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Planning Analysis and Design of Residential Building, Quantity Survey

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Abstract:
Residential building detail estimation and costing or Quantity surveying The primary objective of this project is to gain sufficient knowledge in planning, analysis, and design of building and Quantity surveying. Our project deals with the plan and design of a Bank building. It is a reinforced concrete framed structure consisting of G +2 with adequate facilities.IS 456:2000 codes is the basic code for general construction in concrete structures, hence all the structural members are designed using limit state method in accordance with the IS 456:2000 code and design aids. The planning of any building in India will be recognized by National Building Code (NBC) , hence the building is planned in accordance with the National Building Code of India.The residential building has proper ventilation, it is provided with sufficient doors, windows. Water supply and electrification are also provided. The ceiling height is provided as 3.2m, for assembly buildings as mentioned Building Code (NBC).

INTRODUCTION:

1.1 General:
The main objective of our project is to know the various design aspects like planning, analysis and design etc.We have planned to design a bank building consisting of three floors (G+2).The planning is done as per the requirements and regulations given by the National Building Code (NBC).

1.2 Practical considerations:
Besides all the fundamentals of planning discussed, following practical points should be additionally considered:

1) The elements of the building should be strong and capable to withstand the likely adverse effects of natural agencies.
2) Strength, stability, convenience and comfort of the occupants should be the first consideration in planning.
3) Elevation should be simple but attractive. The number of doors and windows provided should be less for a bank building.
4) The provisions of built in furniture at proper places are useful from the point of view of utility.
5) Since the plan is for a bank building, the locker rooms must be secured with thicker walls than usual.

1.3 Planning considerations:
The plan and detailing was drawn using Auto CAD. The proposed area of the bank is 324sq.m. The shape of the building is rectangular in plan. The building consists of ground floor, first floor and second floor.The parking space is provided around the building. The floor height of the building is 3.2m.The height of the parapet wall is 1m.The staircase is provided with enough safe.

Area of each floor is given below
Ground floor = 108 sq.m
First floor = 108 sq.m
Second floor = 108 sq.m
Total area = 324 sq.m

1.4 Specifications:

1.4.1 Footing:
Earth work excavation for foundation is proposed to a depth of 1.50m.below the ground level. For design, the safe bearing capacity of soil is assumed as 200KN/m^2.Isolated footings are provided with a concrete grade of M20. The maximum axial load 2210KN as arrived from analysis result is taken for the design of the footing.

1.4.2 Damp proof coarse:
The damp proof coarse is to be provided around the plinth level using C.M 1:3 with a thickness of 20mm. The column below the ground level are also provided with damp proof coarse of C.M 1:3.

1.4.3 Plinth:
The plinth beam will be at a level of 0.5m above the ground level. M20 grade of concrete is used and Fe415 steel was used for plinth design.

1.4.4 Frames:
All the R.C.C. structural components are designed using M20 grade steel. Each member is designed separately for its loading conditionAnd its location as per the IS 456:2000 and SP 16 codes. The dimension of slab, beam, column and footing are designed according to the IS 456:2000 code. The column is designed as per the design principles given in SP-16 and the axial load was taken from the analysis results.

1.4.5 Super Structure:
The super structure is proposed in CM.1:6 using second class brick work. Brick partition walls of 110mm thick are also proposed using the C.M 1:4 with a width of 300mm as a safety measure.

1.4.6 Roof:
R.C.C Roof in M20 concrete is to be laid. A layer of weathering coarse using brick jelly lime mortar is to be used. Considering the future expansion of the structure, the roof slab is also designed as same as that of the floor slabs.

1.4.7 Flooring:
In each floor, all the rooms are to be provided with P.C.C. 1:5:10 as flooring base. The floors of entrance, toilet floors, staircase and entire flat are to be finished with granite tiles over the P.C.C. 1:2:4 flooring.

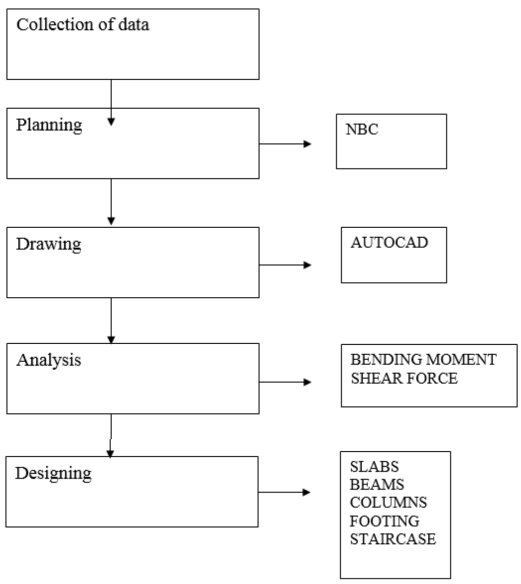
1.4.8 Plastering:
All walls and structural members including the basement will be plastered smooth with C.M. 1:5 externally and internally, using 12mm thick plastering mortar.

1.4.9 Doors and windows:
The main door will be of steel having a sliding shutter. The other doors inside the bank are to be provided with aluminium panel. The windows are to be provided with steel and glazing is provided to supply a good light from outside.

1.4.10 Staircase:
The stair will be of M20 grade concrete and Fe415 steel with a rise of 150mm and tread of 300mm. The staircase is designed as spanning parallel to landing slab referring to IS 456-2000.

1.4.11 White washing, Colour washing, Painting:
All the inner walls are to be finished with a first coat of white cement wash and then colouring as required. All the joiners and iron works are to be finished with two coats of synthetic enamel paint. The toilet walls are to be provided with mat finishing.

METHODOLOGY
3.1 Introduction:
Structural analysis is the application of solid mechanics to predict the response (in terms of force and displacements) of a given structure (existing or proposed) subjected to specified loads.



Based on degree of indeterminacy the structure will be classified as

i. Determinate structure
ii. Indeterminate structure

The determinate structure can be completely analyzed by using equilibrium equation. I.e. M =0;V=0; & H=0. Example: simply supported beam, cantilever beam, overhanging beam. In the indeterminate structure, can't be complete analyzed by equilibrium equations. Example: Fixed beam, continuous beam, and propped cantilever beam.

Moment Area method:
This method is used for analyzing cantilever and fixed beam.

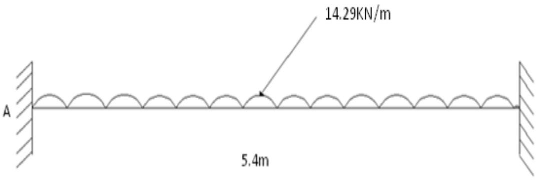
Theorem of three moment equation:
It is more suitable for continuous beam.
Moment distribution method:
It is the iterative technique.

Slope- deflection method:
When the beam has more than four spans then the calculation is difficult.

Stiffness method:
Force and displacements play on important role in the structural analysis. In this method the force is measured to produce a unit displacement.

Flexibility method:
It is the inverse of stiffness. It is defined as the measure of displacement caused by the unit load. The moment distribution method for the analysis of beam is adopted in this project.

FIXED END MOMENTS:



Type 1

Span AB

MF_{AB}=

$$\frac{-Wl^2}{12} = \frac{-42.34\times(3.2)^2}{12} = -36.12\ KNm$$

$$MF_{BA} = \frac{Wl^2}{12} = \frac{42.34\times(3.2)^2}{12} = 36.12\ KNm$$

MF_{BC} = MF_{CB}

Distribution factor (DF)

@Joint B

$$DF_{AB} = \frac{K_{BA}}{K_{BA}+K_{BC}} = \frac{0.3125}{0.3125+0.3125} = 0.5$$

$$DF_{BC} = \frac{K_{BC}}{K_{BC}+K_{BA}} = \frac{0.3125}{0.3125+0.3125} = 0.5$$

DESIGN:
Introduction:
Proper nomenclature of floors and storey's and also unified and improved methods of designating the structural members eliminate the possible confusion and led to less efforts and saving in time in the preparation of design calculation and drawings.There are two main methods to design the structural members, they are working stress method and limit state method. Here, we adopt the limit state method for designing all the structural members involved, in our project. The structures are designed to its elastic limit in the working stress method, whereas in the limit state method of design, the structural members are designed up to its plastic limits.

Both the methods are having the safety value. But, the most economical method is the limits state method, which is adopted in every constructional design nowadays. Hence we planned to go for the limit state method of design. For our project work we took only for important structural members to design they are slab, beam, column and footing. The slab is designed by assuming it as simply supported with four edges discontinuous, for easier design calculation.The beam is designed by knowing its span and its location (inner and outer). The beam has to carry the self-weight of slab and live load of 4KN on its self-weight also. The live load on each beam will be calculated separately by considering the load transmission diagram. In some beams where the wall is constructed above it, the self-weight of wall has to be added.

4.1 Design Of Slab
4.1.1 Slab 1: Two adjacent edges discontinuous
Data
Dimension of slab = 3 m × 3 m f_{ck} = 20 N/m^2
Support width = 230 mm f_y = 415 N/m^2
Live load = 4 KN/m^2
Floor finish = 1 KN/m^2
Depth of slab
Minimum depth = Span / B.V × M.F
B.V = 26 (For continuous slab)
M.F = 1.4
Minimum depth d = 3000/(26 × 1.2) = 96.15 mm ≈ 100 mm
Assume effective cover = 25 mm, Using 10 mm diameter bars
Effective depth = d = 100 mm
Overall depth = D = 100 + 25 + (10/2) = 130 mm
- d = 100 mm

- D = 130 mm

COST ESTIMATION:

It is one of the most important steps in project management. A cost estimate establishes the base line of the project cost at different stages of development of the project. A cost estimate at a given stage of project development represents a prediction provided by the cost engineer or estimator on the basis of available data. Cost estimation is also necessary to evaluate profit measures and survivability. Cost estimation should be accurate enough to properly manage any project. Any project starts with the cost and benefits analysis, so if cost estimation is inaccurate then benefits (profit) also comes inaccurate and may lead to loss. For construction industry cost estimation becomes even more important due to its being a long time process and estimating cost over a time includes other temporal factors also. Here, we tried to explore different methods available for cost estimation in construction industry.

1. Costs in Construction Firm

The costs of a constructed facility to the owner include both the initial capital cost and the subsequent operation and maintenance costs. Each of these major cost categories consists of a number of cost components.

The capital cost for a construction project includes the expenses related to the initial establishment of the facility:

1. Land acquisition, including assembly, holding and improvement
2. Planning and feasibility studies
3. Architectural and engineering design
4. Construction, including materials, equipment and labor
5. Field supervision of construction
6. Construction financing
7. Insurance and taxes during construction
8. Owner's general office overhead
9. Equipment and furnishings not included in construction
10. Inspection and testing

The operation and maintenance cost in subsequent years over the project life cycle includes the following expenses:

1. Land rent, if applicable
2. Operating staff
3. Labor and material for maintenance and repairs
4. Periodic renovations
5. Insurance and taxes
6. Financing costs
7. Utilities
8. Owner's other expenses

Approaches to Cost Estimation:

Cost engineering is defined as that area of engineering practice where engineering judgment and experience are utilized in the application of scientific principles and techniques to the problem of cost estimation, cost control and profitability. All cost estimation is performed according to one or some combination of the following basic approaches: -

Production function:

In construction, the production function may be expressed by the relationship between the volume of construction and a factor of production such as labor or capital. A production function relates the amount or volume of output to the various inputs of labor, material and equipment. For example, the amount of output Q may be derived as a function of various input factors x_1, x_2, ..., x_n by means of mathematical and/or statistical methods. Thus, for a specified level of output, we may attempt to find a set of values for the input factors so as to minimize the production cost. The relationship between the size of a building project (expressed in square feet) to the input labor (expressed in labor hours per square foot) is an example of a production function for construction.

Empirical cost inference:

Empirical estimation of cost functions requires statistical techniques which relate the cost of constructing or operating a facility to a few important characteristics or attributes of the system. The role of statistical inference is to estimate the best parameter values or constants in an assumed cost function. Usually, this is accomplished by means of regression analysis techniques.

Unit costs for bill of quantities:

A unit cost is assigned to each of the facility components or tasks as represented by the bill of quantities. The total cost is the summation of the products of the quantities multiplied by the corresponding unit costs. The unit cost method is straightforward in principle but quite laborious in application.

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The initial step is to break down or disaggregate a process into a number of tasks. Collectively, these tasks must be completed for the construction of a facility. Once these tasks are defined and quantities representing these tasks are assessed, a unit cost is assigned to each and then the total cost is determined by summing the costs incurred in each task. The level of detail in decomposing into tasks will vary considerably from one estimate to another.

Allocation of joint costs:

Allocations of cost from existing accounts may be used to develop a cost function of an operation. The basic idea in this method is that each expenditure item can be assigned to particular characteristics of the operation. Ideally, the allocation of joint costs should be causally related to the category of basic costs in an allocation process. In many instances, however, a causal relationship between the allocation factor and the cost item cannot be identified or may not exist. For example, in construction projects, the accounts for basic costs may be classified according to (1) labor, (2) material, (3) construction equipment, (4) construction supervision, and (5) general office overhead. These basic costs may then be allocated proportionally to various tasks which are subdivisions of a project. Apart from these methods, some other categorizations exist like one having estimates as Project Comparison Estimating or Parametric Cost Estimating, Area & Volume Estimating, Assembly & System Estimating, and Unit Price & Schedule Estimating is there defined in terms of granularity, duration and accuracy as shown in the diagram: - Relative accuracy of different estimate types (Courtesy of From Concept to Bid…Successful Estimating Methods by John D. Bledsoe)

Types of Construction Cost Estimates:

Construction cost estimates may be viewed from different perspectives because of different institutional requirements. In spite of the many types of cost estimates used at different stages of a project, cost estimates can best be classified into three major categories according to their functions. A construction cost estimate serves one of the three basic functions: design, bid and control.

Design Estimates:

For the owner or its designated design professionals, the types of cost estimates encountered run parallel with the planning and design as follows:

- Screening estimates (or order of magnitude estimates)
- Preliminary estimates (or conceptual estimates)
- Detailed estimates (or definitive estimates)
- Engineer's estimates based on plans and specifications

In the planning and design stages of a project, various design estimates reflect the progress of the design. At the very early stage, the screening estimate or order of magnitude estimate is usually made before the facility is designed, and must therefore rely on the cost data of similar facilities built in the past. A preliminary estimate or conceptual estimate is based on the conceptual design of the facility at the state when the basic technologies for the design are known. The detailed estimate or definitive estimate is made when the scope of work is clearly defined and the detailed design is in progress so that the essential features of the facility are identifiable. The engineer's estimate is based on the completed plans and specifications when they are ready for the owner to solicit bids from construction contractors. In preparing these estimates, the design professional will include expected amounts for contractors' overhead and profits.

Bid Estimates:

For the contractor, a bid estimate submitted to the owner either for competitive bidding or negotiation consists of direct construction cost including field supervision, plus a markup to cover general overhead and profits. The direct cost of construction for bid estimates is usually derived from a combination of the following approaches.

- Subcontractor quotations
- Quantity takeoffs
- Construction procedures.

The contractor's bid estimates often reflect the desire of the contractor to secure the job as well as the estimating tools at its disposal. Some contractors have well established cost estimating procedures while others do not. Since only the lowest bidder will be the winner of the contract in most bidding contests, any effort devoted to cost estimating is a loss to the contractor who is not a successful bidder. Consequently, the contractor may put in the least amount of possible effort for making a cost estimate if it believes that its chance of success is not high.

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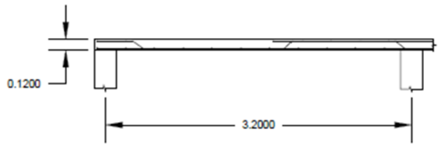
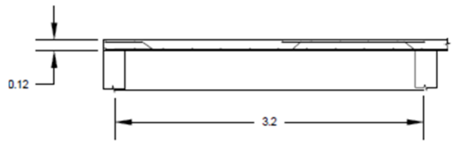
REINFORCEMENT DETAILS:

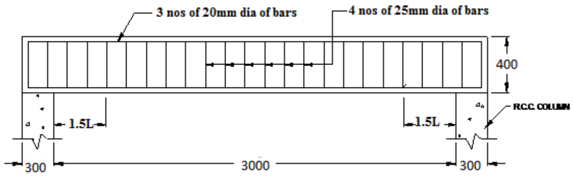
5.1 SLAB-1 TWO WAY SLAB



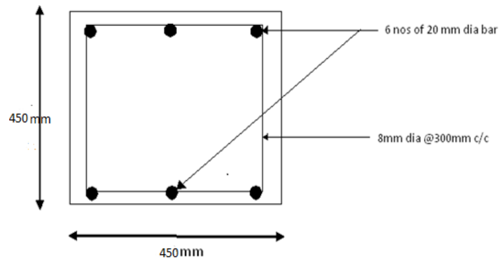
5.2 SLAB-2 ONE WAY SLAB



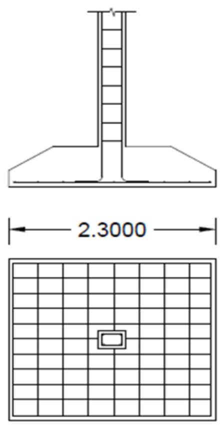
5.3 Beam- Reinforcement Details



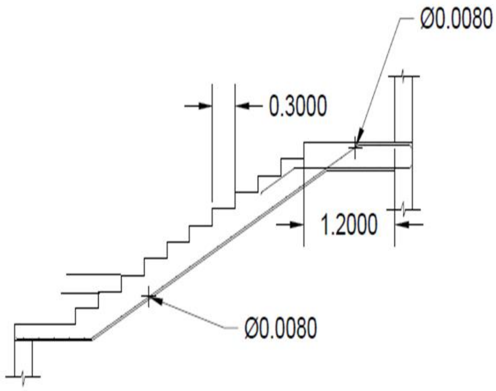
5.4 Column – Reinforcement Details



5.4 REINFORCEMENT DETAILS IN FOOTING



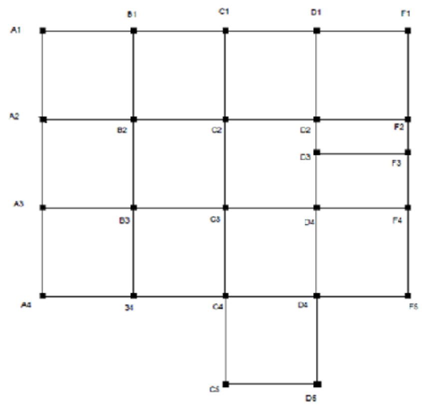
5.6 REINFORCEMENT DETAILS OF STAIRCASE



CONCLUSION:

In this project, PLANNING DESIGNING AND ANALYSING OF RESIDENTIAL BUILDING. We all the members of our team has learned to plan a building with referring to National Building Code of India -2005.This bank building project has made us to learn Drawing and drafting the building plans using Auto cad software.In this bank building project we learnt to create the models by giving nodes and property to the structural elements using analysis and also we learnt to the same structure with corresponding loads as given IS 875 part 1&2 using analysis.

CENTRE LINE PLOT



This project is very useful in making us learn the design by referring to the IS 456:2000 for each slab and beam. SP: 16 codes alone are used for easier design of columns yet we learned to design the columns.The important thing that we done was referring to a lot of books for designing and we are very much satisfied with exposing to field of design.

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