

Design, Analysis and Cost Estimation for the Proposed Hostel Building

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ABSTRACT: The principle of the work is to gain the idea of art and science of designing multi-storied structure with economy, elegance, safety, serviceability and durability. It also deals with problems involved and to gain ability over solving the problems. This has been an excellent opportunity for us to put into the engineering Knowledge which has been acquired during the curriculum. The entire process of structural planning and design requires not only imagination and conceptual thinking but also Knowledge of structural engineering besides Knowledge of practical aspects, such as relevant design codes and bye laws, backed up with ample experience, intuition and judgment.

KEYWORDS: Safety, Serviceability, Durability, Design codes

I. INTRODUCTION

Any construction project in general, begins with the wish of the builder or the client to build a building and architecture who gives a form to the needs of the builder. The role of a structural engineer who configures the building for the requirements so that the structure serves the intended function with structural safety and stability at a minimum possible cost. This project work aims at systematically summarizing the various processes undergone in accomplishing a typical structural design project. The basic objective of our project is the design & analysis of a proposed hostel building at **ATME College of Engineering, Mysuru**, having G+3 floors. The project work involves different faces of civil engineering like Architectural designs & Structural analysis & design by considering Dead Load, Live Loads and its combinations. All design & analysis are done by computer aided design softwares like Auto Cad, Archi Cad, Revit Architecture, & E-Tabs.

At the outset we were exposed to various codes and design standards that form the basis for the structural design work in our country. We went through the special publications of the Bureau of Indian Standards (IS 456:2000, IS 875: 1987 & SP 16:1980), National Building Design Codes for architectural aspects and MUDA Bylaws. At the same time, we also gave importance for the conceptual principals of structural analysis and design.

II. RELATED WORK

B.N.Dutta Estimating and Costing in Civil Engineering (2018): has focused on various methods of estimating and costing of quantities. It emphasizes on the calculations of quantities of materials, tools, equipment, labours etc. and cost associated with them. It consists of numerous examples of estimation of buildings, RCC works, culverts, bridges, etc.

Method of preparing preliminary estimates, analysis of rates, specification, methods of measurements have been dealt in detail with illustration. Many technical data have been included.

In Design and Estimation of a reinforced building: A Case Study (IOSR Journal of Mechanical and Civil Engineering), the cost of various structures of the administrative block of the building are worked out and the design part is done with the help of IS Code 457:2000.

Murat Gunduza et.al (2015): has studied an early cost estimation model for hydroelectric power plant projects. The main indicators considered and studied in this paper are the amount of energy generated in a hydroelectric power plant and the cost of investment and there by decide whether a project investment is feasible or not. Cost of the project is calculated by detailed hydrological study, site investigation, good basin planning, geotechnical survey and various tests of the soils. Multiple regression method and artificial neural network analysis are taken for the validation. The models are developed by the data collected from forty nine hydroelectric power plant projects and five projects are used for the



validation of the models. Comparisons of validation results revealed that the regression model had a 9.94%, and neural network model had 5.04% prediction accuracy. In this paper the neural network shows more prediction accuracy than the regression analysis.

Alfredo Serpell et.al (2013): studied about the cost estimation of new construction projects using an integrated, computer based approach. The paper studies the limitations of computer programs based on parametric estimating methodologies and CBR. Historical data was effectively reused in the modeling which is used by the CBR method. 17 historical data's of construction were selected for the validation purpose. The system produced a suitably detailed and accurate cost estimate for each of the tested projects. This method generates estimates of construction projects with more accuracy and in an efficient way. The automation and support of CBR problem solving seems to make possible to carry out the scope definition process of a project in a short time and without too much effort. Each stage of the process can be assisted without the participation of manual information handling.

Hossein Shams Mianaei et.al (2012): have studied about the estimated cost for drilling wells using the cost estimation method Case Based Reasoning. It is obtained by studying the historic data's and their problems and uses the data's to solve new similar problems. The major findings of his study is that in the proposed CBR model despite limited data, the error of method according to the performance indicators was very low. Therefore, obtained estimation accuracy of the proposed CBR model is high and the model is useful. On the other hand, given that the available estimation methods spend much time to estimate cost, we could save time using the CBR method. In his proposed CBR method, if a feature doesn't have the value, it does not affect the model. While in other methods, if a feature doesn't have the value then the model is not solved. By this method the speed of drilling which is very important is increased.

III. METHODOLOGY

The entire work is divided into three parts:

- Architectural Design and Drafting
- Modelling and Analysis
- RCC design

Architecture is a very broad and humanistic field that is at the same time technical, artistic and social. Today, however, the broad scope of construction, the demand for a wide array of different structures and the general tendency to specialization, very present in the construction field, have resulted in architecture being often divided in several different specializations.

Based on the architectural requirements, it was decided that the structure shall be of a slab and beam type building (RCC framed structure). The location of beams and columns are decided in view with the architectural requirements and they shall also comply with the necessary structural requirements.

The proposed building has framing system consists of columns, beams and slab system. In building the slab sunk unless otherwise specified is by 100mm. The cut-outs in slab are based on the provisions given in clause 31.8 of IS 456-2000.

In the present work an analysis and design of a Multi- Storeyed Hostel building is carried out. The building consists of a ground floor and 3 upper floors (G+3). The site area of the proposed building is 1068.80sq.m (32.00x33.40). Each floor consists of number of rooms with attached toilets, Living, Kitchen/ Dining. A balcony is provided for each room with a dimension of (2.5x1.3m). An architectural design and structural analysis and design of the building is carried out using various software's are as follows.

Table 1:Softwares used for present work

| | |
|----------------------|---|
| MICROSOFT OFFICE | Reporting & spread sheets |
| SOFTWARE NAME | DESCRIPTION |
| AUTO CADD | 2D design & drafting software |
| ARCHI CAD | 3D modeling software |
| REVIT ARCHITECTURE | 3D design & landscaping |
| E TABS | Structural analysis and design software |



IV. EXPERIMENTAL RESULTS

The project work has been taken up to plan and design a Hostel building. While planning sufficient area is provided for rooms, dinning, kitchen, corridors, toilets and water closet. Building should be planned in such a way that its orientation with respect to wind direction should ensure good ventilation and sun light. The orientation of the building in our project is in North direction.

This project consists of ground floor and three upper floors. The site area of the proposed building is 1068.80m² (32.00x33.40).A pair of lift facility and a stair case is provided for easy access and for higher standard of living. For planning here we have used **Auto Cad, Archi Cad, Revit Architecture.**

Table 2: Components and its parts

| SL | FLOOR | COMPONENTS | DIMENSION | NUMBER | AREA | |
|----|-----------------------|-------------------------|-------------------|--------|--------|--|
| 1 | Ground floor | Room | 5.00x5.00 | 3 | 75.00 | |
| 2 | | Room | 2.35x3.00 | 1 | 7.05 | |
| 3 | | Kitchen | 6.50x5.00 | 1 | 32.50 | |
| 4 | | Dining | 7.10x15.10 | 1 | 107.21 | |
| 5 | | Sports room/ recreation | 7.10x10.30 | 1 | 73.13 | |
| 6 | | Guest room | 5.00x5.00 | 1 | 25.00 | |
| 7 | | Warden room | 5.00x5.00 | 1 | 25.00 | |
| 8 | | Hand wash | 7.10x2.20 | 1 | 15.62 | |
| 9 | | Water closet | 1.80x2.20 | 5 | 19.80 | |
| 10 | | Water closet | 1.50x1.50 | 1 | 2.25 | |
| 11 | | Store room | 1.80x1.57 | 1 | 2.83 | |
| 12 | | Utility | 1.80x1.83 | 1 | 3.30 | |
| 13 | | Corridor | 2m wide all round | | | |
| 14 | | Garden area | 11.60x8.10 | 2 | 187.92 | |
| 15 | | Staircase cum lift | 3.22x4.49 | 2 | 28.91 | |
| 16 | | Staircase(backside) | 3.00x5.00 | 1 | 15.00 | |
| 17 | | Lobby | 16.00x4.50 | 1 | 72.00 | |
| 18 | | Entrance | 16.00x5.50 | 1 | 88.00 | |
| 19 | | Outside lawn | 7.40x5.20 | 2 | 76.96 | |
| 1 | 1 st floor | Room | 5.00x5.00 | 8 | 200.00 | |
| 2 | | Warden room | 5.00x5.00 | 1 | 25.00 | |
| 3 | | Sit out | 2.50x1.30 | 8 | 26.00 | |
| 4 | | Dormitory | 7.10x15.60 | 1 | 110.76 | |
| 5 | | Water closet | 1.80x2.20 | 8 | 31.68 | |
| 6 | | Wash room | 8.60x5.00 | 1 | 43.00 | |
| 7 | | Corridor | 2m wide all round | | | |
| 8 | | Staircase cum lift | 3.22x4.49 | 2 | 28.91 | |
| 9 | | Staircase(backside) | 3.00x5.00 | 1 | 15.00 | |
| 1 | 2 nd floor | Room | 5.00x5.00 | 12 | 300.00 | |
| 2 | | Water closet | 1.80x2.20 | 12 | 47.52 | |
| 3 | | Sit out | 2.50x1.30 | 12 | 39.00 | |
| 4 | | Corridor | 2m wide all round | | | |
| 5 | | Staircase cum lift | 3.22x4.49 | 2 | 28.91 | |
| 6 | | Staircase(backside) | 3.00x5.00 | 1 | 15.00 | |
| 1 | 3 rd floor | Room | 5.00x5.00 | 12 | 300.00 | |
| 2 | | Water closet | 1.80x2.20 | 12 | 47.52 | |
| 3 | | Sit out | 2.50x1.30 | 12 | 39.00 | |
| 4 | | Corridor | 2m wide all round | | | |
| 5 | | Staircase cum lift | 3.22x4.49 | 2 | 28.91 | |
| 6 | | Staircase(backside) | 3.00x5.00 | 1 | 15.00 | |

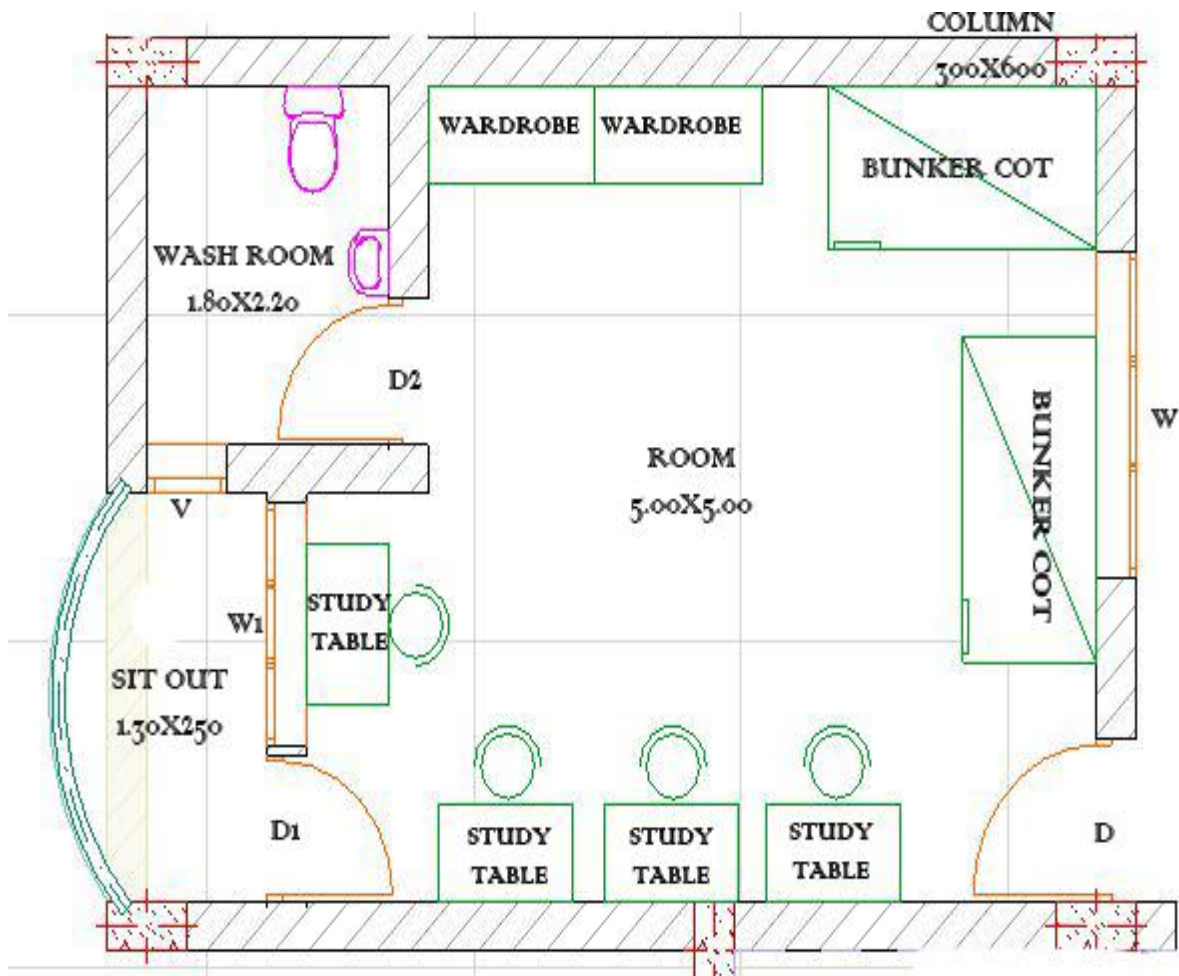
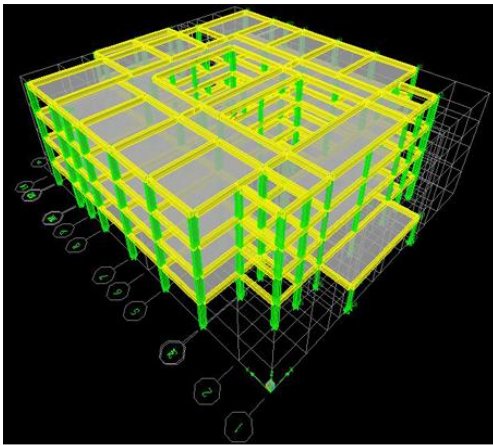


Fig 1: Two dimensional plan of an each room

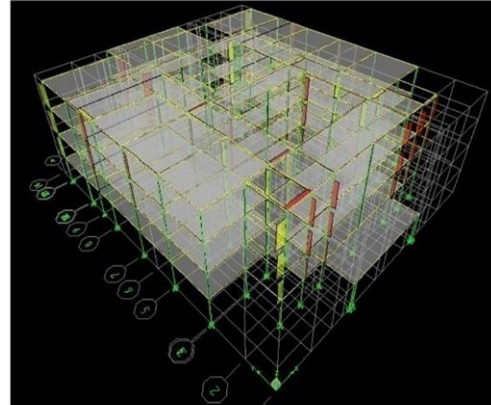
- The 3D model of the building is created in ETABS and STAAD PRO interface by specifying the co-ordinates based on the column locations.
- Suitable cross-sections for the members are assumed and the member properties assigned.
- Support conditions and boundary conditions if any, are defined.



ETABS MODEL

Fig 2: Model of proposed hostel building

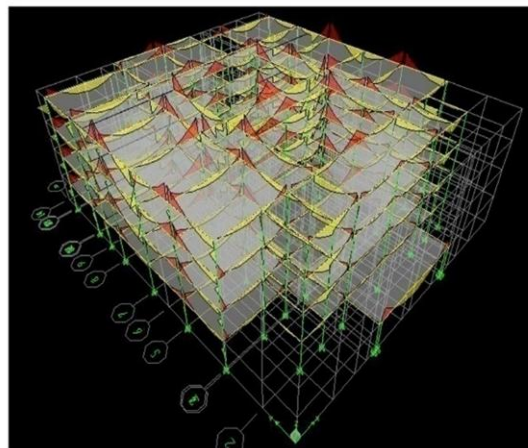
SHEAR FORCE DIAGRAM



ETABS

Fig 3: Shear Force obtained for proposed hostel building

BENDING MOMENT DIAGRAM



ETABS

Fig 4: Bending moment obtained for proposed hostel building

V. CONCLUSION

- Knowledge about planning of the buildings according to Building Bye-Laws and NBC.
- Knowledge about height of a building, ventilation, schedule of openings, coverage area, floor area ratio, water requirements and sanitary fixtures with respect to NBC.
- We can get good aesthetic appearance and Knowledge about visualization of structure is obtained.
- By using architectural software's like **AutoCAD, Archicad, Revit architecture** we can get a sneak visuals of a building before construction.
- Knowledge about preparation of structural design report is obtained and learned to apply our engineering knowledge to practical field.
- Nowadays, it's very essential for design engineer to know some basic knowledge about software because manual analysis for multi-storeyed building is very tedious process.
- Practical knowledge regarding execution of various construction stages in the site.
- The Analysis made by manually then it is checked by using **ETABS** software. The results obtained from

software are similar to that of results obtained from manual calculations.

➤ This project consists of both manual and computerized methods of analysis and design. Nowadays more and more people are computerizing their office calculation in order to save their time and avoid errors knowledge of **ETABS** software are must for any Structural Engineer along with the usual calculations and designs. In our work we have used manual methods and computerized methods for design.

➤ Estimating serves a number of purposes in the construction process including preparation of bids and cost control. The role of the estimator includes preparing conceptual estimates, preliminary estimates, pre-bid estimates, post bid estimates, cost control, final project cost, cost on the operating construction period and cost of remodeling or demolition of the construction.

➤ Estimation as well as preparation for project, especially mission critical ones, should be done so that it can reduce risks in implementing project, control and assess this implementation process.

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