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MODELLING AND ANALYSIS OF PILE FOUNDATION

B DEVA KUMAR YADAV[1] ,A RAMAKRISHNAIAH[2], T MURALI KRISHNA[3]

[1]M.Tech(student),Civil Department, BES GROUP OF INSTITUTIONS, Angallu, Andhra Pradesh, India
[2]Associate professor, Civil Department, BES GROUP OF INSTITUTIONS, Angallu, Andhra Pradesh, India
[3]Associate professor, Civil Engg. Department, S V UNIVERSITY, Tirupati, Andhra Pradesh, India.

ABSTRACT - *Multi storied buildings are common in urban society therefore its design is also important. The structures which are located in the seismic prone regions where neglecting earthquake loads in the design procedure will lead to uncertainty and will cause disaster,*

Therefore IS Code recommends several seismic zones according to their occurrence and types of soils and nature of the tectonic plates. To understand the importance of seismic load on overall performance of RC structural system, a 3D mathematical model of RC structural frames which is of G+10 in height , the plan of the mathematical model is symmetrical about both axes i.e., longitudinal and transverse. The seismic analysis such as Equivalent static and Linear Dynamic (Response Spectrum) analysis as per IS 1893:2002 have been performed.

The load is applied on two mutual orthogonal directions. The parameters such has fundamental natural time period, mode shapes, storey displacements, storey drifts and bases hear have been studied in detail. Since all the building loads have to transfer by the soil beneath the building. The soil characteristics presumes to be weak enough (may be black cotton soil), the depth of hard strata presumes to be at 6 meters from the Ground level, therefore providing foundations like Isolated or Combined or Raft will be more costlier , Therefore the optimum foundation will be Pile foundation suitable for this condition. Detailed pile foundation has been modeled in SAFE v12. All the loadings for the foundation design are taken from the above building design. All the piles and pile caps have been designed and detailed for practical feasibility according to IS 456:2000.

1. INTRODUCTION:

In general, all Multi-storied buildings (structures) are of 3 types they are

(1) Load bearing construction
(2) Composite construction
(3) Framed construction

But among the above 3 types, in the present stage all the multistoried structure are framed construction which are durable. An engineering structure is a congregation of member of elements transferring the loads and providing a space to serve preferred purpose.

The structure design is an art of designing the structure with economy and elegance, a long-lasting structure that which can safely carry the forces and can serve the desired function satisfactorily during its predictable service life span. The whole process of structural planning and designing requires not only imagination and conceptual thinking (which forms arts of designing) but of practical aspects, such as appropriate design codes and byelaws, backed up by full of experience, organization and decision.

The procedure of design starts with planning of a structure, first and foremost to meet the functional purpose of the user or client. The functional necessities and the aspect of the aesthetics normally by an architect while the part of safety, serviceability, durability and economy of the structure for its projected use over the life span.

A building can be defined as a structure wide-ranging by consisting of wall, floors and roofs, erected to provide sheltered space for different uses such as habitation, education, business, industrialized, storage space, hospitalization, activity, devotion etc.,

Normally all buildings are constructed according to drawings and specifications given by architects. Each city has its approved building bye-laws to which buildings must verify. The buildings bye-laws gives data's like minimum front, side and back setbacks, minimum height and area of livable rooms, kitchen, bath, minimum area of windows, width of stair case etc., apart from relevant bye-laws the building design should ensure most favorable utilization of built-up space (i.e. Area under circulation should be minimum) thermal comfort, sufficient ventilation, pleasing illumination and acoustical

characteristics and it should satisfy the efficient requirements of people who live and work in the building.

2. ANALYSISGENERAL:

Seismic Analysis is a sub-let of structural analysis and it is the computation of the responses of a building structure due to earthquakes. It is part of the method of structural design, earthquake engineering or structural assessment and retrofit in region where earthquakes are common.

In this project two types of analysis had been used namely:-

a) Equivalent Static Analysis
b) Response Spectrum Analysis

3.1 EQUIVALENT STATIC ANALYSIS:-

Equivalent Static Analysis is a linear static analysis. This move towards define a means to symbolize the effect of trembling ground motion when sequence of forces are act on a building, throughout a seismic design reaction spectrum. This method assumes that the building respond in its basic mode. The application of this method is extensive in many building codes by apply factor to account for superior buildings with some superior modes, and for little levels of twisting. To withstand for effects due to yielding of the structure, many codes appropriate modification factors that reduce the design forces.

In this, the lateral force equal to the design basis earthquake is useful statically. The bottom measurement of the building at the plinth level alongside the way of lateral forces is represented as *d* and elevation of the building from the support is represented as *h*.

According to IS 1893-2002 this analysis can be performed by using the expression

$$Q_S = \frac{V_B X \sum W_I H_I 2}{\sum W_I H_I}$$

Where Q_s= Lateral Load Distribution at Storey

W_i=Seismic Weight of Structure

H_I=Height of the Structure

V_B=Design Base Shear, which can be determine by using, $V_B = A_h W$

$$A_h = \frac{Z x I x SA}{2x Rxg}$$

Z=Zone factor, I=Importance factor, R=Response reduction factor,

However, the ratio (I/R*)* shall not be greater than 1.0.

S_a / g =Average response acceleration coefficient

3.2 RESPONSE SPECTRUM:-

To carry out the seismic analysis and design of a structure to be built at a exacting location, the definite time history record is necessary. But, it is not likely to have such records at all location. Further, the seismic analysis of structures can't be carry out simply based on the highest value of the ground acceleration as the reaction of the structure depend upon the rate of recurrence content of ground motion and its own dynamic properties. Earthquake response spectrum is the most popular tool to conquer the above difficulties, in the seismic analysis of structures.

There is calculation compensation in using the response spectrum method of seismic analysis for prediction of displacements and member forces in structural systems. The method involve the computation of only the highest values of the displacements and member forces in each mode of vibration using smooth design spectra that are the average of numerous earthquake motions.

Response spectra are curves plot between highest response of SDOF system subjected to specified earthquake ground motion and its time period Response spectrum can be interpret as the locus of highest response of a SDOF system for known damping ratio. Response spectra thus helps in obtain the max out structural responses under linear range, which can be used for obtain lateral forces urbanized in structure due to earthquake thus facilitate in earthquake-resistant design of structures.

Generally response of a SDOF system is determined by time domain or frequency domain analysis, and for a specified time period of system, highest response is picked. This procedure is sustained for all range of probable time periods of SDOF system. Plot with time period on x-axis and response capacity on y-axis is the necessary response spectra pertaining to specific damping ratio and input ground motion. Similar procedure is carried out with dissimilar damping ratios to obtain overall response spectra.

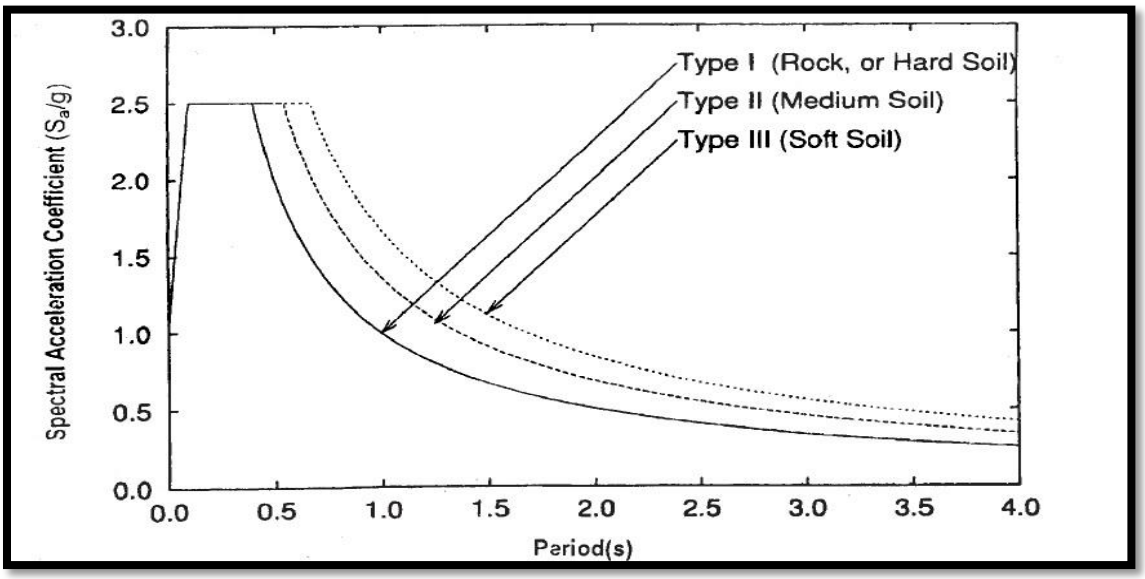

Fig.6 Response Spectrum Curve

The highest response is plotted in opposition to the undamped natural period and for different damping values, and can be uttered in terms of maximum absolute acceleration, maximum relative velocity, or maximum relative displacement.

Table No. : 1 Description of the Structure:

1. Frame type	Special Moment Resisting Frame
2. Building	G+10
3. G+Pod1+Pod2 Storey Heights	4m
4. Typical storey Height	3.2m
5. Plan Dimensions	24m x 24m
6. Size of Columns	
a) Rectangular Column	350mm x 700mm
b) Circular Column	500mm Diameter
7. Size of Beams	350mm x 550mm
8. Slab thickness	125mm
9. Thickness of Wall	200mm
10. Shear wall thickness	230mm

4. DESCRIPTION OF THE STRUCTURE:

The details of the structure like type, size, materials used, height, Plan Dimensions, Loads, assumptions, etc., are given below:

11. Unit weight of RCC	30 KN/m^2
12. Unit weight of Masonry	20 KN/m^2
13. Live Load Intensity on Floor	4 KN/m^2
14. Weight of Floor finish	1 KN/m^2
15. Earthquake load	as per IS 1893
16. Seismic Zone	II
17. Importance factor	1.5
18. Response reduction factor	5
19. Concrete Grade Mix for Slabs, Beams, columns	M30
20. Grade of Rebar Used	Fe500

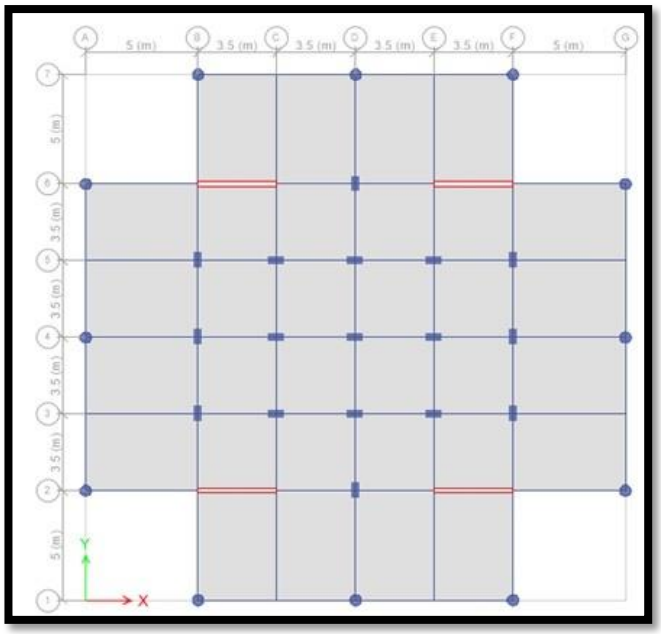

Fig.7 Plan of the Podium Storeys -1 & 2

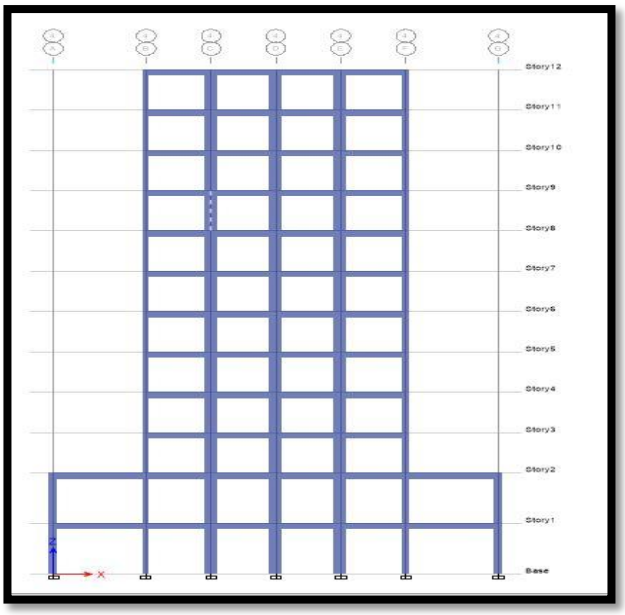

Fig.9 Elevation of building view -1

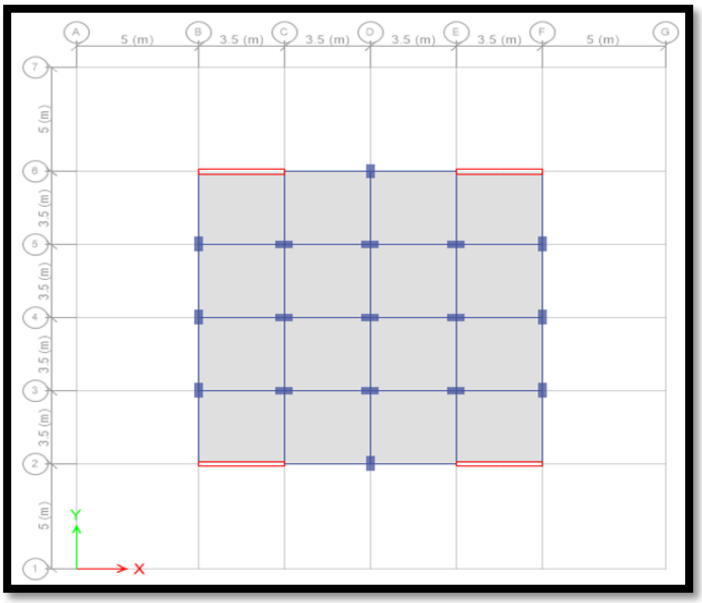

Fig.8 Plan of the Typical Storeys -3 to 10

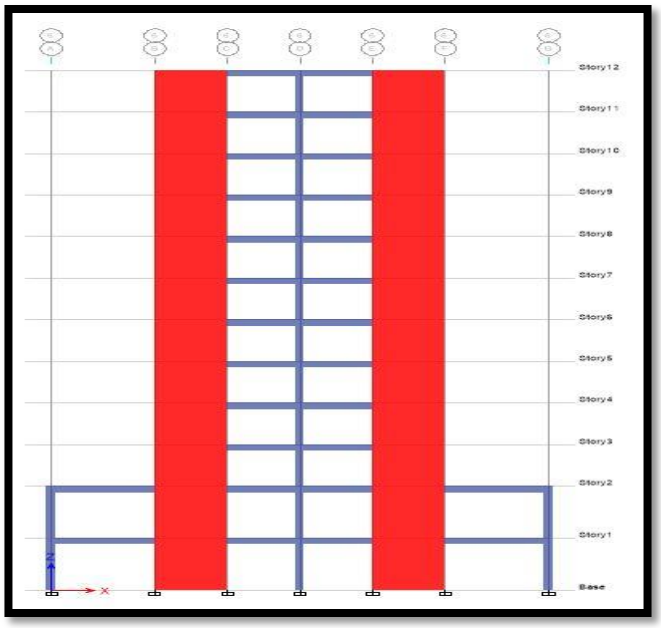

Fig.10 Elevation of building view -2

5. MODELLING OF STRUCTURE:

It is very important to build up a computational model from which design of foundation is perform. The initial part of this chapter presents a summary of a variety of parameters defining the computational models, the basic assumptions and the geometry of the chosen building considered for this study.

Perfect modeling of the nonlinear properties of a range of structural elements is very significant in nonlinear analysis. A thorough description on the nonlinear modeling of RC frames is shown in this report. Modelingof a building involves the modeling and collection of its several load-carrying elements. Model must preferably show the deformability, stiffness strength, and mass distribution. Modeling of the structural elements and material properties used in the current study is discussed below.

In this project structure is analyzed using E-TABS and then the analyzed results are taken and pilefoundation is designed using SAFE. The results are in terms of storey displacement, Storey drift, lateral forces, Fundamental Time period, storey shear, modes shapes etc.

6. OVERVIEW OF ETABS SOFTWARE:

ETABS features commanding and entirely integrated modules for design of both steel and reinforced concrete structures. The program provides the user with choices to create, analyze and design structural models, the entire within the same user interface.

The program gives us an interactive environment in which the user can learn the stress conditions, make suitable changes, for instance revising member properties, and re-examine the results without the need to re-run the analysis. Detailed design data is brought up by a single mouse click on an element. Members can be grouped jointly for design purposes. The output in both graphical and tabulated formats can be readily printed.

The program is prearranged to sustain a ample range of the latest national and international building design codes for the automated design and test out of steel and concrete frame members. The design is depend upon a set of user-specified loading combinations. Yet, the program gives a set of in-built load combinations for every design code supported in ETABS. If the default load combinations are acceptable, no defining of extra load combinations is needed.

The display of the output is clear and concise. The data is in a type that permits the engineer to take proper remedial measures in the occasion of member overstress. Backup design data created by the program is also given for suitable verification of the results.

7. CONCLUSIONS:

From the above detailed study following conclusions have been listed as fallows

- From above detailed study it can be concluded that, modeling of 3D mathematical building models in software like ETABS are more user-friendly in which Earthquake loading can easily be applied according to country's codal provisions.
- Detailed seismic analysis reveals that, analysis and design of multistoried buildings are important in which ignoring the seismic loads will invite sever disaster in earthquake prone zone.
- Modal studies shows that, considered building model is performing excellently according to IS-1893-2002.
- Drifts and Displacements are within the specified limits prescribed by IS codes.
- Shear wall will increases the lateral stability of the building in turn reduce the Lateral displacement and increases base shears.
- Detail piles and piles cap have been modeled in SAFEv12.0. Depth, Punching shear, steel and vertical displacements for all the pile caps are well within the prescribed limits.
- Software like SAFEv12.0 is most suitable for deep foundation analysis and designs.

7.1SCOPE FOR FUTURE WORK:

The work can be extended by considering real time earthquake in the form of time history functions. It can also be extended where plastic hinges are assigned to frame elements, in which performance of the structures for various performance levels can be found out.

When buildings are situated in hilly terrain, where construction of foundation will be challenging task, there soil structure interaction can be done.

8. References:

1. Harry G. Poulos, Coffey Geotechnics, Sydney, Australia on "The Design of High-Rise Building Foundations" in Geotec Hanoi 2011 October.

2. Naw ChoHtetSoe& Dr. Nilar Aye, all Departmentof Civil Engg, Mandalay Technological University, Mandalay, Myanmar on "Design of Suitable Foundation for Twelve-Storey Reinforced Concrete Building" in May-2014.

3. Debasis Roy Dept. of Civil EnggIIT, Kharagpur on Design Of Shallow And Deep Foundations For Earthquakes in March 2013.

4. A. Murali Krishna&A. PhaniTeja Dept. of Civil Engineering, IITGuwahti, Guwahati, Assam, India on Seismic Design of Pile Foundations for Different Ground Conditions inWCEE 2012.

5. Geoffrey R. Martin University of Southern California & Ignatius Po Lam Earth Mechanics, Inc. Fountain Valley, CA, USA, on Seismic Design of Pile Foundations: Structural and Geotechnical Issues in April 1995.

6. Yoshihiro Sugimura Professor, Department of Architecture & Building Science, Graduate School of Engineering, Tohoku University, Sendai, JAPAN &Madan B. Karkee Professor, Dept. of Architecture & Environment System, Akita Prefectural University, Akita, JAPAN on Nature Of Damage To Pile Foundation Of Buildings In Recent Earthquakes And Some Proposals For Seismic Design.

7. András Mahler Dept. of Geotechnics Budapest University of Technology, Hungary on Use Of Cone Penetration Test In Pile Design in December,2004.

8. Baleshwar Singh &NingombamThoiba Singh Dept. of Civil Engg. Indian IIT Guwahati, India on Influence of Piles on Load settlement Behavior Of Raft Foundation inDecember 2011.

BIOGRAPHY:

B DEVA KUMAR YADAV
CIVIL ENGINEERING
GVIC,BES INSTITUTIONS
ANGALLU,
MADANAPALLI,
CHITTOOR DIST.
ANDHRAPRADESH-517325