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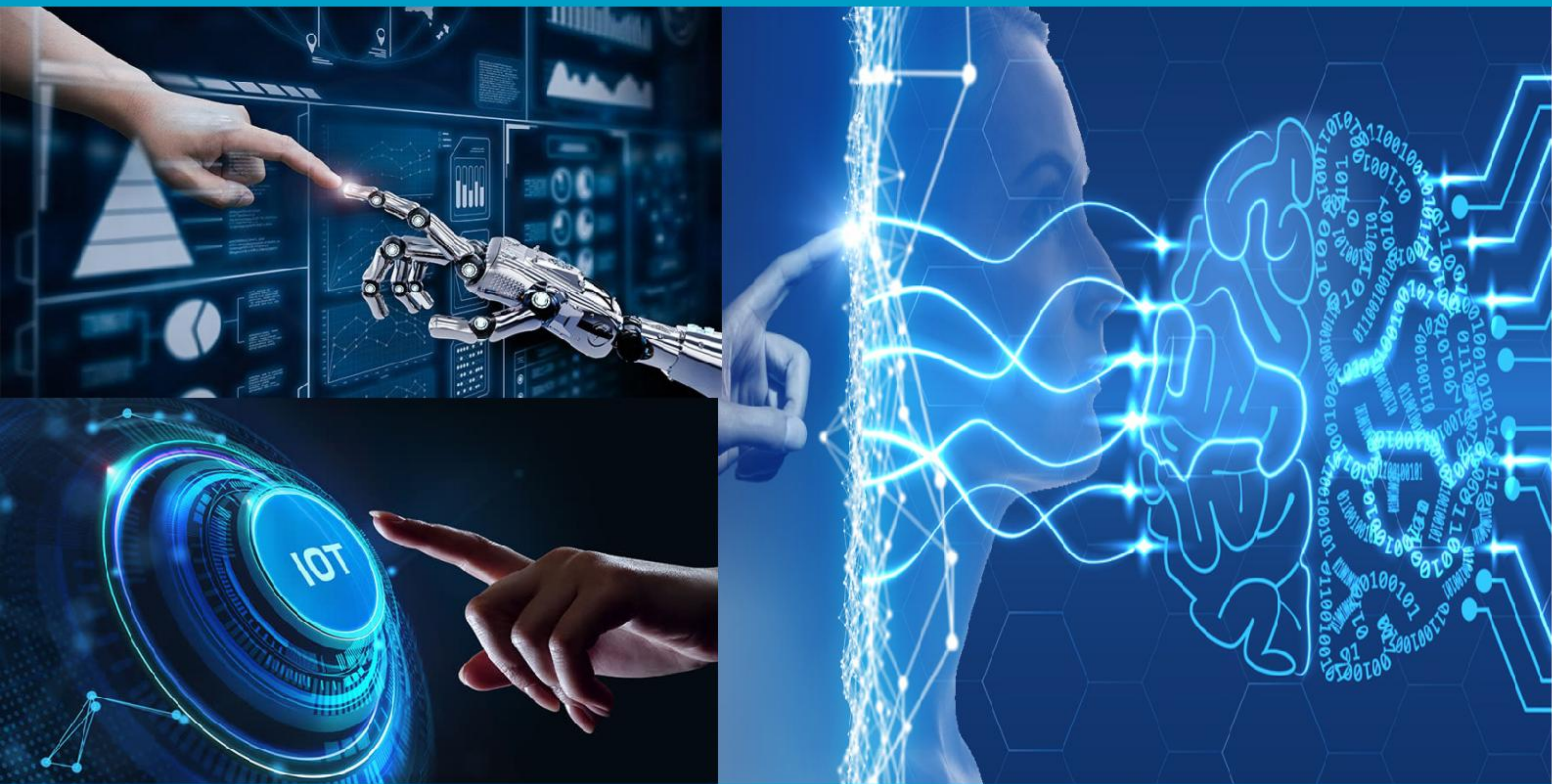

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Seismic Analysis and Design of Hospital Building Using E-Tab

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ABSTRACT: These motions may be felt everywhere on the planet. The structure vibrates as a result of the ground movements, which causes inertial pressures to be exerted on it. Consequently, buildings situated in Seismic zones are built and specified to assure acceptable levels of safety while maintaining acceptable levels of strength, serviceability, and stability in the face of seismic pressures. A significant number of buildings are undergoing seismic-resistant construction at the moment. This is evident from the fact that the performance of a significant number of reinforced concrete buildings that were subjected to strong earthquakes in different regions of the globe was good. Additionally, these codes have outlined the types of earthquakes that can occur. During the course of this investigation, the blueprint for the G+5 Hospital was created using the Auto CAD tool, and the structure was designed with the E-TAB programme. In order to calculate the dead load, the living load, and the seismic load, the formulae IS: 456-2000 and IS 1893: 2002 are used. In order to fulfil the standards given in IS: 1786-1985, we make use of concrete of grade M25 and HYSD bars of type Fe415. At the beginning of the planning process for the project, the seismic load requirements of IS456:2000 were not taken into account at all. After that, the structure is designed while taking into mind the earthquake loads and IS1893: 2002. The detailing has been finished using both of these methods in line with their specifications. The Indian Standard guidelines will be followed by the planned hospital, and these guidelines will be utilised in the research and design of the structure. There are many different sorts of analysis procedures, and each of these processes is dictated by the external stresses, the structural materials, and the structural model.

KEYWORDS: hospital building, E-Tab, ground movements, Seismic zones, seismic-resistant, Auto-CAD

I. INTRODUCTION

Seismic waves are created when the earth's crust suddenly releases energy, which is what causes earthquakes. It's possible that seismic vibrations can go a long way. Studying the effects of earthquakes on building performance requires an understanding of peak ground acceleration (PGA) and peak ground velocity (PGV), peak ground displacement (PGD) and frequency content and duration. In the business world, structural analysis is sometimes referred to as the "backbone" of the industry. Over the course of the last few years, there has been an increasing emphasis placed on doing research on the structures via the use of computer-aided software and hardware. But it isn't always necessary to do such in-depth studies; sometimes, merely an approximation of an analysis will be adequate to suit our objectives, Skyscrapers and other sorts of constructions that have a great number of bays and a number of floors are becoming more common in urban areas these days. The research of the frameworks of multi-story buildings proves to be rather tedious since such frameworks contain an excessive number of joints that are free to wiggle. This makes the analysis of the frameworks of multi-story structures quite hard. Even if the method of distributing moments that is used the vast majority of the time is applied to each and every one of the joints, the quantity of labour that must be performed will nonetheless be quite extensive. However, in order to conduct a preliminary study of the structures, it is necessary to make a number of assumptions and use several replacement analysis approaches. The whole new section of the hospital was constructed with Delhi in mind. The structure that houses the hospital has a total built-up area of 315 square metres and is composed of six storeys (the ground floor plus five more). An orthopaedic ward, The building is currently under construction in Delhi. Because hospitals are such important facilities and must continue to function normally after an earthquake, their exteriors have to be constructed in compliance with the principles that govern earthquake design. The present investigation is centred on the seismic analysis of RC buildings that are (G+6) storeys tall. For this purpose, the structural analysis and design software known as STAAD Pro is being used. The floor design of the hospital has a totally regular arrangement of rooms. Every level is exactly the same height as the one that came before it, giving it a total story height of H = 3 metres. The structure that houses the hospital has a total of seven floors, the lowest of which is the basement. Above ground, it consists of six storeys. Due to the fact that the length of the Hospital building is 21 metres and its width is 15 metres, the area is 315 metres squared.

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Every story uses the same amount of space for its column. The width of the beam remains the same from one level to the next. It is essential to ensure that the structure housing the hospital is capable of withstanding an earthquake. This is due to the fact that the hospital is the most vital location during a catastrophe in which to provide humanitarian relief and medical care. The purpose of this research is to provide comparisons between the study and the design of a hospital building that has G+6 stories. The structure is likely to be subjected to many instances of seismic loads all at once.

It is an essential piece of equipment for quake-prone regions, such as Japan, the north-east of India, Nepal, the Philippines, and many other countries. This type of analysis is especially crucial for the design of components of RCC structures such as beams, columns, and slabs that are developed in compliance to the standard IS 13920:2016. The seismic forces have a dynamic quality, and in order to assess their mass, mass carrying capacity, ductility, wetness, and stiffness, they are subjected to testing. When doing seismic research on multi-storeyed buildings, IS 1893:2016 is the code that is used.

The structural reaction to powerful earthquakes is dynamic, nonlinear, and unpredictable, hence the issue is difficult in theory to solve because of these characteristics. linear, and predictable (or at the very least, can be well approximated as such), all three traits are very uncommon. As a consequence of this, seismic design requires a specific set of abilities and data, neither of which are necessarily possessed by the typical designer. Seismic codes offer a variety of methods for seismic analysis that are geared toward applications in the real world. (It is important to note that the word "code" is used in a wide sense throughout this work, and encompasses not just codes but also standards, recommendations, and particular requirements.) According to Albert Einstein, the procedures that are employed in codes should be "as basic as feasible, but not simpler."

In contrast to this, research that is geared toward the acquisition of new information need to make use of the most cutting-edge analytical, numerical, and experimental techniques available. It is essential to keep in mind that it is not possible to anticipate the particulars of the ground motion that will take place during future earthquakes. On the other hand, the particulars of the dynamic structure reaction, particularly in the inelastic region, are riddled with high levels of uncertainty. According to Aristotle, "the mark of an educated mind is to rest satisfied with the degree of precision which the nature of the subject admits and not to seek exactness where only an approximation is possible . (The sign of an educated mind is) "it is the sign of an educated mind to rest content with the degree of accuracy which the nature of the topic permits and it is the sign of an educated mind to rest satisfied with the degree of precision which the nature of the subject admits and it is"

II. RESEARCH METHODOLOGY AND PROCEDURE

PROCEDURE INVOLVED IN THESE TYPES

In the course of these analyses, which have been covered before, numerous processes are engaged in order to design structures as per seismic conditions in order to safeguard such buildings from damage in the event of an earthquake. The following are some of the procedures:

Equivalent Static Analysis

This has occurred despite the fact that the average design horizontal seismic load increased. Despite the fact that the average horizontal seismic load in the design was raised, this is the result. One nation that went against the grain of this trend was Japan, which in 1950 had already increased the seismic design loads to account for 20 percent of the building's overall weight. In Italy, an estimate of around 10 percent was provided based on inspections of three buildings that were able to resist the earthquake that occurred in Messina in 1908. This was done in 1908 when the earthquake happened. On the other hand, it would seem that those living in other parts of the world were not aware of this study. According to a piece of writing penned by a Japanese engineer by the name of Naito, "In Japan, as in other seismic nations, it is obligatory by the construction code [from 1924 forward] to take into account a horizontal force of at least 0.1 of the gravity weight, operating on every element of the structure." This statement was made in reference to Japan's construction code. Both of these are considered to be valid sources of information. There is no solid basis for this factor, with the sole exception of the fact that the acceleration of the Kwanto earthquake during the first strong section, as determined by the seismographic data gathered at the Tokyo Imperial University, was of this order. Other than that, there is no solid evidence to support this factor. (Reitherman 2012, page number 172) [Citation needed] In the year 1930, Freeman expressed a position that was quite similar to this one. According to what he had to say, "There is a recent idea espoused by seismologists, and incorporated in the preliminary building standards of several California towns, that the engineer should work to a seismic coefficient of 1/10 g.... " When one explores the background of this rule, one realises that it is a matter of opinion rather than a matter of measurement; it is a product not of the seismometer but of the "guessometer." In other words, the genesis of this rule is a matter of opinion rather than a matter

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of measurement. The reasons why ten percent of a building's total weight is regarded as an adequate horizontal seismic load for the purposes of design have changed over the course of time. This is because the phrase "Partial or complete destruction of certain structures" According to the findings, the values that were reported for the peak ground acceleration were far lower than they ought to have been. This is the conclusion drawn from the analysis of the data.

Understand seismic

The seismic analysis is a component of the structural analysis, which includes the computation of how a building would behave in the event of an earthquake. It is an integral aspect of the process of structural design, assessment, and retrofitting in areas prone to earthquakes.

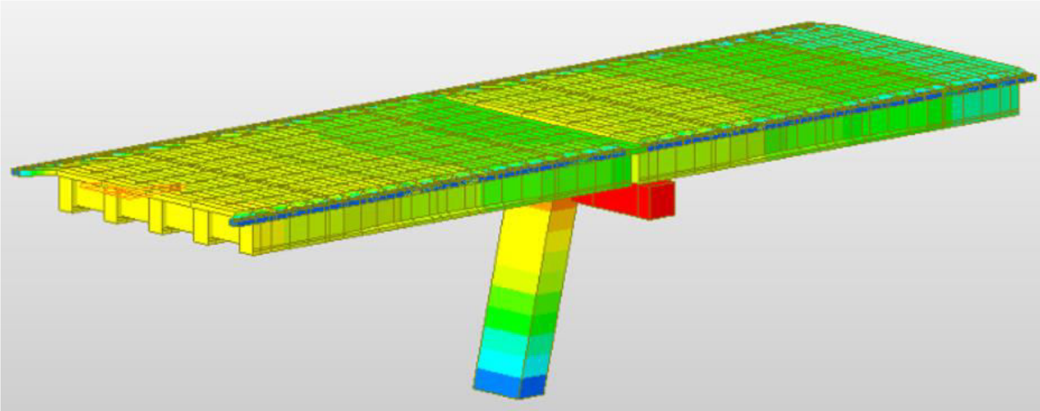

Fig.1: Deformation of PSC bridge under seismic loading

In the past, bridges were not given much consideration when it came to seismic designs. However, as time has progressed, it has been discovered that for a region that is prone to earthquakes, seismic design might be the determining factor. Additionally, when the bridge is exposed to seismic stress and enters the non-linear range, there is a redistribution of forces that occurs, which has to be taken into consideration. In this piece, we will concentrate on gaining an overall comprehension of the many types of seismic analysis that may be carried out.

III. SIMULATION AND DESIGN

The structural design aspect of the subject of civil engineering is often considered as the most essential component of the profession as a whole. These are all examples of building components and elements. The next step in the design process is to figure out where the beams and columns will be put once it has been determined where the main plan of the structure that is to be created will be.

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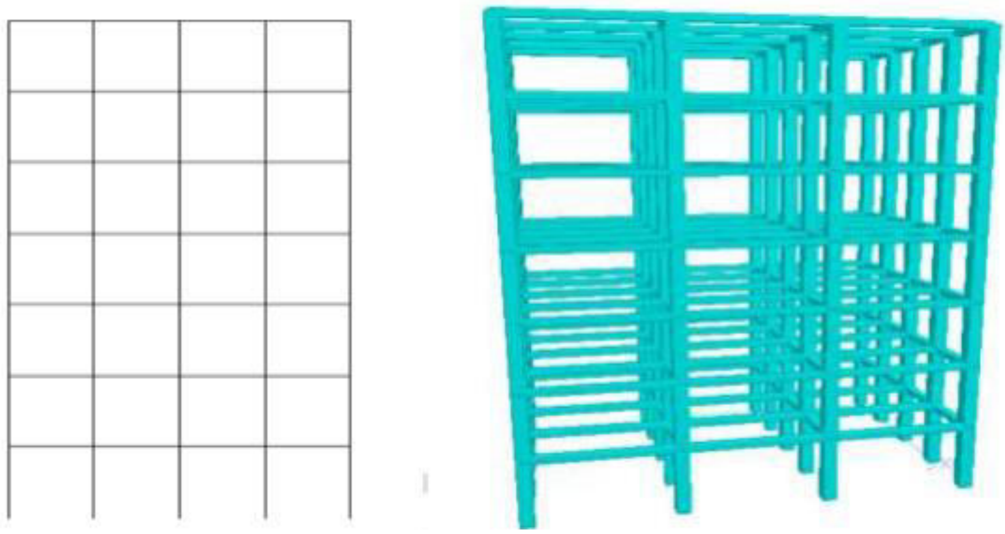

Fig.2: Frame of the proposed Structure and 3D presentation of the Hospital Building (Without Slab)

Once determining the loads, the following stage is to design the component that will initially carry the load, which in this instance will be the slabs. This will be done after the loads have been calculated. The loads are transferred from the slabs to the beams, where they are then received by the beams.

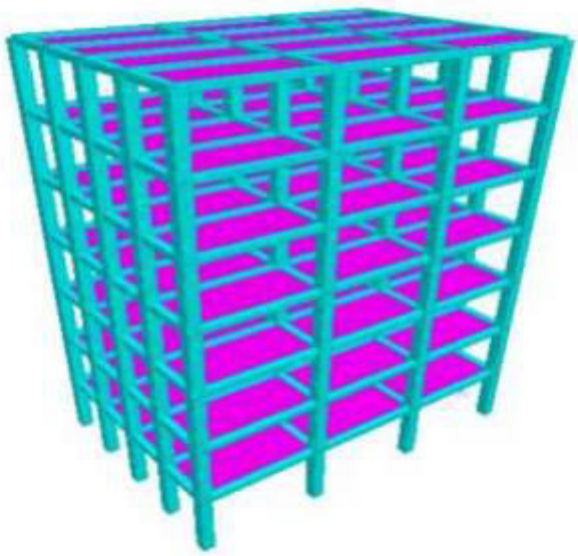

Fig.3: Isometric view ofHospital Building

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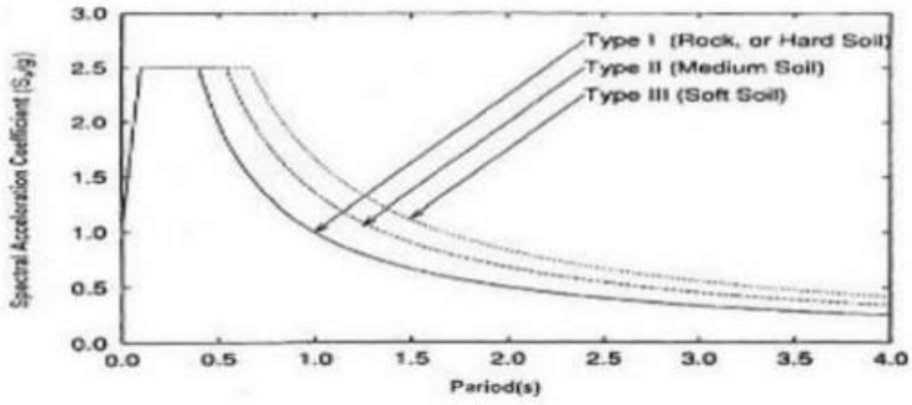

Fig 4: Standardized Soil Classification Graph

After that, the loads, the majority of which are shear, are passed from the beams to the columns. When designing columns, it is critical to have a solid grasp of the conditions to which they will be subjected at various points in time. For the purpose of doing this, the Moment Distribution Method for frame analysis is used. In the end, the loading from the column as well as the soil carrying capacity value for that particular location are what define the design of the footings.

Table 1: Dead and Live Loads Table

Gravity loads	
Dead and Live loads	Value
Slab load	2.25 kN/m2
Wall load	16.6kN/m
Floor finish	1.5kN/m2
Live load	4kN/m2

Static forces that remain relatively constant over a lengthy period of time are known as dead loads. They may be in either tension or compression at any one time. This phrase may relate to a technique of testing performed in a laboratory, or it may refer to the typical use of a material or construction. Variable or moving loads are often referred to as live loads. These may have a considerable dynamic component and may entail things like impact, momentum, vibration, the slosh dynamics of fluids, and other things along those lines.

Table 2: Properties of concreate

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Properties of Concrete and Steel bar as Per IS 456171			
Concrete Properties		Steel Bar Properties	
Unit weight (yc)	25 kN/m3	Unit weight (ys)	76.33kN/m3
Modulus of elasticity	21718.8MPa	Modulus of elasticity	2x105MPa
Poisson ratio (vs.)	0.17	Poisson ratio (vs)	0.3
Thermal coefficient (ac)	1x10-5	Thermal coefficient(as)	1.2x10-5
Shear modulus (cc)	9316.95MPa	Shear modulus (Ss)	76.8195MPa
Damping ratio (c c)	5%	Yield strength	415MPa
Compressive strength (Fc)	25MPa	Compressive strength (Fs)	485MPa

Table 3: Structural element used

Beam and column length and cross section dimension.

Structural Element	Cross section (mm x mm)	Length (m)
Beam in (x) longitudinal direction	300 X 300	10 m
Beam in (z) transverse direction	300 X 300	15m
columns	450 X 450	21m(3mx7m=21m)

Table 4: Zone Factors Values

Zone factor values

Seismic Intensity	Seismic Intensity Seismic Zone	Z
low	1	0.10
Moderate	2	0.16
severe	3	0.26
Very severe	4	0.32

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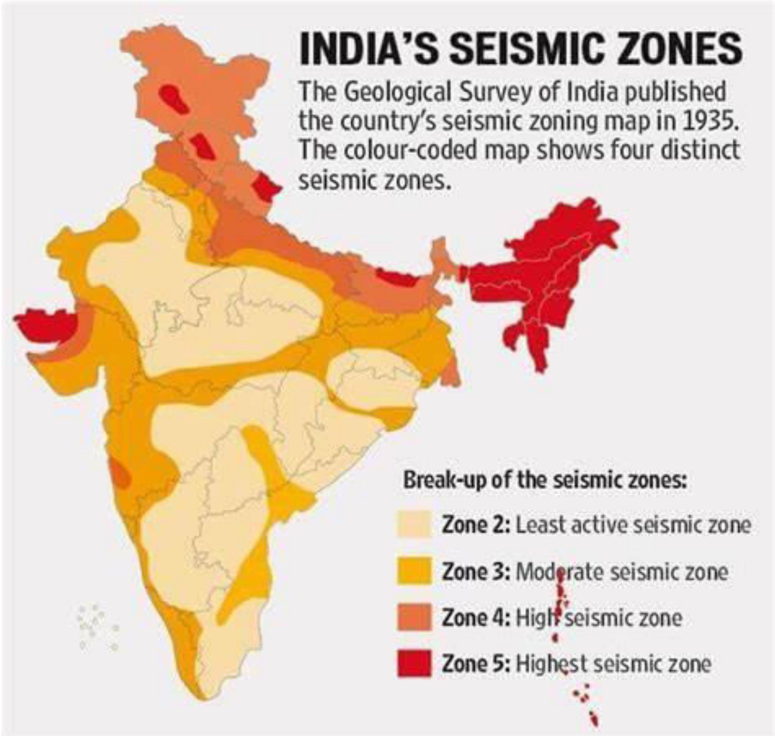

Fig 5:SeismicValue Zone

A region that is at a certain degree of risk owing to the potential for earthquakes is referred to as a seismic hazard zone. A seismic hazard zone is considered to be high when it is located in close proximity to a seismic zone that is known to have a high number of earthquakes, whereas a seismic hazard zone is considered to be low when it is located farther away from a seismic zone.

Calculation

- Footing Geomtery

Design Type: Calculate Dimension

Footing Thickness (Ft): 305.000 mm

Footing Length - X (Fl): 1000.000 mm

Footing Width - Z (Fw): 1000.000 mm

Eccentricity along X (Oxd) : 0.000 mm

Eccentricity along Z (Ozd): 0.000 mm

Column Dimensions

Column Shape : Rectangular

Column Length - X (Pl): Column Length - X (Pl) :0.450 m

Column Width - Z (Pw): 0.450 m

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Consider Parament for Budling design (Hospital Standard as per the Software suggested in above analysis)

Concrete and Rebar Properties

Unit Weight of Concrete: 25.000 kN/m3 Minimum Bar Size: Ø6

Strength of Concrete: 25.000 N/mm2 Maximum Bar Size: Ø32

Yield Strength of Steel: 415.000 N/mm2 Minimum Bar Spacing: 50.000 mm

Maximum Bar Spacing: 500.000 mm Pedestal Clear Cover (P, CL): 50.000 mm

Footing Clear Cover (F, CL): 50.000 mm

The G+5 Hospital building was drafted in the Auto CAD programme in this research, and the E-TAB software was used to design the structure (including the beams, columns, footings, and seismic load analysis by applying the equivalent static approach). The formulas IS: 456-2000 and IS 1893: 2002 are used in the computation of the dead load, the living load, and the earthquake load. Concrete grade M25 and HYSD bars Fe415 are used in accordance with the requirements of IS: 1786-1985. Initially, the building was planned without any consideration for seismic loads in accordance with IS456:2000. After that, the building is developed taking the earthquake loads and IS1893: 2002 into consideration. The detailing has been completed in accordance with both of these techniques. The proposed hospital follows the Indian Standard norms were used for the study and design of the building. There are many distinct kinds of analysis processes, each of which is determined by the external loads, structural materials, and structural model. Some examples of these processes are linear static analysis, linear dynamic analysis, nonlinear static analysis, and nonlinear dynamic analysis.

V. CONCLUSION AND FUTURE SCOPE

During an earthquake, horizontal and vertical ground motions radiate from the epicentre. These movements are global. Ground motions cause the structure to shake, causing inertial pressures. In seismic zones, buildings are developed and specified to provide appropriate levels of safety, strength, serviceability, and stability. Several structures are now being made earthquake-resistant. Several reinforced concrete structures that were exposed to large earthquakes across the world performed well, proving this. The Indian standard codes IS: 1893-1984 and IS: 13920-1993 provide earthquake-resistant design standards, earthquake probability, structural and foundation features, and permissible damage. These codes also include earthquake kinds. During this inquiry, the G+5 Hospital was developed utilising Auto CAD and E-TAB (including the beams, columns, footings, and seismic load analysis by applying the equivalent static approach). IS: 456-2000 and IS 1893: 2002 are used to determine dead, living, and seismic loads. We employ M25 concrete and Fe415 HYSD bars to meet IS: 1786-1985 specifications. At the start of project planning, IS456:2000 seismic load criteria were ignored. The structure is then developed using IS1893: 2002 and seismic loading. Both approaches were used to complete the details as specified. The projected hospital would follow Indian Standard criteria for research and design. External stresses, structural materials, and the structural model determine each analytical approach. This category includes linear static, linear dynamic, nonlinear static, and nonlinear dynamic analyses.

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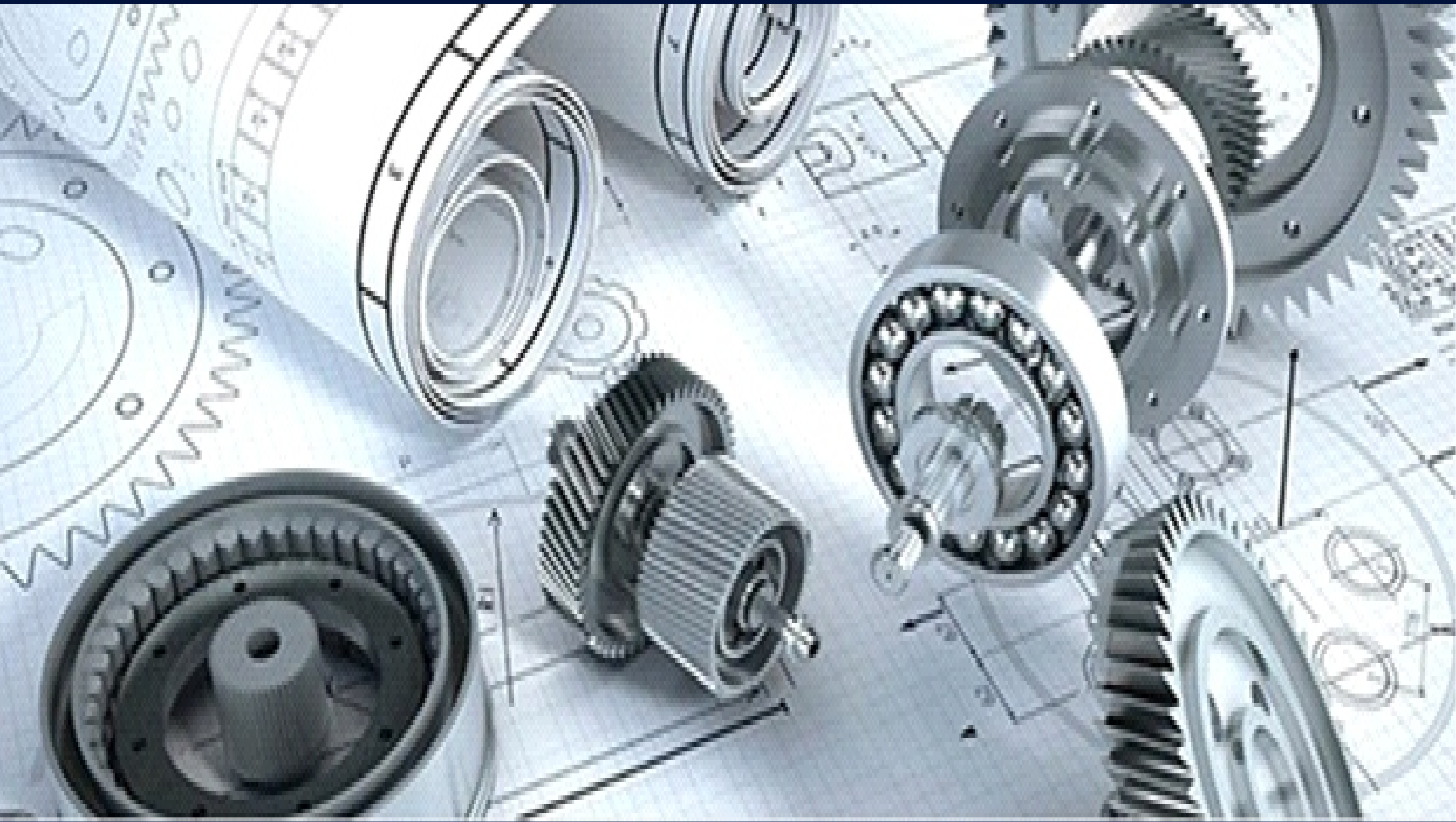

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