LECTURE NOTE

ON

CONSTRUCTION MANAGEMENT(TH.2)

6TH SEMESTER IN CIVIL ENGG.

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objectives of construction Management

The main objectives of construction Manageme are:

(i) completing the work within estimated budget and specified time.

ii- Evolving a reputation for high quality workmanship.

iii- Providing safe and satisfactory working conditions for all personnel and workers

iv- Taking sound decisions at the lowest practical management level through delegation of authority

v- Motivating people to give of their best within their capacities.

vi- Creating an organisation that works as a team

Functions

The functions of construction Management are:

i- Planning and scheduling-: Planning involves formulation of a number of alternative realistic work plans for achieving specified objectives and finally selecting a plan which is best suited from the stand-point of available resources and constraints imposed upon the project.

scheduling is the fitting of the final work plan to a time scale. It shows the duration and order of various construction activities.

ii- organising-: organising is concerned with division of the total construction work into manageable departments/sections and systematically arranging various operations by delegating specific tasks to individuals.

iii- staffing-: organising invoves the division of project work into sections and staffi

s the provision of people to fill the positions
created. Recruiting the right people,
arranging staff training courses.

v- Directing -: The directing function is concern
ed with training sub ordinates to carry out
assigned tasks, supervising their work and
guiding their efforts.

- Controlling -: Controlling is necessary for
ensuring effective and efficient working.
The essential steps in Management control
are:

→ Measurement of actual performance in term
- s of progress, quality and cost incurred.

→ Comparison of actual and planned perform
-ance

→ Analysis of shortfall in performance when it
occurs and identification and implementation
of suitable remedial measures.

i- co-ordinating -: Since authority converges
to the top of the organisational pyramid, it is
necessary to bring together and coordinate
the work of various departments and sections.
Regular meeting of departmental / section heads
with top management are fundamental to
proper coordination, so that plans, problems
and remedies are discussed for determining
the best solution.

Construction Team

The construction team consists of owner,
Engineers / architects and contractor.

Owner

The owner may be an individual, group
of individuals, private or public undertaking
The owner has an ultimate authority over
the project. The owner is the final holder
of major decision-making power regarding
managerial, financial and administrative
aspects.

→ He approves changes if any in the project scope or schedules.

Engineers and Architects

→ This includes structural, mechanical and electrical engineers, architects, quantity surveyors, specialists such as structural consultants, safety and maintenance planners, soil investigators etc.

The roles of the team members are as follows.

i- Architect -: The role of the architect is to assess the client's functional requirements design for pleasing and aesthetic appearance and to assist the engineers for proper design

ii- Structural Engineer -: The role of the stru -ctural engineer is to prepare structural design of structures and to prepare the working drawings based on the architect's plans.

iii- Mechanical Engineer -: The role of the Mechanical Engineer is mainly concerned with design and preparation of working drawings for heating, ventilating, air conditioning and other mechani -cal services associated with the construction project activities during and after constru -ction.

iv- Electrical Engineer -: The electrical Engineer is concerned with the design and preparation of working drawings for electrical power and distribution systems during and after construction.

V - Quantity surveyors -: The role of quanti -ty surveyors is to:

a - estimate the cost of work to be done and actually carried out.

- Prepare the bill of quantities and tend -er documents before tendering:

- Assess the extra costs due to special features.
- Prepare the cash flow statements during construction.
- Prepare the final account on completion of the project.

Contractor

→ The contractor may be an individual under taking small contracts or a large construction company undertaking turn-key projects.

→ Contractors whether small or big need the services of qualified engineers.

→ Some of the engineers employed by the contractor deal with office work such as designing, tendering, scheduling etc.

→ In some projects, the contractor may sublet part of the work to sub contractors or petty contractors. This is done because a contractor may not have the required infrastructure for certain works.

→ The contractor submits running bills for payment based on the progress of work and materials brought at site.

Proper interaction bet^n the construction team (owner, engineer, architect and contractor) leads to the smooth and efficient execution of a construction project. Proper understanding of functions/activities of each team plays a vital role in achieving speed, economy, efficiency and quality in all construction projects.

Resources for construction Management

1- Men
2- Machines
3- Materials
4- Money.

2nd chapter CONSTRUCTIONAL PLANNING

Importance of construction planning

→ Planning is the starting point of all management functions.

→ Planning leads to organising and staffing followed by directing, controlling and coordinating.

→ A graph schedule is known as a programme forms the basis for effective planning

The essential characteristics of a good programme are

→ It must be suitable for use as a control tool against which progress can be measured.

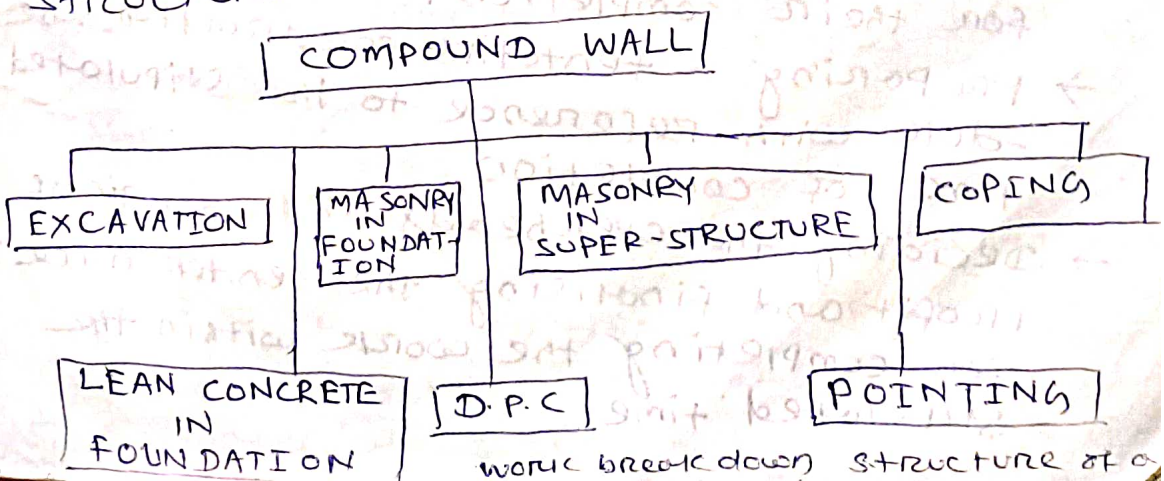
→ It must be sufficiently accurate to enable its use for forecasting requirements of material, manpower, machinery and more

→ It must provide for difficulties likely to be encountered in future in respect of quality, scope, processes etc for taking remedial measures.

→ There are two ~~boo~~ types of planning namely, policy planning and planning associated with technical operations.

Work breakdown structure

The functional elements of a project and their inter-relationship are determined by a technique known as work breakdown structure.



work breakdown structure of a

breakdown structure of a building from book

→ In general, a system is broken down into sub systems and each sub system into major components.

→ The objective is to identify discrete activities or tasks that can be planned, estimated, scheduled, executed and controlled for completion.

STAGES OF PLANNING

Planning for construction may be done in the following two stages

→ Pre-tender stage
→ Contract stage.

Pre-tender stage

Pre-tender planning is broad-based and is carried out by the contractor.
Pre-tender planning includes the following steps

→ Examining drawings and specifications to identify various items of work.
→ carrying out site investigation and market survey to assess the availability and rates of materials, manpower, machinery and other facilities
→ Identifying alternative methods of executing the work for selecting the most suitable and economical method.
→ Estimating the quantities of different items of work and the time required for their completion.
→ Preparing a tentative construction schedule with reference to the stipulated time of completion.
→ Deciding the overheads and margin of profit and finalising the tender price for completing the work within the stipulated time.

Contract stage

The contract stage is also called post-tender stage or construction stage.

→ After the pre-tender stage, the contractor has to undertake detailed planning to organise various activities of construction work so that the project may be completed within the scheduled time.

Contract stage planning involves the following steps.

→ Estabishing a good communication system bet^n members of the construction team (i.e: owner, engineers / architects and contractor) for the smooth running of project work.

→ Evaluating alternative construction methods identified during the pre-tender stage in order to select the most economical and efficient method.

→ studying inter-relationships of various items of work and finalisation of proper sequence of operation.

→ Calculating the phased requirement of construction materials such as cement, aggregate, bricks, steel etc.

→ Determining the phased requirement of plant and machinery including repair and maintenance facilities.

→ preparing details of manpower requirement including labour, supervisors and managerial staff for various stages of the work.

Preparation of Material schedule

→ Material schedules showing weekly requirements of commodities are prepared from the construction programme.

→ A material schedule enables storage

space to be adequately planned and necessary arrangements to be made for timely delivery of materials.

→ Disruption of work due to shortage of material - s can be avoided by using a material sche - dule.

→ The material schedule may be prepared eith - er monthwise or weekwise depending on the extent of the project and storage space

Ex

A typical material schedule prepared weekwise for the construction of a temporary shed (8m x 20m)

Name of work ..... prepared by.....

Date .....

Material	unit	weeks				
		1	2	3	4	5
Cement	No.	1100				
Brick	No.	-				
Sand	cum	-				

Preparation of labour schedule

Labour schedules depict the manpower require - ments of the project in a tabular form for various stages. The labour schedule serves the following purposes during the construction stage.

→ It provides the site incharge with ample warning of his future labour requirements.

→ By noting the actual work force regularly on the chart, a direct measure of labour expenditure on site can be obtained.

→ If a manpower shortage is likely in a partic - ular section of the project.

→ It helps in efficient and optimum deployment of the labour force in various sections of the project.

Name of work ---- prepared by ----

Date ----

Manpower (Labour)	Weeks 1	2	3	4	5
Foreman	1	1	1	1	1
carpenters	—	—	—	1	1
welders	—	—	3	2	1
Mixer operator	—	—	1	—	—

Preparation of equipment (machinery) schedule

→ An equipment schedule is prepared for all plant/equipment required to be deployed on the project.

→ From this schedule, delays in the work that may occur either due to non-availability or breakdown of equipment can be averted.

Ex Construction of temporary shed, the equipment schedule is shown below

Name of work ---- prepared by ----

Date ----

Equipment	Weeks 1	2	3	4	5	6
concrete mixer	—	—	1	—	—	—
Vibrator	—	—	1	—	—	—
welding set	—	—	1	1	1	
Truck	—	—	—	—	—	1
Equipment for						

Preparation of finance schedule

→ Finance schedules are essential both for the pre-tender and construction stages.

→ The finance schedule shows the amount of cash required at different stages of construction project.

→ It also considers cash inflow from the running bills and indicates finances required for the successful completion of the project.

Construction scheduling by bar charts

→ The conventional method of scheduling used in the construction industry is the bar chart.

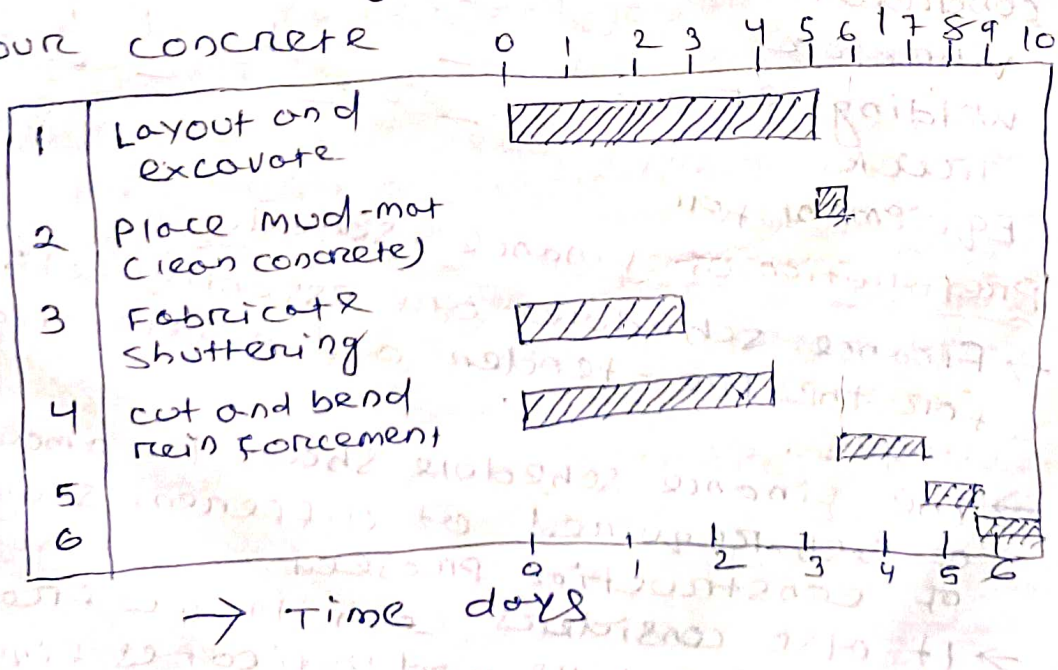
→ A bar chart consists of two co-ordinate axes, one showing the time and the other showing jobs or activities to be performed.

→ Each job is depicted in the form of a horizontal line or bar and the length of a bar indicates duration of the job or activity.

→ In a bar chart, some of the bars run parallel to each other and some run serially with one bar beginning after the other bar ends.

Ex

Activities	Time (days)
Layout and excavate (foundation)	5
Place mud-mat (lean concrete)	1
Fabricate shuttering	3
cut and bend reinforcement	4
Fix reinforcement	2
Fix shuttering	1
Pour concrete	



Bar chart for construction of equipment foundation.

Limitations of bar charts are as follows:

(i) Interdependencies of activities

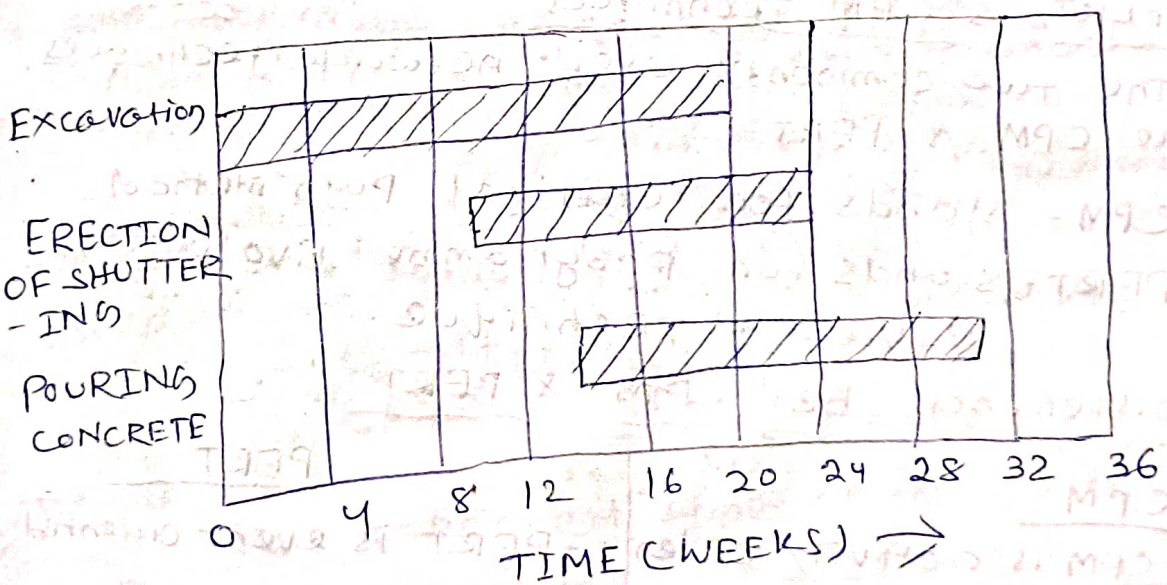
→ A construction project consists of a large number of activities.

→ The bar chart does not show clearly the interdependencies among the various activities. This is a major deficiency

FOR EX

A construction project involving excavating foundation, ~~mixt~~ fixing shuttering and concreting in which the time consumed by each activity is as under

Excavating foundation	20 weeks
Fixing shuttering	14 weeks
concreting	16 weeks



(ii) PROJECT PROGRESS

→ A conventional bar chart cannot be used as an efficient control device because it does not show the progress of work

→ A knowledge of the quantum of work completed or progress achieved is essentia in any project.

→ A conventional bar chart can be made more useful by modifying it.

→ In the modified bar chart, the progress of work can be depicted by colouring/ hatchi

bar bars

iii)- Quantities of items of work

→ The bar chart depicts the time schedule for various activities but it does not indicate the quantities of work.

→ The bar chart may be improved by showing quantities of work against individual items.

(iv) Critical Activities

→ Another limitation of the bar chart is that it does not indicate critical activities requiring careful attention of the construction team.

→ Knowledge of critical activities is essential for rescheduling or accelerating the project completion.

PERT, & CPM Techniques

The two commonly used network techniques are CPM & PERT.

CPM - stands for critical path method

PERT - stands for Programme Evaluation and Review Technique.

Difference bet^n CPM & PERT

CPM	PERT
1 - CPM is activity oriented	1 - PERT is event oriented
2 - Single time estimates are used for the various activities i.e. the time estimates are deterministic.	2 - The time estimates for activities are probabilistic The following three types of time estimates are used for each activity. i - optimistic time (t_o) ii - pessimistic time (t_p) iii - Likely time (t_L).
3 - CPM is used for repetitive types of projects where the time estimates for various activities are either known or can be determined fairly accurately	3 - PERT is used for pioneering type of projects i.e. projects which are the first of their own kind and where prior data about activity time is not available.

4- CPM places emphasis upon optimising allocation of resources and minimising overall project cost

4- PERT lays emphasis on reducing project completion time without cost constraint.

Optimistic Time (t_o)

Optimistic time (t_o) or It is the shortest possible time for completing an activity if everything proceeds as planned without any problem i.e. the activity is performed under ideal conditions.

Most Likely Time (t_L)

Most likely time is the time for completing an activity under normal conditions.

→ In this case, conditions are not ideal and minor.

Pessimistic Time (t_p)

Pessimistic time is the maximum time required to complete an activity under abnormal or extremely adverse conditions in which everything goes wrong.

The expected time estimate for each activity is computed on the basis of statistics as under

$$t_e = \frac{t_o + 4t_l + t_p}{6}$$

where,

t_e = expected time of the activity

t_o = optimistic time estimate

t_l = most likely time estimate

t_p = pessimistic time estimate.

PRO Estimate the expected time of each of the following activities from the three time estimates

SR NO.	Activity	Time Estimate in days t_o	t_l	t_p
1	Driving precost Piles for a bridge obutment	22	30	50
2	Erecting roof trusses for a factory shed	11	14	17

3	Concreting foundation of turbo-generator	3	5 1/4	6
4	Fabricating sheet metal A.C ducts for an auditorium	12	16	17

Sol^{n}

1- Driving precast piles for a bridge abutment

$$\text{Expected Time } (t_e) = \frac{t_o + 4t_l + t_p}{6}$$

$$= \frac{22 + 4 \times 30 + 50}{6}$$

$$= 32 \text{ days.}$$

2- Erecting roof trusses for a factory shed

$$t_e = \frac{11 + 4 \times 14 + 17}{6} = 14 \text{ days}$$

3- concreting foundation of Turbo-generator

$$t_e = \frac{3 + 4 \times 5\frac{1}{4} + 6}{6} = 5 \text{ days}$$

4- Fabricating sheet mental A.C ducts for an auditorium

$$t_e = \frac{12 + 4 \times 16 + 17}{6} = 15\frac{1}{2} \text{ days.}$$

Activity

Performance of a specific task, operation, job or function which consumes time and resources and has a definite begining and end is called an activity.

For EX

Excavate foundation, lay brick work, backfill trench, fix shuttering

Event

An instantaneous point in time marking the beginning or end of one or more activities is called an event.

→ An event consumes no time or resources.

Ex: Excavation completed, brick work laid, wall concreted.

Network

A network is a diagrammatic representation of a work plan showing the activities, step-by-step, leading to the established goal.

→ It depicts the inter-dependence bet^n the various activities. i.e: which activ-ies can be done together and which activities must precede or succeed othe

Network Representation

The following two systems of network representation i.e: Activity-on-Arrow (A-O-A) system and Activity-on-Node (A-O-N) system are used for development and analysis of networks in CPM/PERT

1- Activity-on-Arrow (A-O-A) System

In this system an activity is graphic-y represented by an arrow drawn fro left to right.

Ex

Fix shuttering
4 (days)

Representation of Activity

An event is graphically represented by a number enclosed in a circle. T beginning of an activity is marked by a 'tail event' or preceding event and the end by a 'head event' or succeeding event.