"PLANNING AND SCHEDULING OF FLATS: THE HERMITAGE PARK"

A PROJECT

Submitted in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

CIVIL ENGINEERING

Under the supervision of

Dr. Ashok Kumar Gupta

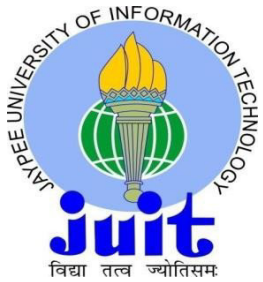
Head of Department

By

SHORYA SINGLA

121708

to



JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

WAKNAGHAT SOLAN – 173 234

HIMACHAL PRADESH INDIA

Feb-June 2016

CONTENTS

CERTIFICATE

This is to certify that the work which is being presented in the project titled **"PLANNING AND SCHEDULING OF FLATS THE HERMITAGE PARK"** in partial fulfillment of the requirements for the award of the degree of Bachelor of technology and submitted in Civil Engineering Department, Jaypee University of Information Technology, Waknaghat is an authentic record of work carried out by **SHORYA SINGLA (121708)** during a period from August 2015 to December 2015 under the supervision of H.O.D. **Dr. Prof. Ashok Kumar Gupta**, Civil Engineering Department, Jaypee University of Information Technology, Waknaghat.

The above statement made is correct to the best of my knowledge.

Date: - /0 /2016

Dr. ASHOK KUMAR GUPTA
Professor and Head,
Civil Engineering Department
JUIT Waknaghat

ACKNOWLEDGEMENT

The success of any project depends largely on the encouragement and guidelines of many others. Therefore I take this opportunity to express my sincere gratitude to the people who have been instrumental in the successful completion of the project. I would like to express my sincere appreciation and gratitude to my guide **Dr. Prof. Ashok Kumar Gupta** without whose able guidance, tremendous support and continuous motivation, the project would not have been carried to perfection. I sincerely thank him for spending all his valuable time and energies during the execution of project.

I take this opportunity to express my sincere gratitude to the Head of Department of Civil Engineering for all his support and valuable inputs. I thank him for reviving Civil Engineering as the overall mentor by leading with a vision and teaching us with a knowledge imparting attitude.

The successful compilation of final year project depends on the knowledge and attitude inculcated in the total length of the course. So I want to express my sincere gratitude to all the faculties who taught us during the four years of B.Tech.

I would also like to thank my friends, library staff and several authors of various text books and research papers which have been referred in this project but have remained unmentioned in the list of references

SHORYA SINGLA

(121708)

ABSTRACT

This Project deals with the knowledge of PLANNING and SCHEDULING of Construction of Flats. It deals with different methods and techniques of Planning and Scheduling.

It involves the planning of selection of site, architectural plan. Construcion Schedule , Construction cost including cost of labour , material , time and machinery. Also it involves the rate analysis i.e costing amd estimation which further gives the total cost of a flat.

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1 : INTRODUCTION

1.1 Introduction to Planning and Scheduling

Project management requires a logically structured sequence of processes. Structure is plainly the dominant feature when considering project organization. But nowhere is the structured approach more important than in the planning and control functions. Structure and logic should be keywords for any project manager. It is not by accident that critical path networks are also known as logic diagrams. Even in perfect conditions, with low risk, good management support and a clearly defined project, many variables must be solved along the path to effective planning and control. It is only through a systematic, structured approach that truly representative plans and budgets, the foundations for control, can be made.

1.2 General Requirements

The amount and quality of information available to project managers will vary according to the stage of the project life cycle but, in general, their role will be to create order out of uncertainty and chaos.

When a project is at its very beginning, information may be scant and unreliable. Among the project manager's first tasks will be to determine what the project is, to establish or crystallize its objectives, and to determine how the project is to be carried out (the project strategy). If contactors are to be employed, this will also include determining the contract strategy.

The work required to achieve the objectives will then have to be defined and quantified before the people needed to carry out the work can be assembled, both within and outside the parent organization. This might involve contracts being let to other companies, as well as expecting contributions from many different groups and departments of the parent company.

Responsibility for elements of the project work must be assigned and a project organization set up. These organizational elements will have to be coordinated, and relationships and communication links established – that is, all these people will have to be integrated. Particular care will be needed to achieve effective integration, coordination and communication if several companies are to be involved in the project.

Work will then have to be sequenced and scheduled so that it can be carried out in a logical and practical manner. The quantities and types of resource needed will have to be calculated, both as day-by-day forecasts and holistically over the complete time span of the project. Cost estimates must be made, and used to construct time-phased budgets, cash outflow schedules and (for higher management use) net cash flow schedules. All these estimates, plans and schedules must be treated as a single integrated entity, and must be related to the project organizational elements.

Many decisions will have to be taken and resources allocated to start up a project and carry it through successfully to fulfill its time, cost and technical objectives. The mechanism enabling the project manager to take these decisions, allocate resources and carry out the above actions is the project planning process. Planning should integrate the many diverse elements and companies involved. It must provide the communication links, so that all can be managed as one 'global' organization instead of several separate entities.

Every project has to be planned more or less uniquely, and effective project planning is critical to project success.

1.3 OBJECTIVES

1. To plan and schedule the construction of flats.
2. To study the plan of the project and provide the necessary information about the buildings and facilities to be provided in the project.

1.4 PROJECT INFORMATION

- **COMPANY** – Paradigm Business Ventures
- **PROJECT COST** – Rs.200 crores
- **PROJECT DURATION** – 3 years
- **NO. OF TOWERS -** 8
- **NO. OF STOREYS –** 14 + terrace
- **NO. OF FLATS –** 4 on each floor
- **TOTAL AREA-** 3,42,000 sq. ft.
- **AREA OF SINGLE FLAT-** 1560 sq. ft.

CHAPTER 2 : PROJECT PLANNING

2.1 Planning

Planning aims at formulation of a time based plan of action for coordinating various activities and resources to achieve specified objectives. Planning is the process of developing the project plan. The plan outlines how the project is to be directed to achieve the assigned goals. It specifies a predetermined and committed future course of action, based on discussions and decisions made on the current knowledge and estimation of future trends.

2.2 Construction planning

The construction planning process is stimulated through a study of project documents. These documents include but are not limited to the available technical and commercial studies and investigations, designs and drawings, estimation of quantities, construction method statements, project planning data, contract documents, site conditions, market survey, local resources, project environment and the client's organization. The planning process takes in to account, the strengths and weakness of the organizations.

2.3 Objectives of planning

- Proper design of each element of the project
- Proper selection of equipment and machinery in big projects, the use of large capacity plants are found economical
- Procurement of materials well in advance
- Proper arrangement of repair of equipment and machinery
- Employment of trained and experienced staff on the project
- To provide incentive for good workers

- To arrange constant flow of funds for the completion of project
- To provide proper safety measures and ventilation, proper arrangement of light and water.

2.4 Types of project plans

Planning the entire project from its inception to completion requires a vast coverage, varied skills and different types of plans. The nature of plans encountered in a typical construction project are indicated below

Types of project plans

Development stage	nature of plan
Inception stage	project feasibility plan
Engineering stage	project preliminary plan
Implementation stage	project construction plan

2.5 Work tasks

Work tasks represent the necessary frame work to permit scheduling of construction activities, along with estimating the resources required by the individual work tasks and a necessary precedence or required sequence among the tasks. The terms work tasks or activities are often used interchangeably in construction plans to refer to specific defined items ofwork.

2.6 Project planning techniques

TABLE 2.1 Project Planning Techniques

Stages	Planning process	Techniques/methods
Planning time	Breaking down project work, developing time network plans	Work break down, network analysis, gnat chart
Planning resources	Forecasting resource requirements, planning manpower requirements, planning material requirements, budgeting costs, designing organizational structure	Man power scheduling Material scheduling Resource allocation Cost planning & budgeting Equipment selection and scheduling
Planning implementation	Formulating monitoring methodology	Resource productivity control, time control, contribution control, budgetary control

2.7 Steps involved in planning

a. defining the scope of work to be performed
b. preparing the logic or network diagram to establish a relationship among activities and integrating these diagrams to develop the networkmodel
c. analyzing the project network or models to determine project duration, and identifying critical and non-critical activities
d. Exploring trade-off between time to cost to arrive at optimal time and costs for completing the project.
e. Establishing standards for planning and controlling men, materials, equipment, costs and income of each work package
f. Forecasting input resources, production costs and the value of the work done
g. Forecasting the project budget allocations for achieving targets assigned to each organizational unit
h. Designing a control system for the organization
i. Developing the resources, time and cost control methodology

Project Planning involves listing of all the activities/tasks that are involved in the project. Requirement of materials, manpower, machineries and money are determined in this phase. Estimates of costs and duration for the various activities are made. The objective of project planning is to identify the various activities and operations require to be performed for the completion of the job and to produce a time table or proper sequential relationship between the activities, with each activity allocated a start date and finish date and with the assurance that the things necessary to do each activity will be available when required.

The steps required to accomplish such a planning include logic (planning), timing, analysis and scheduling. Input for planning comes from the estimating departments, project managers, field engineers, foremen, contractors. Planning is the base of the whole project and must be based on clearly defined objectives. With proper planning, adequate resources are available at the right moment and adequate time is allowed for each stage in the process and all the various component activities start at appropriate times.

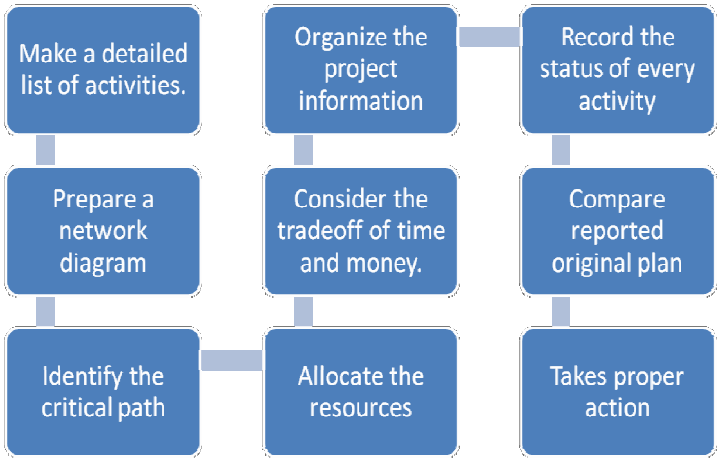


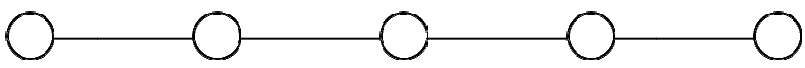
Fig. 2.1: Steps involved in Project Planning

2.8 Precedence relationship among activities

Precedence relations between activities signify that the activities must take place in a particular sequence. Numerous natural sequences exist for construction activities due to requirements for structural integrity, regulations and other technical requirements.

For example

Excavate Trench place formwork place reinforcement pour concrete



2.9. Activity and Event.

i. **activity**
ii. **event**

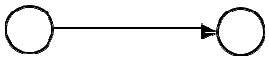
Activity: a project can be broken down in to various operations and process necessary for its completion. Each of these operations and processes, which consume time and possibly resources, is called activity. The activities are represented by arrows.

For example:

Excavation

2

Event: it is the state between the completion of a preceding activity and the beginning of the succeeding one. It has no duration an event is shown by a circle or ellipse



1 2

2.10 Activity direct cost

This is the cost that can be traced in full with the execution of a specific activity. It consists of costs of direct labour, direct equipment and other direct costs.
For example: in the activity of roof concreting, the following direct costs would be involved.

Types of costs	**item of costs**
Direct materials	cost of concrete and steel
Direct labour	cost of labour employed

2.11 Activity indirect cost.

This is the cost that incurred while performing an activity, but cannot be traced directly to its execution. In other words, all costs other than the direct ones fall in this category. These represent the apportioned share of supervision; general and administration costs are commonly refer to as overheads.

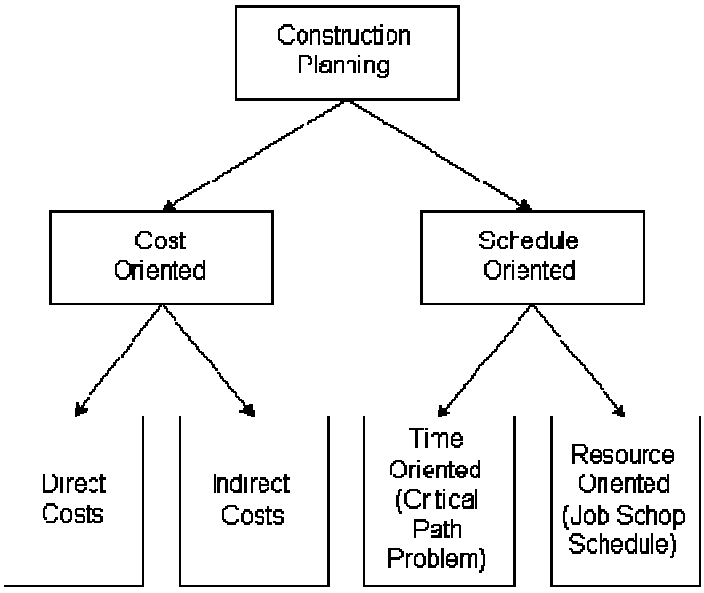


Fig. 2.2: Types of Construction Planning

2.12 PROJECT PLANNING

1) Site Selection

2) Architectural plan

2.12.1 SITE SELECTION

1. Public transportation:
   a) Airport - 10 mins
   b) Bus Stand - 3 mins
   c) Railway Station - 12 mins
2. Malls & multiplexes
   a) Paras Downtown - 3 mins
   b) DT Mall - 12 mins
   c) Elante Mall - 11 mins
   d) Metro / Best Price - 6 mins

3. Golf Course:
   a) Panchkula Golf Course - 7 Mins
   b) Chandigarh Golf - 16 mins
   c) Golf Range - 14 mins

4. IT / Industrial Areas Panchkula:
   a) Industrial Area 5 mins
   b) IT Park, Panchkula - 7 mins
   c) Chandigarh IT Park - 12 Mins
   d) Chandigarh Industrial Area - 12 mins

5. Hospitals:
   a) GMCH, Sector 32, Chandigarh - 10 mins
   b) Upcoming Zirakpur General Hospital - 2 mins
   c) Golden Medical Center - 3 mins

2.12.2 ARCHITECTURAL PLAN

a) MASTER PLAN

b) SINGLE FLOOR PLAN

c) LAYOUT PLAN OF 3BHK + 3BATHS + STORE

Fig 2.3 Master Plan

Fig 2.4 Single Floor Plan

Fig 2.5 Layout Plan – 3BHK + 3Bath + Store

CHAPTER 3 CONSTRUCTION SCHEDULE

3.1 Introduction of Scheduling

A construction project schedule may mean different things to the designers, contractors, subcontractors, suppliers and the owners involved in the construction process. The schedule may mean the completion date required for phase of the work. The schedule may mean the schedule values the contractors submit against which monthly progress payments will be made. The schedule may also refer to the process of sequencing and phasing individual activities required to complete the project. In this report construction schedule means a graphical presentation, which shows the phasing rate of construction activities with the starting and completion dates are sequential relationship among the various activities in a project so that the work can be carried out in an orderly and effective manner.

3.2 Objective of scheduling

Scheduling means putting the plan on calendar basis. A project network shows the sequence and inters dependencies of activities, their time and their earliest and latest completion time, but these needs to be scheduled to determine commencement and termination dates of each activity. Using optimum resources or working within resource constraints, it is a time table of work. A basic distinction exists between resource oriented scheduling techniques. The project is divided into number of operations.

3.3 Advantages of scheduling.

- By studying of any work and the many alternative methods of execution, we can choose the best one.
- It gives a clear idea regarding the required men, materials and equipments at different stages of work.
- Resource utilization is optimized.
- Actual progress of the work is monitored with the actual plan. If there is any delay, proper remedial measures can be taken to avoid such delays.

3.4 Purpose of work scheduling

The bar – chart type work schedule provides a simplified version of the work plan, which can easily be understood by all concerned with planning, co – ordination, execution and control of the project.

- It validates the time objectives: A work schedule shows the planned sequence of activities, data – wise while putting the work plan on a calendar basis, it takes into account reduced efficiency of resources to adverse climatic conditions and other factors.

- It evaluates the implications of scheduling constraints: A work schedule brings out the implications of constraints and enables preparation of a plan of work within the frame work of these constrains

3.5 Steps involved in schedule chart

(a) Select the EST point of activity layout on the graph, and draw a line sloping equal to its rate of execution i.e., 1 unit per day.

(b) Plot the lowest rate slowing line and mark its intersection with the top to foundation horizontal line.

(c) Starting from the point of intersection, move forward horizontally on the top line and identify latest completion point of subsequent activity as indicated by the set back.

3.6. Factors affecting work scheduling

a) Time: Most of the projects carry time constraints in the form of imposed dates, these dates may include constraints on start and completion of activities.

b) Manpower: Man power is one of the main in the successful execution of projects. The idle labour time is paid for and the strikes and breakdown of work are kept in view by manpower.

c) Materials: Construction materials are increasingly becoming scarce and their procurement is a time consuming process. The schedule aids in forecasting of materials and their timely supply determines the economics and progress work**.**

3.7 Purpose of numbering events

i. It simplifies the identification and description of a n activity in terms of event numbers.

ii. The activities are coded as i- j where i and j are the event numbers as commencement and termination of an activity.

iii. It helps in developing identification code for computer application.

iv. It systematizes the computations of critical path for each activity as far as possible, the number of the proceeding event it should be less than that of the succeeding event.

3.8 Critical Path, PERT and Dummy Activity.

1. Critical path:

The longest path through the network is called critical path and its length determines the minimum durations in which the project can be completed.

2. PERT (Programme Evaluation and Review Technique):

PERT is vent oriented. It is parabolistic model i.e., it takes into account uncertainties involved in the estimation time of a job or an activity. It uses three estimates of the activity time, optimistic time and pessimistic time and, most likely time.

3. Dummy activity:

It is superimposed activity, which does not represent any specific operation or process. It has zero duration and consumes no resources, its purpose is two fold.

(a) To provide a logical link to maintain the correct.

(b) To simplify the description of concurrent activities in terms of event numbers.

The dummy activity is drawn like any other activity, but with dotted lines.

3.9 Significance of critical path.

(a) It is the longest path in the network, however it is possible for a network to have more than one critical path. The sum of the durations of critical activities along the critical path determines the duration of the project.

(b). It is the most sensitive path, any change in duration critical activities along the critical path is bound to effect the duration of the entire project.

3.10 EST , LST , EFT , LFT.

1. EST (Earliest Start Time) :

This is the earliest time an activity can be started, assuming that all the activities prior to it have taken place as early as possible.

2. LST (Latest Start Time) :

This is the latest time an activity can start consistent, with the completion of the project in the stipulated time. The LST of an activity is determined by subtracting the activity duration from the LFT of succeeding event.

3. EFT (Earliest Finish Time):

It is the earliest time by which an activity can be completed assuming that all the activities prior to it begin at their EST.

4. LFT (Latest Finish Time):

It is the latest time by which an activity must be completed to ensure the completion of project within the stipulated time.

3.11 Classification of networks.

1. Skeleton network
2. Master network
3. Detail network
4. Summary network.

3.12 Float , Total Float.

(a) Float:

The difference between the latest start time and earliest start time of an activity is called as float. Float is a measure of the amount of time by which the start of an activity can be delayed consistent with the completion of the project on time.

(b) Total Float:

Total float of an activity is defined as the difference between the maximum duration of time available for the completion and duration required to carry out that duration.

3.13 Resource leveling and crashing

Resource leveling:

The aim is reduce the peak resource requirements and smooth out period to period assignment within a constraint on the project duration.

Crashing:

Higher amounts of direct activity cost would be associated with smaller activity duration times, while longer duration time would involve comparatively lower direct cost. Such deliberate reduction of activity times by putting in extra effort is called Crashing.

3.14 Normal Cost and Time , Crash Cost and Time

1. Normal cost:

Normal cost is the lowest possible direct cost required to complete an activity.

2. Normal time:

Normal time is the maximum time required to complete an activity at normal cost.

3. Crash time:

Crash time is the minimum possible time in which an activity can be completed using additional resources.

4. Crash cost:

Crash cost is the direct cost i.e., anticipated in completing an activity within the crash time.

3.15 Activity cost slope.

Activity cost slope is the rate of increase in the cost of activity per unit with a decrease in time. The cost slope indicates the additional cost incurred per unit of time saved in reducing the duration of an activity.

$$\text{Activity Cost slope} = \frac{(\text{crash cost} - \text{Normal cost})}{(\text{Normal time} - \text{Crash time})}$$

3.16 Project Scheduling Steps

A project schedule is simply a projected timetable of construction operations. There are several steps involved in the devising of an efficient and workable job schedule.

The following list is offered as a procedural guide in this regard:

- Estimation of time required to carry out each network activity.
- Using these time estimates, compute the time period required for overall project completion.
- Estimate time intervals within which each activity must start and finish satisfying the completion date requirement.
- Estimation of quantities of work for each of the component activity involved.
- Identify these activities whose expedient execution is crucial to timely project completion.
- If the project completion date is not constant with contract or other requirements, shorten the project duration at least possible cost.
- Utilizing the surplus of float times that most activities possess, adjust the start and finish times of selected activities to minimize resource conflicts and smooth out demands on manpower and equipments.
- Makeup a working project schedule that shows anticipated calendar dates for the start and finish of each activity.

3.17 Steps involved in scheduling of construction of flats

3.17.1 method 1

1. **Site preparation** This involves clearing of the site and pegging out of the site by the surveyor. Sometimes retaining walls will also be built at this stage if required.
2. **Slab** The plumber will need to lay plumbing that will be located beneath the slab of the development. This needs to be done before the slab can be formed up. The slab piering is then completed as per the engineer's specifications and plans and then the slab can be poured. It's very exciting to see the slabs go down.
3. **Frames and roof trusses** The frames are generally prepared before being delivered to site and can be erected very quickly with a day or so. It's great to walk around the site once the frames are up and get a feel for each room.
4. **Roof tiling of metal roofing** Some builders prefer to complete the roof before starting the brickwork and other builders work the other way around. I've found predominately builders want to get the roof on as quickly as possible to protect the frames.
5. **Brick work** This stage really gives the development true structure, and you can feel the development making good progress when you see the brickwork completed.

6. **Rough ins** This involves the electrical and plumbing wiring and pipes to be installed before the internal linings to the frames.
7. **Internal linings** After the rough in is complete, the insulation will be installed into the wall and ceilings and then the plaster will start on lining the walls and ceilings. You really get a good sense of space within the dwellings at this stage.
8. **Waterproofing and tiling** The wet areas will be water-proofed in preparation for the tilers to start work, generally after or even during the timber mould out.
9. **Timber mould out** This stage involves the carpenters installing the skirting boards, architraves, door jams and doors and kitchens.
10. **Lock up** is when all external doors including garage doors are on.
11. **P.C. fit out.** P.C. is a term for a prime cost item and includes tapware, bath, mirror, vanities and other accessories, which are installed at this stage.
12. **Practical completion.** This is the point in time when an inspection is conducted when builder is almost finished. You will walk through the development with the site manager and point out any items that still need attention. By this time it should only be touch ups and minor items requiring installation.
13. **Handover** This is when you are happy the construction has been completed to your satisfaction and to the plans and after paying the builder's final invoice, keys will be handed over to you.

3.17.2 method 2

- **Break Ground**
- **Excavation**
- **Foundation**
    - Concrete Forms
    - Pour Foundation Wall
    - Concrete Slab Pour
        - Gravel
        - Water Barrier
        - Rigid Foam
        - Rebar (and PEX tubing for radiant floor heating)
        - Pour Concrete for Slab
- **Utilities**
    - Sewer, Electrical, Water, Gas
- **Framing**
    - Balloon Framing
    - Sheathing
    - Roof
    - Stairs
    - Windows
- **Roofing**
- **Weather Resistant Barrier**
    - Rain Screen
- **Rough Plumbing**
- **Mechanical Sytems**
    - HVAC
- **Lighting and Electrical**

    - Ambient
    - Task
    - Accent
    - Perimeter
- **Air Sealing**
- **Insulation**
    - Spray Foam, Blown-in Insulation, or Batt Insulation
- **Drywall**
    - Sheetrock, Mudding, Sanding, Primer
- **Siding**
- **Flooring**
- **Tiling**
- **Painting**
- **Cabinets, Shelving**
- **Finish Plumbing**
- **Finish Electrical and Lighting**
- **Certificate of Occupancy**
- **Modifications**
- **Moving In**

CHAPTER 4 : CONSTRUCTION COST

4.1 Cost of labour

LABOUR REQUIREMENT FOR VARIOUS BUILDING WORKS

LABOUR REQUIREMENT FOR VARIOUS BUILDING WORKS :The table below shows the recommended labour requirement for various civil engineering/building/construction works :S.No .Description of work Unit Labour Recommended constant in days.Remarks1) Excavation over.

- Reinforcement laying-2900/TON
- Plaster - outer-9/feet2

  inner-4.5/feet2
- Brickwork-Rs11/feet2
- Shuttering-Rs6.5/feet2
- Water proofing-Rs2/feet2
- Pad –Rs1.5/feet2
- Casting –Rs 15/feet3
- Electrical-11000/flat
- Plumbing-10500/flat

4.2. Cost of materials

CALCULATE QUANTITIES OF MATERIALS FOR CONCRETE

Quantities of materials for the production of required quantity of concrete of given mix proportions can be calculated by absolute volume method.

QUANTITIES OF MATERIALS PER CUBIC METRE OF CONCRETE

Quantity of materials such as cement, sand, coarse aggregates and water required per cubic meter of concrete and mortar varies with the mix design...

MEASUREMENT OF REINFORCED CONCRETE WORKS

Measurement of Reinforced Concrete Works:1. The Quantities can be rounded off to the nearest two decimals.2. Concrete in Structural members, such as columns, Beams...

METHODS & UNITS OF MEASUREMENTS OF CIVIL WORKS

The units of measurements for civil engineering works are mainly categorized for their nature, shape and size and for making payments to the contractor....

UNITS OF MEASUREMENT AND PAYMENT FOR CIVIL WORKS

Units of Measurement and payment for works in civil engineering are given in table below:

Sl. No .Particulars of items Units of measurement Unit...

SIZE AND QUANTITY OF REINFORCEMENT FOR BUILDING WORKS

Reinforcement is required for reinforced concrete members such as footings, beams, columns, slabs, lintels etc. Estimation of reinforcement quantity is required prior to tendering...

ESTIMATION METHODS OF BUILDING WORKS

The estimation of building quantities like earth work, foundation concrete, brickwork in plinth and super structure etc., can be workout by any of following.

- Cement – Rs 250 per bag
- Sand-Rs 17 to 20/ CF
- Coarse sand-Rs 30 to 33/CF
- Bricks- Rs 4500-5000/1000
- Steel –Rs 40-45/kg
- RMC-3800/m3

4.3. Machinery Used

- Monkey lift
- Lift mixture
- Vibrator
- Electrical steel cutter
- Batching mixture
- JCB

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 inital establishment of the facility:

- Land acquisition, including assembly, holding and improvement
- Planning and feasibility studies
- Architectural and engineering design
- Construction, including materials, equipment and labor
- Field supervision of construction
- Construction financing
- Insurance and taxes during construction
- Owner's general office overhead
- Equipment and furnishings not included in construction
- Inspection and testing

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

- Land rent, if applicable
- Operating staff
- Labour and material for maintenance and repairs
- Periodic renovations
- Insurance and taxes
- Financing costs
- Utilities
- Owner's other expenses

4.4 Project Cost Accounts

Table 4.1: Illustrative Set of Project Cost Accounts

201	Clearing and Preparing Site
202 202.1 202.2 202.3 202.31 202.32 202.33	Substructure Excavation and Shoring Piling Concrete Masonry Mixing and Placing Formwork Reinforcing
203	Outside Utilities (water, gas, sewer, etc.)
204 204.1 204.2 204.3 204.4 204.5 204.6 204.61 204.62 204.63 204.64 204.65 204.66 204.67 204.68 204.69 204.7 204.71 204.72 204.73 204.74 204.72	Superstructure Masonry Construction Structural Steel Wood Framing, Partitions, etc. Exterior Finishes (brickwork, terra cotta, cut stone, etc.) Roofing, Drains, Gutters, Flashing, etc. Interior Finish and Trim Finish Flooring, Stairs, Doors, Trim Glass, Windows, Glazing Marble, Tile, Terrazzo Lathing and Plastering Soundproofing and Insulation Finish Hardware Painting and Decorating Waterproofing Sprinklers and Fire Protection Service Work Electrical Work Heating and Ventilating Plumbing and Sewage Air Conditioning Fire Alarm, Telephone, Security, Miscellaneous
205	Paving, Curbs, Walks
206	Installed Equipment (elevators, revolving doors, mail chutes, etc.)
207	Fencing

4.5 Approx. quantity of work to be done per day

Table 4.2: Approximate quantity of work to be done per day

SNo.	Particulars of items	Quantity	Perday
1.	Brick work in lime or cement mortar in foundation and plinth	1.25cum	(45cuft)per mason
2.	Brick work in lime or cement mortar in superstructure	1.00cum	(35cuft)per mason
3.	Brick work in mud mortar in foundation and plinth	1.50cum	(55cuft)per mason
4.	Brick work in mud mortar in superstructure	1.25cum	(45cuft)per mason
5.	Brick in cement or l ime mortar in arches	0.55 cum	(20cuft)per mason
6.	Brick in cement or l ime mortar in jack arches	0.55 cum	(20cuft)per mason
7.	Half brick wall in partition	5.00sqm	(50sqft) per mason
8.	Coursed rubble stone masonry in lime cement mortar including dressing	0.80cum	(30 cuft)per mason
9.	Random rubble stone masonry in lime or cement mortar	1.00cum	(35cuft)per mason
10.	Ashlars masonry in l ime or cement mortar	0.40cum	(15cuft)per mason
11.	Stone arch work	0.40cum	(15cuft)per mason
12.	Lime concrete in foundation or floor	8.50cum	(300cuft)per mason
13.	Lime concrete in roof terracing	6.00cum	(200cuft)per mason
14.	Lime concrete 1:2; 4	5.00cum	(175cuft)per mason
15.	RB work	1.00cum	(35cuft)per mason

16.	RCC work	3.00cum	(125cuft)per mason
17.	12mm (1/ 2) plastering with cement or lime mortar	8.00sqm	(80sqft) per mason
18.	Pointing with cement or lime mortar	10.00sqm	(100sqft)per mason
19.	White washing or colour washing coats	70.00sqm	(700sqft)per white washer
20.	White washing or colour washing coats	200.00sqm	(2000sqft)per white washer
21.	Painting or varnishing doors or windows one coat	25sqm	(250sqft)per painter
22.	Coal tarring or soligum painting one coat	35.00sqm	(350sqft)per painter
23.	Painting large surface one coat	35.00sqm	(350sqft)per painter
24.	Distempering one coat	35.00sqm	(350sqft)per painter
25.	2.5 cm(1') CC floor	7.50sqm	(75sqft) per painter
26.	Flag store floor laying with lime or cement mortar excluding LC	10.00sqm	(100sqft)per painter
27.	Brick on edge in floor l ime or cement mortar excluding LC	7.00sqm	(70sqft) per painter
28.	Brick bat floor as in above	8.00sqm	(80sqft) per painter
29.	Timber framing sal or teak wood	0.07cum	(2. 5cuft)percarpenter
30.	Timber framing sal or country wood	0.15cum	(5cuft) per carpenter
31.	Door and window shutters paneled or glazed	0.15sqm	(7sqft) per carpenter
32.	Door and window shutters paneled or battened	0.80sqm	(0. 80sqft)percarpenter

33.	Sawing hard wood	4.00sqm	(40sqft) per pair
34.	Sawing soft wood	6.00sqm	(60sqft) per pair of sawers
35.	Breaking of brick ballest 40mm (11/2 ”) gauge	0.75cum	(35cuft)per labourer or breaker
36.	Breaking of brick ballest 25mm (1 ”) gauge	0.55cum	(20cuft)per labourer or breaker
37.	Breaking of stone ballest 40mm (11/2 ”) gauge	0.40cum	(10cuft)per labourer or breaker
38.	Breaking of stone ballest 25mm (1 ”) gauge	0.25cum	(10cuft)per labourer or breaker
39.	Ashlar stone dressing	0.70cum	(25cuft)perstonecutter
40.	Flag stone dressing	1.50sqm	(25sqft) perstonecutter
41.	Earthwork in excavation in ordinary soil	3.00cum	(100cuft)per belder mazdoor
42.	Earthwork in excavation in hard soil	2.00cum	(75cuft)per belder mazdoor
43.	Excavation in soil	1.00cum	(35cuft)per belder mazdoor
44.	Number of bricks laid by a mason in brick work upto a height of 3m(10 ”)	600 bricks per mason	
45.	Amount of work done by a mazdoor helper per day		
	Mix	3.00cum	(100cuft)mortar per mazdoor
	Deliver brick	4000 nos to a distance of 15m (50”) per mazdoor	
	Deliver mortar	5.5cum	(200cuft) per mazdoor
46.	Scaffolding cost for single storey building	Re.0.50per cum	(Rest.1.5%cuft) of brick work.

4.6 Actual Cost of a Flat.

Here are what all the costs a builder/developer will charge you when you actually buy a flat and sign the buyer's agreement:

1. **Basic Sale Price (BSP)**: This is actually the price which is advertised by developers and forms the main cost of your property.

2. **Preferential Location Charge (PLC)**: Pay a higher price if you want your property at a location which is preferred by most people. For e.g. a villa on the corner of road or a flat in first four floors of an apartment building are generally considered preferred location. The PLC charges are normally 4% of BSP. So, add 4% to to the total cost if you want a preferred location for yourself.

3. **External Electrification Charges(EEC)**: This is the price charged by developer to lay down wires and cables from electricity consumption meter to the Apartment.

4. **Fire Fighting Equipment Charges (FFEC)**: This is pretty self explanatory. All projects residential or commercial are supposed to install fire safety devices and fire fighting equipment.

5. **Infrastructure Development Charges (IDC)** : These charges are paid direct to state government by the developer for developing the infrastructure for the project. The charges vary from state to state.

6. **External Development Charges (EDC)**: These charges are again paid direct to state government by the developer for developing the external areas surrounding the project. The charges vary from state to state.

7. **Car Parking Space(CPC)** : Have you ever bought parking space in India? If this is the first time you are buying an apartment in a society, then this may come as a surprise to you. But this is a fact that developers do sell car parking space inside the society.
   There are generally two types of parking available. One is open parking and other is a covered one (in basement). The prices for both are also different. The open parking is cheaper than covered one. You need to purchase at least one parking with your apartment even if you don't have a car to park
   Also, if you want you can buy both covered and open parking.

8. **Club Membership**: This has become a common norm these days to create a club inside a society itself for recreational activities. Your society may or may not have this facility but if it has, it does NOT come FREE. You need to pay a price for it and it is NOT optional.

9. **Power back Up Charges**: Power failure may be an alien term in developed countries but India certainly needs a good power back-up. There are charges for setting up the power back up plant inside your society and keep your air conditioners running even when there is a power cut from state electricity board.

10. **Electric Connection charges**: Do not be under the impression that if you have paid the EEC and power back up charges, you are done with your electricity needs. EEC is an amount charged by developer only to set up the infrastructure for bringing electricity to your apartment.
    You will have to pay the actual application fees for installing the electricity meter and a connection to the electricity board of your state for actually getting electricity.

11. **Water, drainage and sewerage charges** : Hmm…fed up of all the charges? How can we forget the most precious resource on earth? You would be required to pay for water facility set up in the complex too. The charges are paid to government and will vary according to your state.

12. **Stamp duty and registration charges**: These charges are paid to state government for registering property on your name. This fees is charged as a percentage of the registered value of the property and varies from state to state.

13. **Service Tax**: This is an absolute killer as far as buying a property is concerned. Government charges you service tax on under-construction property at the current prevailing rate on the total cost of the apartment. The charge of service tax on under-construction property has been question in court and a decision is pending at the time of writing this article. If court decides in favor of public, then we may be saved from paying this senseless fees.

Please note that all the charges are calculated on the basis of SUPER AREA and NOT BUILT UP AREA. As per industry standards, the difference between super area and built-up area is approximately 18-20%. i.e. while you pay the price for 1560 sq. ft. (super area), the actual built up area in your apartment would be somewhat 1248 Sq. Ft. (1560 – 20% of 1560).

Nature	**Amount (in Rs.)**	**Calculation Basis**
BSP	46,64,400	1560 Sq. feet * 2,990
PLC	1,86,576	4% of BSP. You may or may NOT opt for a PLC location.
EEC & FFEC	78,000	1560 Sq. ft * Rs. 50 per Sq. ft.
EDC & IDC	1,56,000	1560 Sq. ft. * Rs. 100 per Sq. ft.
Extra Car parking space	2,50,000	Optional
Club membership	75,000	Fixed amount

Power back-up	50,000	Fixed amount for 3kva
Electric Connection charges	3,000	Fixed amount(Approximate value)
Water, Drainage and Sewerage	3,000	Fixed amount(Approximate value)
Stamp Duty and Registration fees	2,79,864	6% of BSP. Need to be paid to government
Total (advertised cost)	46,64,400	
Total (Extra and hidden costs)	10,81,440	
Grand Total	57,45,840	

So, you can see yourself that the actual cost of the apartment is increased by Rs. 10.81 lakhs. Hence, the real rate is Rs.3683 Per Sq. Ft. instead of Rs. 2990 per Sq. ft. as advertised by developer.

REFERENCES

1. A.C. Doyle, "A Study in Scarlet," *The Complete Sherlock Holmes*, Doubleday & Co., pg. 83, 1930.

2. See, for example, Paulson, B.C., S.A. Douglas, A. Kalk, A. Touran and G.A. Victor, "Simulation and Analysis of Construction Operations," *ASCE Journal of Technical Topics in Civil Engineering*, 109(2), August, 1983, pp. 89, or Carr, R.I., "Simulation of Construction Project Duration," *ASCE Journal of the Construction Division,* 105(2), June 1979, 117-128.

3. For a description of a laser leveling system, see Paulson, B.C., Jr., "Automation and Robotics for Construction," *ASCE Journal of Construction Engineering and Management*, (111)3, pp. 190-207, Sept. 1985.

4. See Baker, K.R., *Introduction to Sequencing and Scheduling*, John-Wiley and Sons, New York, 1974, for an introduction to scheduling in manufacturing

5. See Skibniewski, M.J. and C.T. Hendrickson, "Evaluation Method for Robotics Implementation: Application to Concrete Form Cleaning," *Proc. Second Intl. Conf. on Robotics in Construction*, Carnegie-Mellon University, Pittsburgh, PA., 1985, for more detail on the work process design of a concrete form cleaning robot.

6. This example is adapted from Aras, R. and J. Surkis, "PERT and CPM Techniques in Project Management," *ASCE Journal of the Construction Division,* Vol. 90, No. CO1, March, 1964.

7. For a discussion of network reachability and connectivity computational algorithms, see Chapters 2 and 7 in N. Christofides, *Graph Theory: An Algorithmic Approach*, London: Academic Press, 1975, or any other text on graph theory.

8. See H.R. Thomas, C.T. Matthews and J.G. Ward, "Learning Curve Models of Construction Productivity," *ASCE Journal of Construction Engineering and Management*, Vol. 112, No. 2, June 1986, pp. 245-258.

9. http://www.thehermitagepark.com/