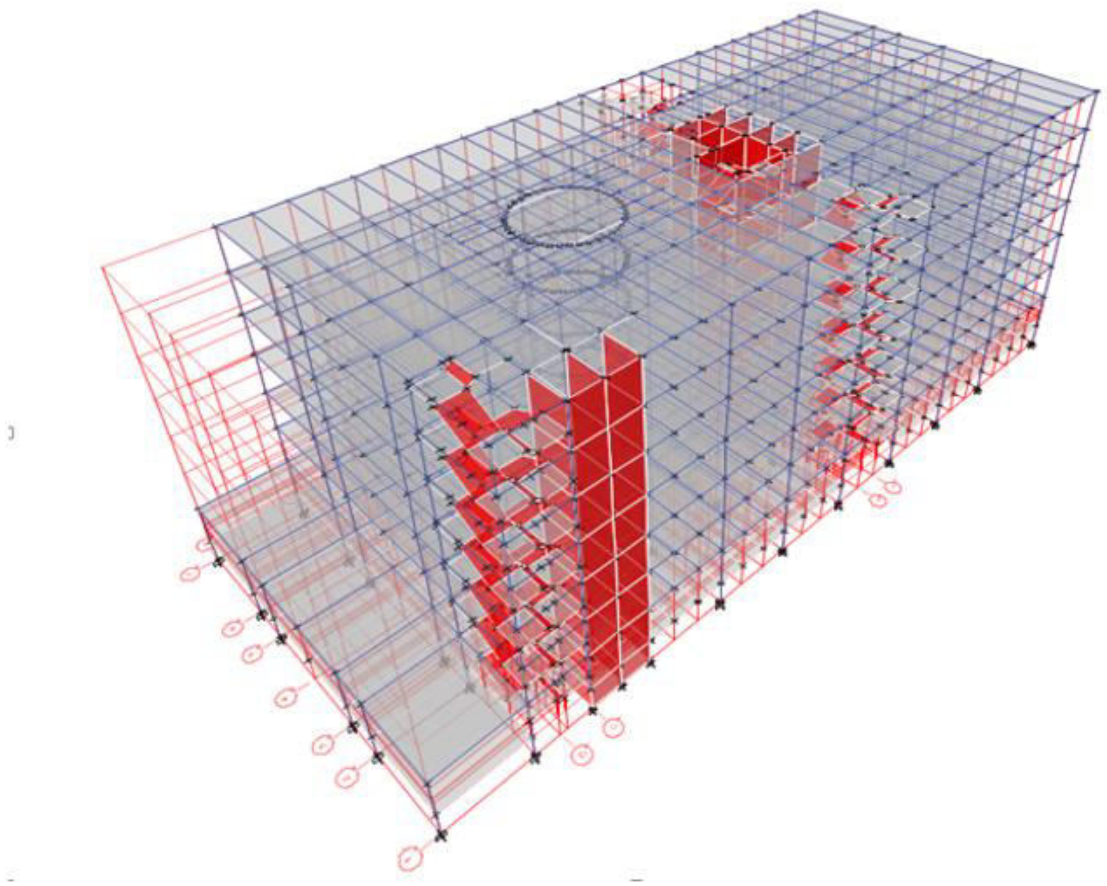
E. Floor to floor height = 3.5m

PLAN OF THE HOSPITAL BUILDING



PLAN OF HOSPITAL BUILDING IN ETAB

MODELLING OF THE HOSPITAL BUILDING



3D MODEL OF HOSPITAL BUILDING IN ETAB

REFERENCES:-

[1] J.Sankar, E.V.Raghava Rao & N.Chennakesavulu, Design of G+4 hospital building for earthquake resistance, International Journal of Engineering Sciences & Research Technology, 5(12), 2016, 2277-9655.

[2] M. I. Adiyanto, T. A. Majid & S. S. Zaini, Analysis and Design of 3 Story Hospital Structure Subjected to Seismic Load Using staad pro, International Conference of construction and Building Technology,6(17),*2008*.

[3] A. E. Hassaballa, M. A. Ismaeil & F. M. Adam, Seismic Evaluation and Retrofitting of Existing Hospital Building in the Sudan, Open Journal of Civil Engineering, 4, 2014, 159-172.

[4] Md. Abdul Hasan, Performance of reinforced concrete hospital building subjected to earthquake using base isolation, Malaysian Journal of Civil Engineering, 28(2), 2016, 257-269.

[5] C. Sahin, Seismic Retrofitting of Existing Structures, Civil and Environmental Engineering, 6(24), 2014,346.

[6] V.P. Selvam & K.Nagamani, Seismic response of existing RC building under revised seismic zone classification using pushover analysis, International Journal of Engineering Sciences & Research Technology,6,2015, 23-32.

[7] A. E. Hassaballa, F. M. Adam & M. A. Ismaeil, Seismic Analysis of a Reinforced Concrete Building by Response Spectrum Method, International Journal of Civil Engineering ,3, September. 2013, 01-09.

[8] Syed Mohammad Zakir Ali & Amaresha, Seismic Analysis of RC High Rise Structural Building with Multiple Soft Story at Various Level using Etabs, International Journal for Scientific Research & Developmen,3, *2015, 2321-0613*.

[9] F. Harmawan, H. Indarto & R. Soetanto, Retrofitting in the middle of project execution : case study of a public hoaspital building, Procedia Engineering , 171, 2017, 323 – 332.

[10] D. Bhavar, P. Dhake & R. Oghale, Retrofitting of Existing RCC Buildings by Method of Jacketing, International Journal of Research in Modern Engineering and Emerging Technology,5, 2013,2320-6586.