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Full Length Research Article

Analysis And Design Of Hospital G+3 Using Etabs

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Abstract
Every building has got its form, function and aesthetics. We consider that the Architects will takeof them and the structural engineer will be responsible for strength and safety of structure. A building or structure should be constructed according to Indian Standard specified by the concerned department. Generally there are different types of buildings such as Residential, Commercial centers, Offices and Educational and Institutional buildings, Government offices, etc. E-tabs allows structural engineers to analyse and design virtually any type of structure through its flexible modelling environment, advanced features and fluent data collaboration. In this project we have designed a Primary health center building (RCC) using E-tabs which includes design of constituent elements such as slabs, beams, columns and footings. Study ofloads acting on building and R.C.C design with reference to IS875 and IS456-200. We conclude that E-tab is a very powerful tool which can save much time and is very accuratein Designs. Primary Health Centre (PHCs), sometimes referred to as public health centers are state-owned rural health care facilities. They are essentially single-physician clinics usually with facilities for minor surgeries, thus it is concluded that E-tab package is suitable for the design of a multistore building.

KEYWORDS*: Primary Health Centre (PHC), Reinforced Concrete (RCC), ETABS Software, Structural Analysis, Structural Design,*

INTRODUCTION

A building is a man-made structure with a roof and walls standing more or less permanently in one place. Buildings come in a variety of shapes, sizes and functions, and have been adapted throughout history for a wide number of factors, from building materials available, to weather conditions, to land prices, ground conditions, specific uses and aesthetic reasons. To better understand the term building compares the list of structures. Buildings serve several needs of society – primarily as shelter from weather, security, living space, privacy, to store belongings, and to comfortably live and work. A building as a shelter represents a physical division of the human habitat (a place of comfort and safety) and the outside (a place that at times may be harsh and harmful). Ever since the first cave paintings, buildings have also become objects or canvases of artistic expression.

In recent years, interest in sustainable planning and building practices has also become an intentional part of the design process of many new buildings. A slab is a flat two dimensional planar structural element having thickness small compared to its other two dimensions. It provides a working flat surface or a covering shelter in buildings. It primarily transfers the load by bending in one or two directions. Reinforced concrete slabs are used in floors, roofs and walls of buildings and as the decks of bridges. The floor system of a structure can take many forms such as in situ solid slab, ribbed slab or pre-cast units. Slabs may be supported on monolithic concrete beam, steel beams, walls or directly over the columns. Concrete slab behave primarily as flexural members and the design is similar to that of beams.

ETABS

In the last 30 years TABS and ETABS have set the international standards in structural analysis and design. They first took into consideration the characteristic properties of a building's mathematical model, thereby allowing the graphical creation of a building's model in the same sequence that will actually be constructed (slab by slab, floor by floor). Worldwide, ETABS is considered the most popular analysis and design software. The "Top Seismic Product of the 20th Century" (2006) and "Honour Award in Engineering Software" (2002) awards, establish it as the innovator in structural analysis and design and the reference point for the entire market.

The latest version of ETABS continues in that tradition, incorporating structural element terminology that is used on a daily basis (Columns, Beams, Bracings, Shear Walls etc.), contrary to the common civil engineering programs that use terms such as nodes, members etc. Additionally, it offers many automatic functions for the formation, analysis and design of the structural system in an efficient, fast and easy way. The user can easily create a model, apply any kind of load to it and then take advantage of the superior capabilities of

ETABS to perform a start or art analysis and design. ETABS is the solution, whether you are designing a simple 2D frame or performing a dynamic analysis of a complex high-rise that utilizes non-linear dampers for inter-story drift control.

AREAS OF APPLICATION

Analysis and design of building structures with a structural system consisting of beams, slabs, columns, shear walls and bracings. Different materials can be assigned to the structural elements within the same model such as steel, RC, composite or any other user-defined material

Easy and automatic generation of gravity and lateral loads (seismic and wind loads) when compared with other FE general analysis programs

ADVANTAGES

- Graphic input and editing for easy and fast model generation
- 3D generation of the model through plan views and elevations

  Fast model generation using the concept of Similar stories
- Easy editing through the Move, Merge, Mirror and Copy commands
- Accuracy in dimensions by using Snaps (end, perpendicular, middle etc.)
- Fast object creation with one click of the mouse
- Multiple viewing windows.
- 3D view with zoom and pan capability
- 3D axonometric view of the model, plan view, elevation view, elevation development view, custom view defined by the user
- Graphic input of cross sections of any geometry and material (Section Designer)
- Copy and Paste of the geometry of a model to and from spreadsheets
- Export of the model geometry to .dxf files
- Integration with EC – Praxis 3J for the analysis and design of steel connections
- Integration with STEREOSTATIKA for easy import of model geometry and design of RC structures according to Greek Code

OBJECTIVE

The main objective of this study is to identify various parameters that affected the flat slabs. Analysis and Design of Hospital G+3 Story building using E-TABS. The ETABS stands for extended 3D analysis for building system. This is based on the stiffness matrix and finite element based software. The analysis and design is done to satisfy all the checks as per Indian standards. Finally data base is prepared for various structural responses.

SCOPE OF WORK

The analysis is implemented for Analysis and Design of of Hospital G+3 Story building using E-TABS. The structure is analysed for both gravity and lateral loads (seismic and wind loads). The individual structural elements are designed for worst load combinations.

1. LITERATURE SURVEY

Youssef (2001) has worked on Seismic design and analysis of underground structures. Underground facilities are an integral part of the infrastructure of modern society and are used for a wide range of applications, including subways and railways, highways, material storage, and sewage and water transport. Underground facilities built in areas subject to earthquake activity must withstand both seismic and static loading. Historically, underground facilities have experienced a lower rate of damage than surface structures.

Iunio Iervolino (2005) Record Selection for Nonlinear Seismic Analysis of Structures. This study addresses the question of selection and amplitude scaling of accelerograms for predicting the nonlinear seismic response of structures.

M. Kutanis (2002) has worked on earthquake analysis of building structures with foundation uplift in downtown Adapazarı.

Kiyoshi has worked on seismic analysis of reinforced concrete building. Open rectangular continuous frames are the most convenient construction element insofar as usable space is concerned.

Peter Fajfar (2000) has worked on A Nonlinear Analysis Method for Performance Based Seismic Design. A relatively simple nonlinear method for the seismic analysis of structures (the N2 method) is presented. It combines the pushover analysis of a multi degree-of-freedom (MDOF) model with the response spectrum analysis of an equivalent single-degree-of-freedom (SDOF) system.

2. MODELING OF THE STRUCTURE

GENERAL

R.C moment resisting frame structure having G+3 storey is analysed for garvity and latral load (earth quake and wind loads). The effect of axial force, out of plane moments, lateral loads, shear force, storey drift, storey shear and tensile force are observed for different stories. The analysis is carried out using ETABS and data base is prepared for different storey levels as follows.

MODELLING OF R.C MOMENT RESISTING FRAME STRUCTURE

In this present study G+3 Hospital building is considered. The constriction Technology is R.C.C frame structure and slabs. The modelling is done in ETABS as follows.

- The structure is divided into beam and column elements.
- The nodes are created as plan architect plan and node are connected through beam command, columns also connected.
- Boundary conditions are assigned to the nodes

wherever it is required. Boundary conditions are assigned at the bottom of the structure i.e., at ground level where restraints should be against all movements to imitate the behavior of structure.

- The material properties are defined such as mass, weight, modulus of elasticity, Poisson's ratio, strength characteristics etc. The material properties used in the models.
- The geometric properties of the elements are dimensions for the section.
- Elements are assigned to structure.
- Loads are assigned to the joints as they will be applied in the real structure.
- The model should be ready to be analysed forces, stresses and displacements

3. ARCHITECTURE

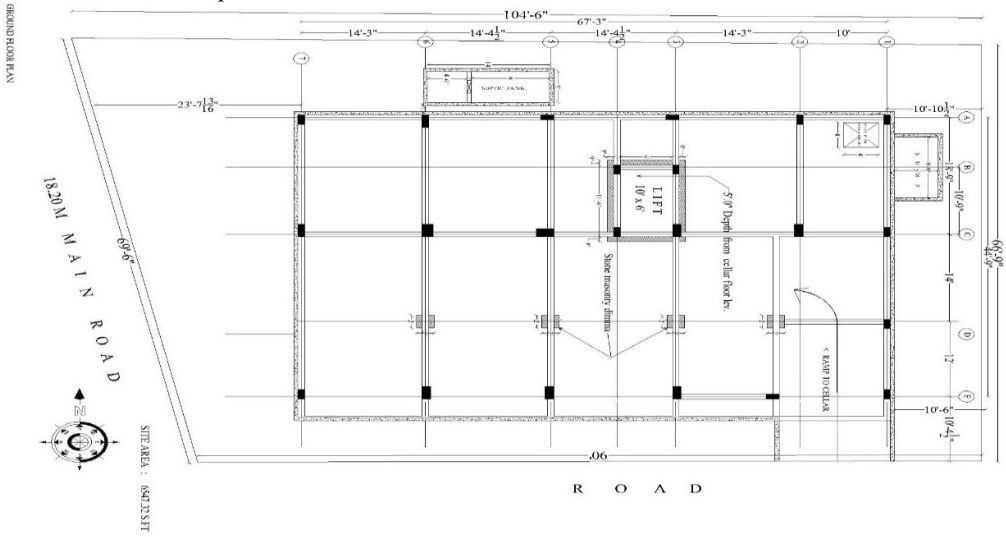
Architecture is the art and science of designing buildings and structures. Wider definition would include within its scope also the design of the total built environment, from the macro level of creating furniture. In the field of building architecture, the skill demanded of an architect range from the more complex, such as for a hospital or stadium, to the apparently simpler, such as planning residential houses. Many architectural works may be seen also as cultural and political symbols, and or work of art. The role of architect though changing, has been central to the successful design and implementation of pleasing built environments in which people live.

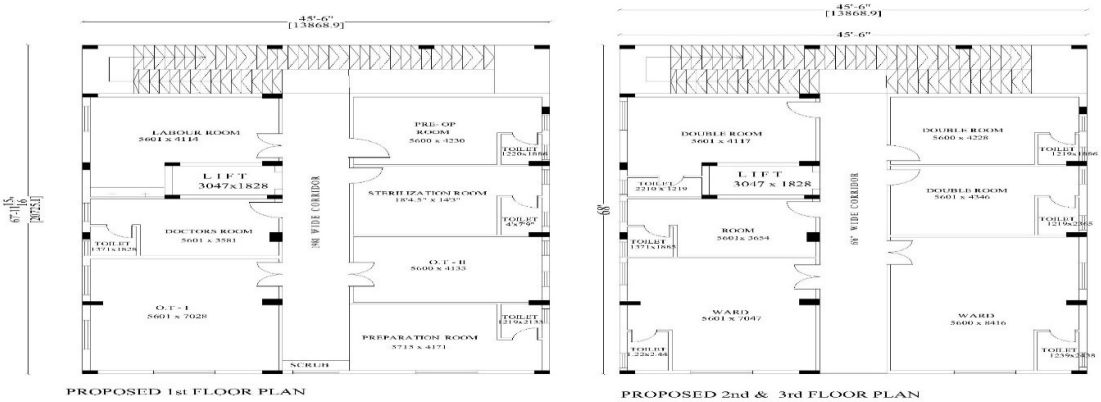
Scope:

The term can be used to connect the implied architecture of abstract things such as music or mathematics the apparent architecture of natural things, such as geological formations or the structure of natural things such as geological formations or the structure of natural things such as geological formation or the structure of biological cells, or explicitly planned architectures of human made things such as software, computers, enterprises, and databases, in addition to buildings. In every usage san architecture may be seen as subjective mapping fro, a human perspective (that of the user in the case of abstract or physical art I facts) to the elements or components.

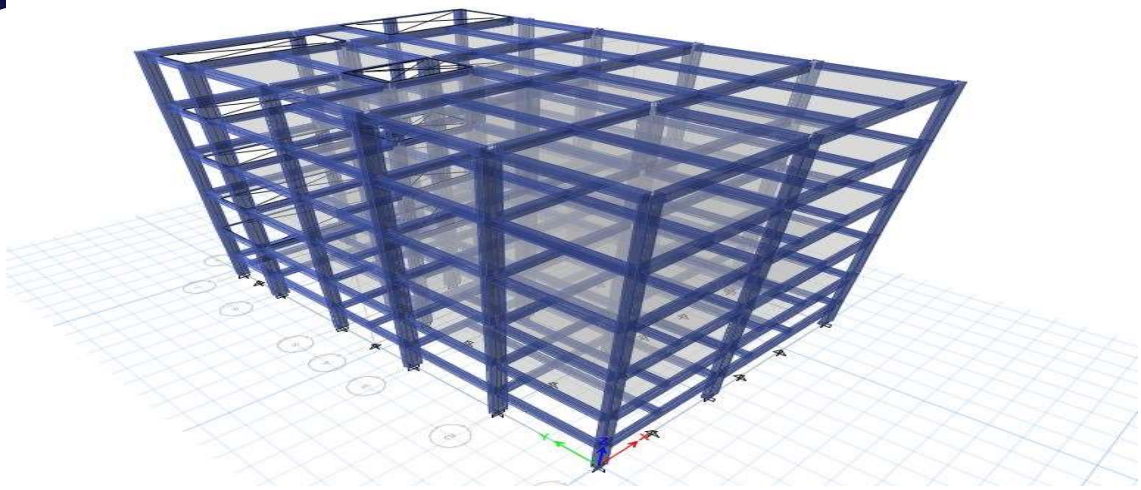
ARCHITECTURAL LAYOUT DRAWINGS

GROUND FLOOR PLAN





FLOOR PLAN



3D view of the structure

ANALYSIS AND RESULT

GENERAL

Structure having G+3 storey is analysed for garvity and latral loads (sesimic and wind load). The effect of axial force, out of plane moments, lateral loads, shear force, storey drift, storey shear and tensile force are observed for different stories. The analysis is carried out using ETABS and data base is prepared for different storey levels as follows.

LOAD CASES AND LOAD COMBINATIONS

Load calculations

WALL LOAD:

Unit weight of brick = 19.0 kN/m3
Floor height = 3.0 m
Beam depth = 0.450 m
Inner wall beams= (3.2-0.45) * 0.115* 19
= 6.0 kN/m

9" Or (230MM) Brick wall = (3.0-0.450) x 0.230 x 19
= 12 kN/m

Railing load or Parapet wall load = 1.2 X 0.1 X19
= 2.3 kN/m

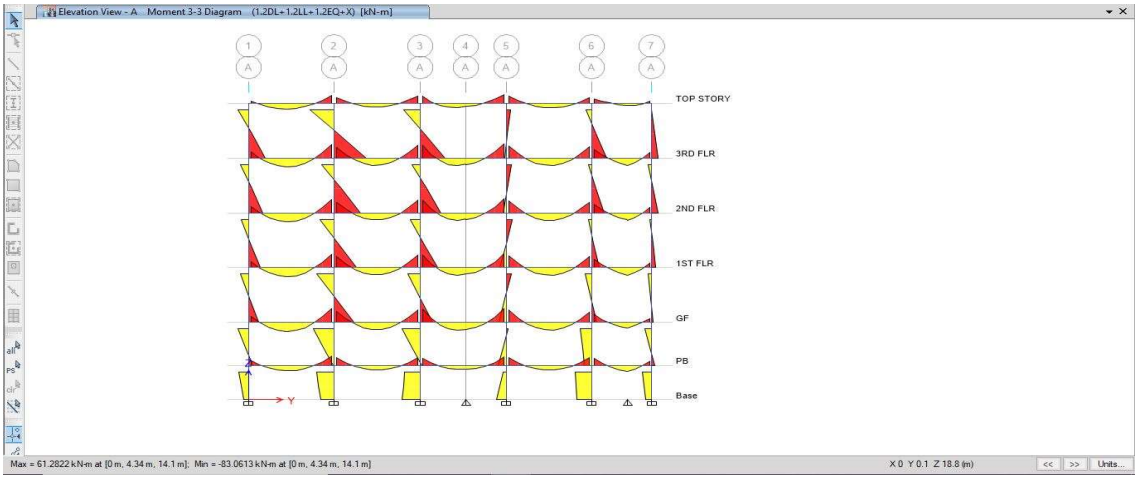
FLOOR LOADS

Imposed loads: - Asper IS875 part-II

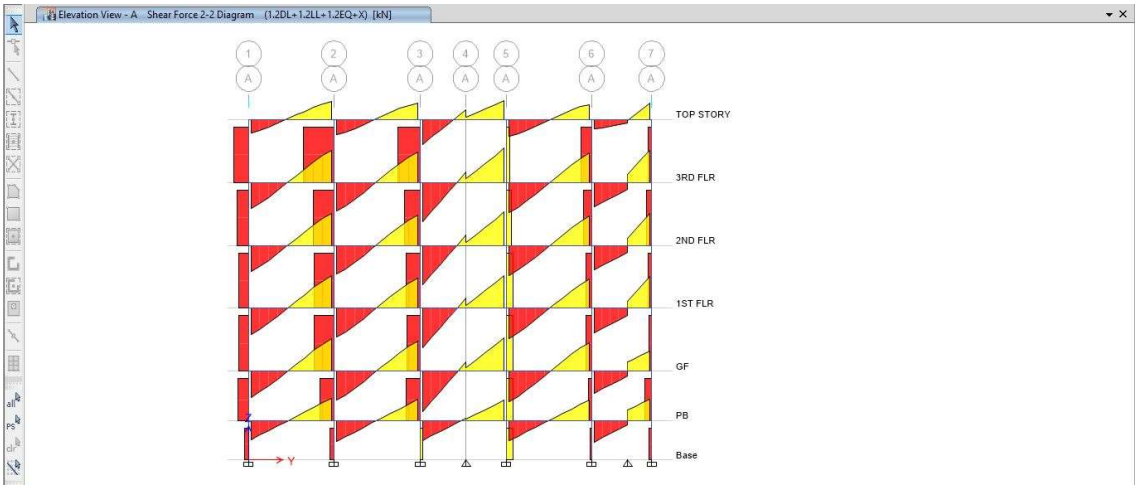
i. All rooms and kitchens – 2.0 kN/m^2
ii. Toilets and bath rooms – 2.0 kN/m^2
iii. Corridors, passages, staircases Including fire escapes and store rooms – 3.0kN/m^2
iv. Balconies – 3.0kN/m^2
v. Commercials , Retail Mercantile Cafeterias and restaurants & Public lounges – 4.0kN/m^2

ANALYSIS RESULTS

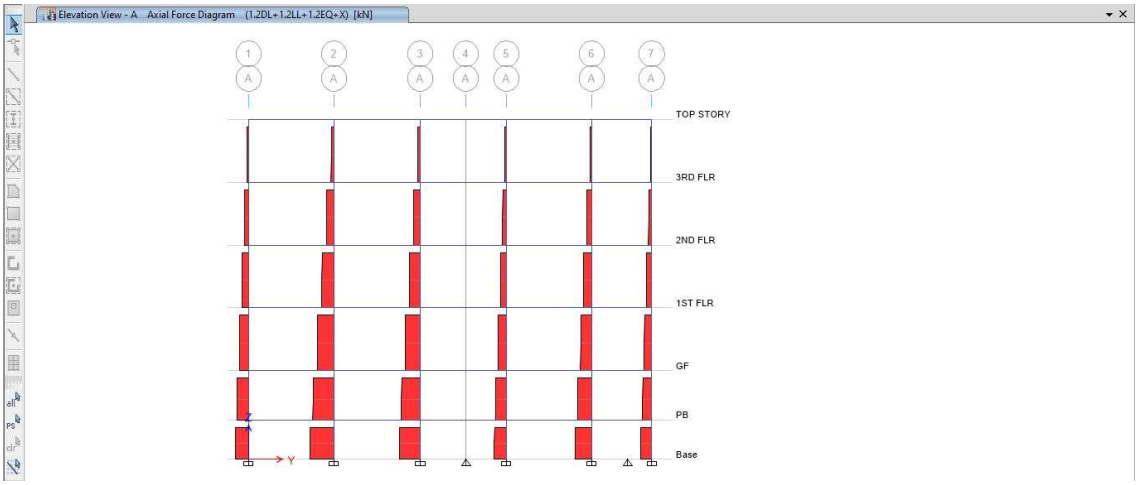
BENDING MOMENT OF FRAME A



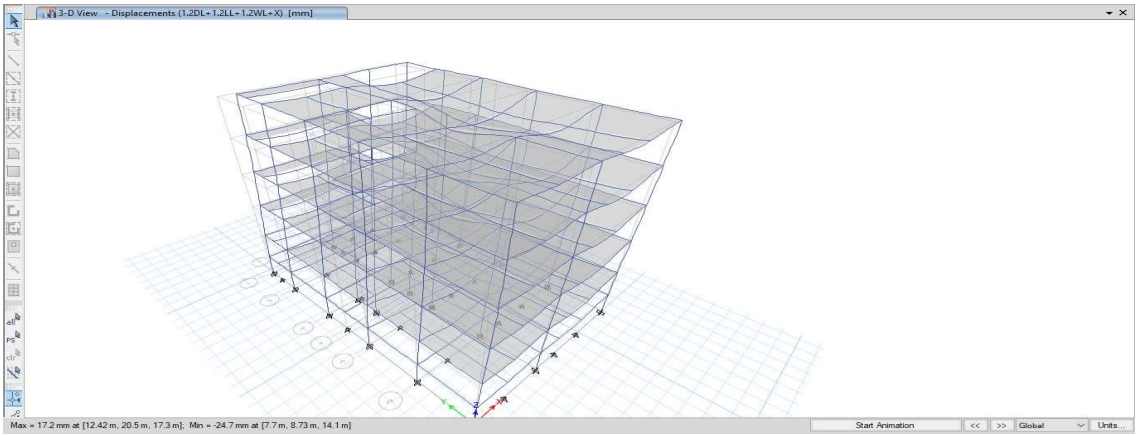
SHEAR FORCE MOMENT OF FRAME A



AXIAL FORCE OF FRAME A



DEFORMED SHAPE



4. Conclusions

Hospital building targets can be achieved by replacing the conventional methods of planning and executing building operation based on special and individual needs and accepting common denominator based on surveys, population needs and rational use of materials and resources. Adoption of any alternative technology on large scale needs a guaranteed market to function and this cannot be established unless the product is effective and economical. Partial prefabrication is an approach towards the above operation under controlled conditions. The essence lies in the systematic approach in building methodology and not necessarily particular construction type or design. The methodology for low cost housing has to be of intermediate type- less sophisticated involving less capital investment.

E-tabs has the capability to calculate the reinforcement needed for any concrete section. The program contains a number of parameters which are designed as per IS: 456(2000). Beams are designed for flexure, shear and torsion.

Design for Flexure:

Maximum sagging (creating tensile stress at the bottom face of the beam) and hogging (creating tensile stress at the top face) moments are calculated for all active load cases at each of the above mentioned sections. Each of these sections are designed to resist both of these critical sagging and hogging moments. Where ever the rectangular section is inadequate as singly reinforced section, doubly reinforced section is tried.

Design for Shear:

Shear reinforcement is calculated to resist both shear forces and torsional moments. Shear capacity calculation at different sections without the shear reinforcement is based on the actual tensile reinforcement provided by STAAD program. Two-legged stirrups are provided to take care of the balance shear forces acting on these sections.

Beam Design Output:

The default design output of the beam contains flexural and shear reinforcement provided along the length of the beam.

Column Design:

Columns are designed for axial forces and biaxial moments at the ends. All active load cases are tested to calculate reinforcement. The loading which yield maximum reinforcement is called the critical load. Column design is done for square section. Square columns are designed with reinforcement distributed on each side equally for the sections under biaxial moments and with reinforcement distributed equally in two faces for sections under uni-axial moment. All major criteria for selecting longitudinal and transverse reinforcement as stipulated by IS: 456 have been taken care of in the column design of STAAD.

BIBLIOGRAPHY

We have used a number of books and code as a reference for carrying out this project work. Some of the books (s) that we refer are mentioned below.

INDIAN STANDARD CODE

- IS CODE 456-2000
- IS CODE 875-1987 PART I
- IS CODE 875-1987 PART II
- IS CODE 875-1987 PART III
- DESIGN AIDS TO IS -456-2000 (SP 16)
- ARRANGEMENT OF REINFORCEMENT USING SP 34