

A STUDY OF VARIATION IN CONSTRUCTION COST AT DIFFERENT STAGES OF EXECUTION OF A RESIDENTIAL BUILDING

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Abstract - Construction technology involves a great potential to enhance productivity and reduce project period. Delay happens in several construction activities. Sometimes delay may be due to the insufficient availability of fund during the period of construction. This paper presents the detailed estimation of the residential building project. Estimation helps to know the quantity of materials required for construction and estimated amount for the completion of project. The objective of this study is to know the stage wise finance required for the construction of the building.

Key Words: Construction Technology, Estimation, Stage wise fund requirement.

1. INTRODUCTION

A building is a dwelling unit which provides the covered space for residence, education, business, worship, manufacturing, storage, hospitals and entertainment. Method of construction to be adopted and the materials to be used depends on materials available, site conditions, climatic conditions and funds required. Every building has to be planned as per a well defined set of bye laws termed as building bye laws which are defined by the concerned government bodies. The conditions in the bye laws such as minimum setbacks, floor area ratio, height of the building etc have to be taken care of during the planning stage. The various norms laid down under the Bye-laws also include minimum areas of openings, area of livable rooms, bathrooms, kitchen, width of staircase etc which also should be given a consideration.

1.1 Types of Buildings

Depending on the type of usage buildings are classified into various types. This classification is based on National building code:

- Residential
- Educational
- Institutional
- Assembly
- Commercial

1.2 Components of A Building

Every building is divided into two parts. They are sub structure and super structure. Sub structure means portion of building below ground level and super structure means

the portion of building above ground level..The components of building can be classified as follows.

- Foundation
- Plinth beam
- Walls
- Columns
- Beams
- Slabs
- Floors
- Doors, Windows, Ventilators
- Stairs
- Roof
- Building finishes

1.3 Different Stages Involved In Construction of A Building

- a. Planning as per BYE-LAWS
- b. Analysis and Design
- c. Planning and scheduling the various activities
- d. Execution.

a. Planning

For all the projects, planning is the prominent part. Planning provides the frame work of the project and the work should be carried out according to the plan. The plan contains the requirements of the clients and structural drawings etc.It helps us to check the accuracy of the work being carried out and the materials required for the construction. Along with the architectural view of the building, structural stability of building is also very important. At the sites where space is very less, proper planning will give the desired satisfaction in the small space.

b. Analysis and Design

There are various loads acting on the building like, dead loads, live loads, earthquake loads, wind loads etc. These loads acting on building are analyzed to design the building. The main objectives of structural design of the building are structural stability, safety and durability of the building. Economical construction of building is possible by an efficient structural design of the building .It also decreases the maintenance cost of the building.

c. Planning and scheduling the various activities

Planning and scheduling plays a very major role in the construction industry. If planning and scheduling is done accurately then it helps the engineers to complete the project within time and the estimated budget. Planning involves deciding the number of labours required for the completion of the work, number of machineries and the materials required. The final plan is fixed in a particular time scale, this is called scheduling. The time in which the work has to be done and the order in which the work has to be carried out is fixed in this scheduling process.

d. Execution

It is the stage where actual work is carried out on the site referring the plan and schedules prepared in the planning stage. The number of labours and quantity of materials required for the project are estimated before the execution. Due to the unforeseen conditions on the site change in plan or design may occur and required decisions must be taken by executive engineers and site engineers.

1.4 Estimation

Calculation of cost of various materials along with their quantities required is termed as estimation. Construction projects are directly affected by the industrial development. Complications in projects are increasing day by day and scales are getting larger. Hence these days the difficulty of completing the project within the budgeted cost, scheduled time and with the required quality. Lack of cost data is the reason for delay in the project and improper quality of the project. Estimation is prepared by using the Architectural and structural design of the project. The proper estimation of project helps in the completion of project within time and cost. Estimation is done based on the project type, cost of material, type of design of the building, strata conditions on the site, period of completion and project size. Estimation of the project is done by three parties. The three parties are contractor, consultant and the project owner. Depending on the experience of the estimator, errors in the cost estimate takes place. Many a time's estimation of the project depends on the profit and loss of the contractor and very less on the project outcome.

1.4.1 Need for estimation of building

- Estimation is needed to know the various quantities of materials and labours required for the construction of the building.
- To check whether the available funds are enough for the completion of project.
- Estimation is required to invite the tenders or quotations for execution of the work.
- Estimation is needed to release the funds for construction by competent authorities.

1.4.2 Estimation depends on the following factors:

- a. **Size of the project:** Number of labours required for the completion of project depends on the area of the project. Area of project may be in sqft or sqm. As the size of project increases the number of labours required for the construction of project increases, materials required for the construction increases and hence the cost of project increases.
- b. **Project type:** Depending on the type of project equipments required for the construction of project change. Technology of construction changes for different types of project. Project type limits the material used for construction and also the labours used for construction. Mainly there are 6 types of project. They are
 - Building
 - Special purpose
 - Heavy type
 - Highway
 - Infrastructure
 - Industrial
- c. **Strata conditions:** During construction, ground conditions are the first concern. Without the knowledge of ground strata, estimation of project will be inaccurate. To estimate the project amount, contractor must presume the ground conditions. If the assumption of ground strata goes wrong then it will lead to the additional cost of the project.
- d. **Client type:** Every client in the construction project has their own ideas, requirements, and objectives. Depending on the requirements and type of ideas the cost of project changes. Different types of clients are as follows
 - Government
 - Authority of
 - housing
 - Public sector
 - Developers
 - Large industrial
 - Medium and small scale industrial
- e. **Cost of material:** Project depends on the type of material, availability of the material in the market. Type of material affects the cost of construction. Maximum cost of the project depends on the type of material used and the quantity of the material required for the construction of project. If the estimation of material required for the construction is calculated accurately then the wastage of

materials can be stopped. Quantity of materials is calculated based on the drawings.

- f. **Design of the project:** Design of the building is depending on type of the loads acting on it and the type of strata conditions. Reinforcement of the building is the major factor affecting the cost of building. So the design is also the major factor to be considered during the estimation.
- g. **Duration of project:** Project cost also depends on the duration of the project. There is a strong connection between the duration of the project and the cost of the project.
- h. **Method of Tendering:** There are two types of tendering.
 - By local advertisements if the contractors are invited for the tendering, this is called as open tendering.
 - Depending on the records, type and size of the project if the contractors are invited then it is Selective Tendering

The various stages of a construction project have an impact on the budget estimated. The execution stage which consists of practical applications has a higher level of impact as there are more variables involved in this stage. Hence having a stage wise estimation during execution helps in overall financial management. In order to obtain the complete estimation of the building the amount required for surveying the site, leveling of the ground and preparing the ground such that it becomes very suitable for the construction. Estimation of the project is carried out in the various stages.

1.5 Objectives

The objective of the paper is to obtain the finance requirement at different stages of construction of a residential building with a view of material procurement and labour cost. The paper gives the complete picture of various stages in a construction project. Primary importance is given for obtaining the project cost at different stages which will help the owner to manage his funds in an efficient manner. This will reduce the unnecessary procurement of funds and help him for a better financial planning.

2. METHODOLOGY

In order to procure the required funds for completion of the project or to arrive at the required cost of the structure estimation is done. Measurement of the building drawings like plan, elevation and section the quantity of materials required is calculated. There are two methods of estimation. They are:

1. Long-wall, Short-wall method
2. Centerline Method

Estimation in this project is carried out by centerline method. Calculations are done very easily and quickly. Total length of all the short walls and long walls is obtained. After this the wall length is multiplied with the thickness of the wall and height of the wall to obtain at the required quantity. It's the simplest method of estimation. Detailed estimation of the building is done to obtain the fund required for the construction of the building. Estimation is done by dividing the complete work into different item of works. And finally adding the rates of all the quantities we get the total amount to be spent for the construction of building.

2.1 Stages of estimation In order to obtain the complete estimation of the building the amount required for surveying the site, leveling of the ground and preparing the ground such that it becomes very suitable for the construction. Estimation of the project is carried out in the various stages. In this work the execution stage is divided into various stages which are as follows

- **Stage 1.**Upto plinth level
- **Stage 2.** Up to first slab level
- **Stage 3.**Upto second slab level
- **Stage 4.**Upto third slab level
- **Stage 5.**Upto fourth slab level
- **Stage6.**Upto terrace roof
- **Stage7.**Machine room
- **Stage8.**Compound wall and gate

At each stage there is a variation in construction cost required which cannot be directly obtained from the abstract of the estimate. Hence in this work emphasis has been given on stage wise estimation. Also the labour requirement and the type of labourers required changes for each stage which has a considerable effect on the estimate for each stage. After working out stage wise estimation different graphs have been plotted to represent the variations in the construction cost.

The bifurcation of the cost has been done on the basis of cost required for material procurement and labour requirement. Further the percentage cost required at each stage is obtained and compared with the total project cost. Below there is a plan of first floor and second floor of residential building. Similarly of all the floors in G+4 residential building.

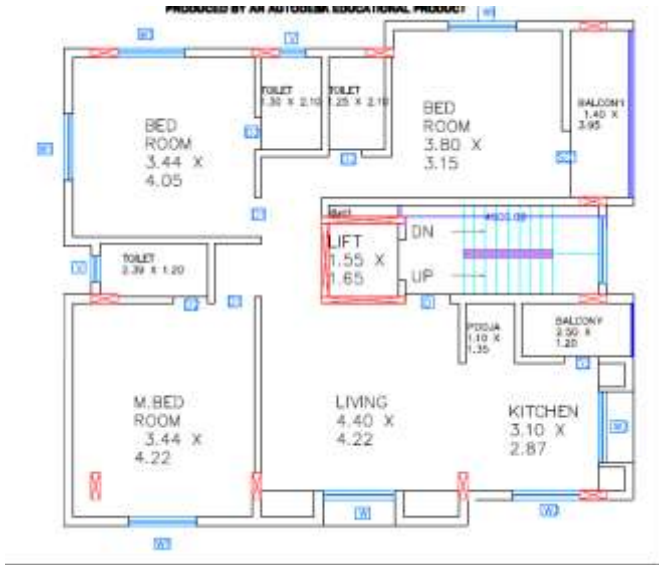


Fig-2.1 First Floor plan of a building

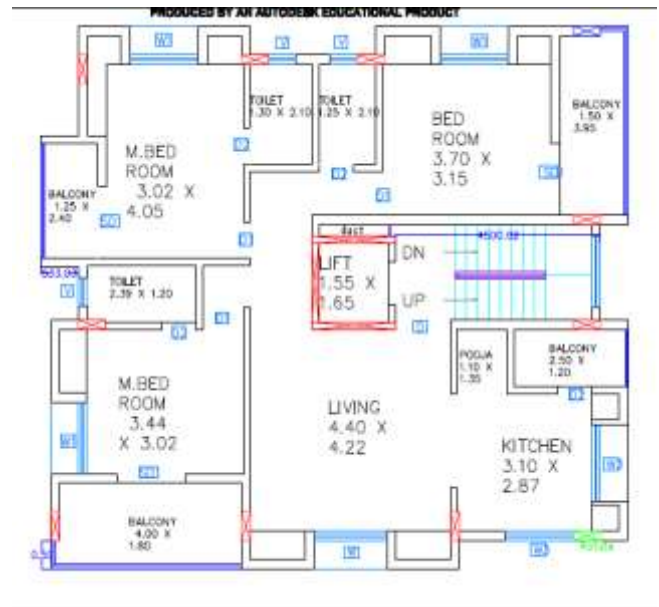


Fig-2.2 First Floor plan of a building

The various stages of a construction project have an impact on the budget estimated. The execution stage which consists of practical applications has a higher level of impact as there are more variables involved in this stage. Hence having a stage wise estimation during execution helps in overall financial management. The work is carried out according the following flow chart. The first flow chart represents the work carried out from clearing of site up to the completion of plinth level. The next flow chart consists the steps of estimation work carried out from ground level to first slab and same is repeated for all the floors.

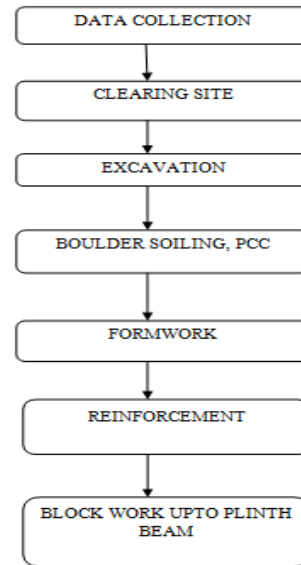


Fig-2.3 Flow chart representing estimation process in stage1

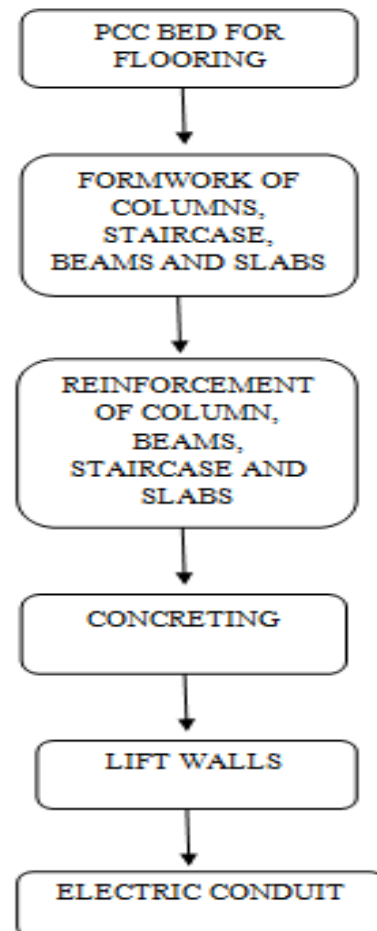


Fig-2.4 Flow chart representing estimation process from stage2 to stage 8

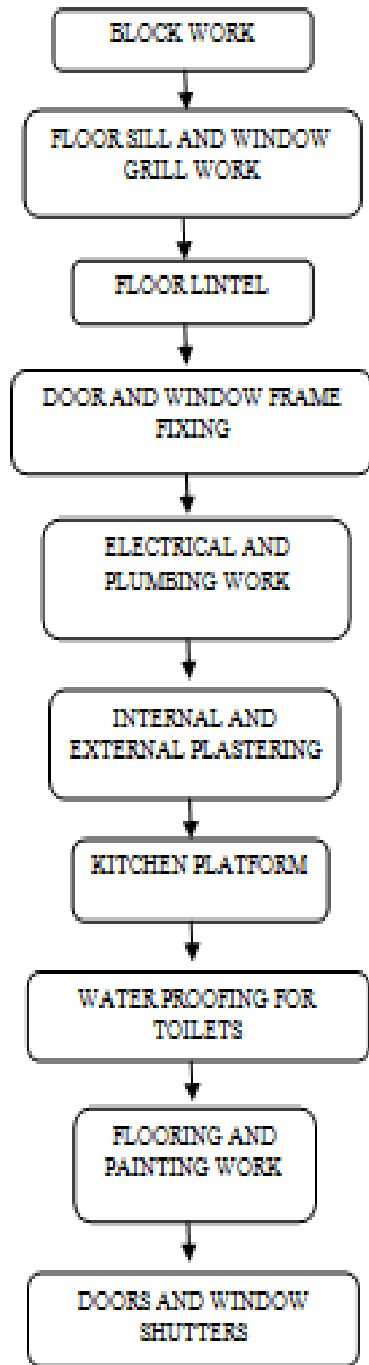


Fig-2.5 Flow chart representing estimation process of finishing products from stage 2 to stage 8

3. RESULTS AND DISCUSSIONS

In this study a detailed estimation of a multistoried building is carried out and importance is given to obtaining estimation stage wise

Table 1: Percentage of amount spent during each stage of construction

STAGES	TOTAL COST(RS)	PERCENTAGE(%)
UPTO PLINTH LEVEL	659697	5.41
UPTO FIRST SLAB LEVEL	1953840	16.02
UPTO SECOND SLAB LEVEL	2474528	20.29
UPTO THIRD SLAB LEVEL	2474528	20.3
UPTO FOURTH SLAB LEVEL	2474528	20.37
UPTO TERRACE ROOF	1494206	12.25
MACHINE ROOM	404663	3.32
COMPOUND WALL AND GATE	249709	2.05
TOTAL COST OF BUILDING=12197696		

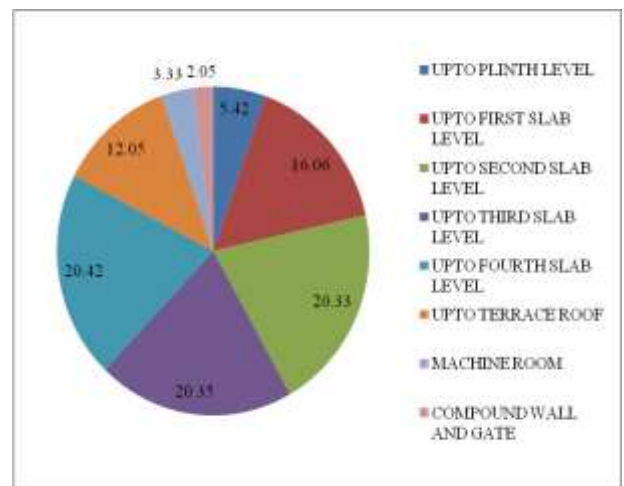


Fig-3.1 Percentage of amount spent during each stage of construction

4. CONCLUSION

The total investment required up to first stage is about 5.24% of the total cost and that required for second stages is 6.06% of the total cost. As the variation in the plan of second,

third and fourth floor are very less. Then the total cost of the third, fourth and fifth level is about 20%. Further the terrace floor level requires investment of about 12.05% as there is very small amount of brick work and generally this floor is open. The lesser activities like building up of machine room, compound wall requires about 5% of the total cost.

REFERENCES

1. Shen Xu, Kecheng Liu (2013) "Cost estimation in building information model" IRC, Henley Business School, UK, RG6 6UD
2. Neven Martinec (2010) "Cost estimate for the construction of residential-commercial building" Institut IGH, Building Engineering Division.
3. Hakan Yaman, Elcin Tas (2007) "A building cost estimation model based on functional elements" ITU A/Z Volume:4, No1.