BHUBANANANDA ODISHA SCHOOL OF ENGINEERING, CUTTACK

DEPARTMENT OF CIVIL ENGINEERING

LECTURE NOTE ON: CONSTRUCTION MANAGEMENT

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CHAPTER 1:

Introduction to Construction Management

1.1 Aims and objectives of construction management.

1.2 Functions of construction management.

1.3 The construction team components- owner,engineer,architect,contractor-their functions and Interrelationship and jurisdiction

1.4 Resources for construction management-men,machines,materials,money

MANAGEMENT

The term management has different senses of use. Sometimes it is used in the sense of an organisation in which different class of people work together to provide qualitative and economical product by the use of human beings and other resources like machine, money and materials.

Or somtimes it may be defined as the process consisting of planning, organising, activiting and controlling the performance to determine and accomplish the objective by the use of men, machines, materials and money.

Management is the art of securing maximum results with the minimum effort.

Significance of Construction Management

In India, construction industry is the second largest economic activity and also the Gross National Product (GNP) of India from construction activities is about 10%. Thus it plays a major role in the development of the national economy. On an average about 50% of the total expenditure of the five year plans is invested in construction works. So, new methods and new techniques must be devised and used to increase the speed and safety in construction.

1.1 Aim and Objective of Constitution Managment

The following are the main objectives of the construction management.

(i) The work should be completed within estimated budget and specified time.

(ii) There should be the motivation to working people to give their level best within their capacities to complete the work.

(iii) There should be qualified and trained staff to suprevise the work properly.

(iv) The execution of work should be done as per specification.

(v) The execution of work should be done as most economically.

(vi) The working quality and workmanship should be good.

(vii) There should be a proper plan of work and it should be organised properly.

(viii) There should be an awareness of creating an organisation that works as a team.

(ix) The workers should have been provided with safe and satisfactory working condition.

Necessity of Construction Management

Construction management is necessary for the following causes.

(i) By adopting the new technologis of construction and supervision, the economy is affected.

(ii) There can be proper co-ordination between agencies and categories of persons using the modern techniques of management.

(iii) The working quality & speed of work can be improved by using modern equipments of construction.

(iv) The completion of work can be done in the minimum possible time duration.

1.2 Functions of Construction Management

The following are the functions of construction management

(i) Planning
(ii) Organizing
(iii) Staffing
(iv) Directing
(v) Controlling
(vi) Co-ordinating
(vii) Communicating.

(i) Planning :

Planning is a basic managerial function. Planning helps in determining the course of action to be followed for achieving various organizational objectives.

It is a decision in advance

(a) what to do

(b) when to do

(c) How to do

(d) who to do

Planning is a process which involves "Thinking before doing". Planning is the identification of a number of alternatives work plans for achieving a specific objective to select a plan finally which is the best suited.

Planning is the determination in advance of a line of action by which certain results are to be achieved. Planning is a process of looking ahead. The prirnary objective of planning is to achieve better results. Planning includes the selection of organisational objectives & developing policies, procedure, programmes, budget and strategies.

(ii) Organizing :

There is a requirement of a number of persons in every business enterprise to look after it's different aspects. It is the responsibility of a manager to set up the objectives or goals to achieve by its personnel and also to define the responsibility of each individual employee in the organisation. The function of organising is to arrange, guide, co-ordinate, direct and control the activities of other factors of production such as men, material, rnoney and rnachines.

Organising is the part of management that involves establishing the intentional structure of roles for the people in an enterprise. The organisaion provides the necessary framework within which people associate for the attainment of business objectives.

The process of organisation involves the following steps.

(i) to identify the work to be performed
(ii) to classify or group the work
(iii) to assign these group of activities or work to individuals
(iv) to delegate authority and fix responsibility
(v) to co-ordinate these authority-responsibility relationships of various activities.

However, the organisation structure should be simple and flexible. The character and type of organisation depends upon the size and nature of the enterprise.

(iii) Staffing:

This function of management involves managing the positions created by organisation process. Staffing is filling the positions in the organisation structure through defining requirements. It is a very important responsibility to select right persons for right jobs in a construction organisation. This function of management includes not only the proper selection of staff in requisite number but also includes their training to handle fresh accomplishments.

Every manager in an organisation has to perform the staffing function in one form or the other in order to get things done through others. But it is a difficult managerial function as the behaviour and actions of human beings can't be predicted.

(iv) Directing:

Directing is concerned with carrying out the desired plans. Direction is called as management in action. It initiates organized and planned action and ensures effective performance by the subordinates towards the organisation of group activities. This function of management ensures that each employee knows what exactly he is supposed to do and how and when to do it. This function is performed at every level of organisation form top managers to employees. The planned programmes may be in the form of bar charts, or net work diagram, drawing, other estimates, detailed specification and other details of the work.

Directing is concerned with the manner in which a manager influences the action of subordinates. This function of management involves motivation, guidance, supervision and communication as well as leading the employees of the organisation.

(v) Controlling:

Control is essential for achieving objectives of an enterprise. Control is the process which enables the management to get it's policies implemented and take corrective action. If planning is the beginning of the management process, then controlling may be said to be the final stage of the management. Controlling is an important action for ensuring effective and effcient working. It reviews the work plan to check and rectify the deviations through appropriate corrective measures.

It also checks the quality of work so that it is completed as per scheduled/specified time. It also keeps control on avoiding the wastage on the use of machines and material and labour output for each item of work. It also controls the expediture on each item of work as per cost estimate. The main purpose of control is to see that the activities achieve the desired results. A control system should be economical, effective and assure corrective action.

The process of controlling involves the following steps.

(i) establising standards of performance target in terms of time

(ii) ensuring actual performance

(iii) comparing the actual performance with the standard.

(iv) finding variances or deviations if any.

(v) taking corrective action or measures.

(vi) Co-ordinating :

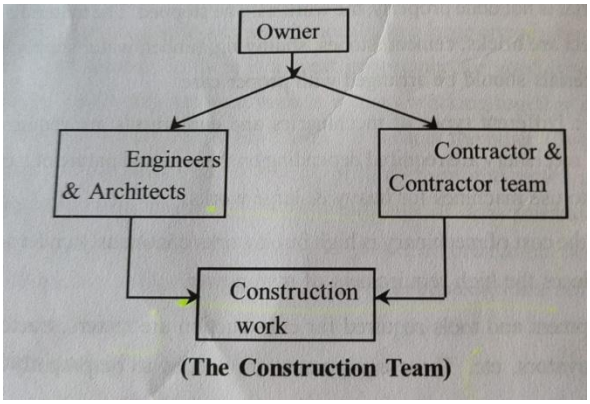
Co-ordination is much wider term than co-operation. Co-operation indicates the willingness of individuals to help each other. Co-ordination, on the other hand, is a conscious managerial effort which is the result of a deliberate action. Co-ordination harmonises the approaches and actions of various employees or group of employees to achieve a common objective. In a construction organisation it is esential to carry out a large number of inter related and inter dependent activities simultanously. In a large organisation, the work is devided into different departments. So there is a great importance for good co-ordination. Also good co-ordination is necessary between various agenies working together on the project so that the work of any one of them should not hinder the work of the other. Co-ordination requires an efficient systern of communication so that each department and secton is aware of their role. Proper co-ordination can be done by regular meetings of departmental/sectional heads with top management and this is the fundamental to proper co-ordination. As a result, variance or deviation problems are sorted out and their corrective remedies are determined for their best solution.

(vi) Communicating:

Communication is the process of transmitting, receiving and understanding the ideas by others for the purpose of effecting desired results. There may be numerous methods of communication like verbal, written orders, reports, instructions etc. As a business organisation has continuty, the process of communication is also a continuous process. Of course, the effectiveness of communication largely depends upon the proper understanding of what is being communicated and what is being received and then responded. Ineffective communication leads to confusion, misunderstading, dissatisfaction and sometimes even workers unrest.

1.3 Construction Team Components

Any project can't be completed by a single individual. There is a requirement of group of person's specific duties to be performed by each member. The construction team consists of engineer/architects and contractor. The requirement of this team is to cooperatively plan, design and execute a particular project. The main objective of this team is to execute the project in the best and most economical manner within a limited scheduled an owner takes up any project, he then employs an engineer/architect to prepare the plan for the project and the engineer designs the project at the lowest possible cost which satisfies the most of the needs of the owner. After this step, the owner engages contractor for the completion of the project.



(The Construction Team)

(i) Owner:

The owner of a construction project may be an individual, group of individuals, private or public body. The owner finances the project and also recognizes the need for a project.

This is the power of an owner to control the project resources such as money, man power & material. The owner also cares for the maintenance of the work & resources.

(ii) Engineers & Architects:

Structural engineers are to prepare structural design of structures. Mechanical engineers are to design and preparation of working drawings for all mechanical services associated with the construction project. Also electrical engineers are to design & prepare working drawing for electrical power & distribution system during & after construction.

An architect is to assess the Client's fundamental requirements, Architect/engineer being a professional man.

(i) He supervises the construction of the project.

(ii) He first does the preliminary investigation for the proposed project.

(iii) He then prepares plans and designs the project for the owner.

(iv) He specifies for the construction.

(v) He then works as an adviser & helps in solving problems which arise during the progress of work.

(vii) He deals with the contractor on behalf of the owner.

(viii)He estimates the cost of work to be done and quantity surveys.

(ix) He prepares the cash-flow statements during construction.

(x) He prepares the bill of quantity & tender documents before tendering. (xi) He prepares the final account on completion of the project.

(iii) Contractor:

The contractor may be an individual for small contracts or large construction company for projects. There is the need of a qualified engineer to every contractor whether small or big.

The contractor executes various types of works and also makes necessary arrangements for labour, machinery, materials, in order to complete the project in the limited scheduled time. In some projects, the contractor may appoint sub-contractor. There is a rate or bid between Contractor & owner before starting any project. When the bid or rate is agreed, then the contractor constructs the projects

1.4 Resources for Construction Management

The following are main resources which are needed for the construction industry.

(i) Money:

Money is first and foremost requirement for any project and it should be arranged before starting any construction project for smooth implementation of a project. Adequate money is highly essential for all other resources are dependent on it. There should be regular supply of money to keep the project moving progressively. If the financial resources are insufficient, then the project will not be completed within the limited scheduled time period. Then there will be wastage of energy & time and also the organizational goal will not be achieved. So money is an important factor for construction management & these financial resources should be planned with special care before starting any project.

(ii) Materials:

Sufficient quantity of materials is required for the completion of any project, and also should be available at the site. These materials required for the project are estimated before starting the project. The materials required for any project is accounted for upto 60% of the total cost at the project, So, it is essential for regular supply of material. If the regular supply of material is not done properly, the work may be stopped. The materials required for a construction project are bricks, cement, stones, shuttering, timber, water supply, electrical fittings etc., these materials should be arranged with proper care.

(iii) Machinery:

Different types of machineries and equipments are required for any construction work. The machinery are required depending on the type and nature of a cnstruction work. It is economical to use machines for heavy & large works.

Though initially, the cost of machinery is high but it works continuously under any adverse situation and it also reduces the high requirement of man power.

The various equipment and tools required for construction are mixers, tractors, cranes, pumps, generators, excavators, etc. These equipments are needed to be properly maintained for any construction activity.

(iv) Man Power:

For the successful completion of any project, man power is an important factor. It may be both skilled and unskilled. There is a requirement of all manpower to start a project from a unskillled labour to supervisory staff according to the planning. Also technical and managerial personnel such as engineers, architects, surveyors, supervisors, technicians are essential for efficient use of human resources. So that it will helpful to achieve project completion within estimated time and budget.

CHAPTER 2

CONSTRUCTIONAL PLANNING

2.1 Importance of Construction Planning

2.2 Developing work breakdown structure for construction work

2.3 Construction Planning stages-Pre-tender stage, Post-tender stage.

2.4 Construction scheduling by Bar charts-preparation of Bar Charts for simple construction works.

2.5 Preparation of schedules for labour materials, machinery, finance for small works

2.6 Limitation of Bar charts

2.7 Construction scheduling by network techniques-definition of terms ,PERT and CPM techniques, advantages and disadvantages of two techniques, network analysis, estimation of time and critical path, application of PERT and CPM techniques in sample construction works

2.1 Importance of Construction Planning

Importance of construction planning are as follows.

(i) The work may be completed within the scheduled time.

(ii) The work may be executed most economically.

(iil) The work will be both qualitative & quantitative.

(iv) There shall be minimum wastage during construction work.

(v) The work should be completed as per specification.

(vi) There will be a minimum cost of maintainance of mechinery & equipment.

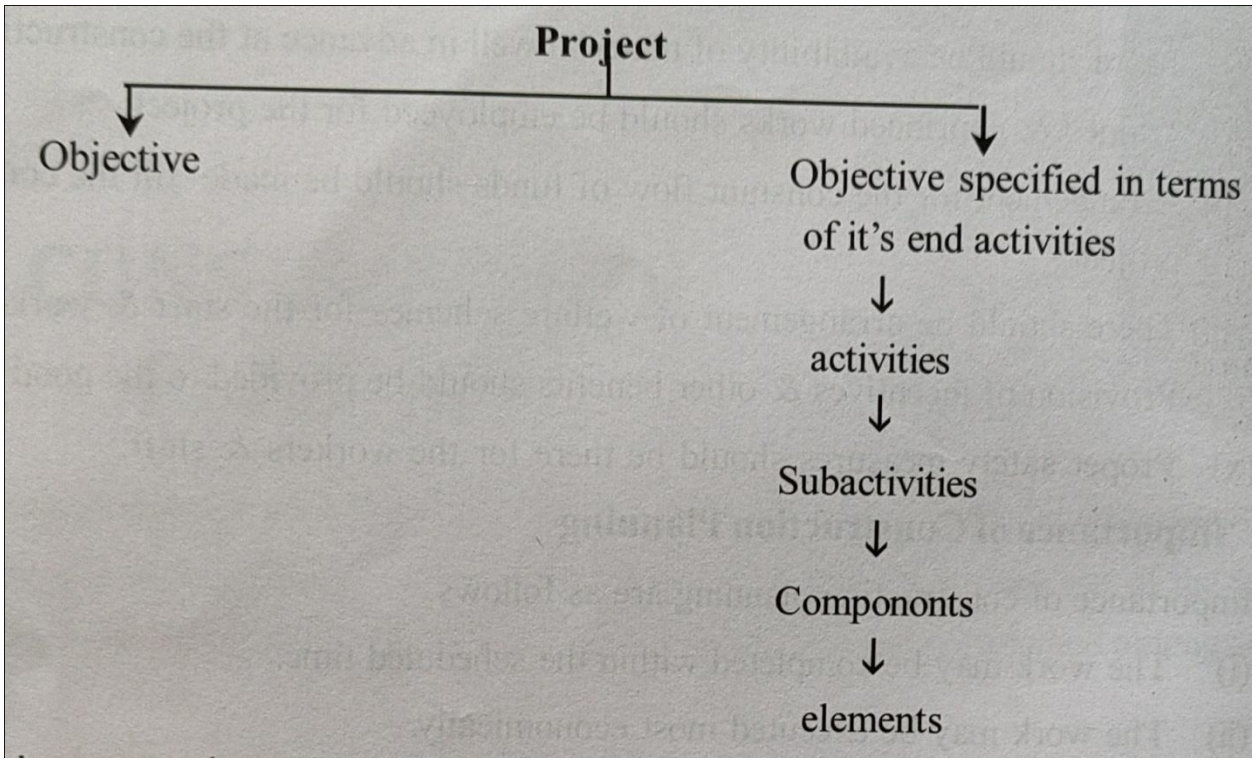
(vii) There will be optimum use of available resources.

(viii) Controlling of construction activities can be possible.

2.2 Developing work breakdown structure for construction work

It is the process of breaking down a project into sub-systems and each sub-system into major components and discrete activities. Also it is a technique through which the functional elements of a project and their inter-relationships are determined. This technique establishes the hierachical order in a system by breaking the project into major systems, sub-systems and discrete activities. Until the system is reduced by breaking down the sub-system & subsystem

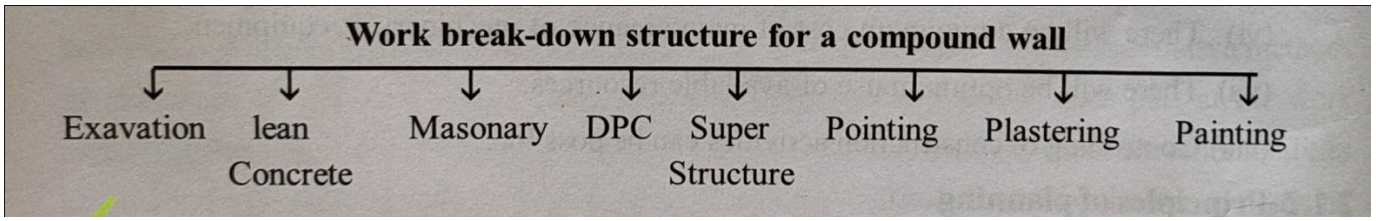
into components or activities representing managable units for planning, the breakdown process is continued. In general, the main objective of breakdown structure in a project is to identify discrete activities which can be planned, scheduled, estimated, executed.



In this system, the major project is first identified in terms of the end activities, then activities are brokaen into subactivities, componets & elements.

For example the construction of a compound wall may be broken down as shown in the figure.

Work break-down structure for a compound wall



2.3. Construction Planning stages-Pre-tender stage, Post-tender stage.

Planning is a very essential activity for efficient implementation of a project at various stages. Construction planning can be divided in the following two stages.

(i) Pre-tender stage

(ii) Contract stage / Post-tender stage

(i) Pre-tender stage Planning:

The pre-tender planning is carried out by the contractor after the receipt of tender notice and before submitting the tender paper. In this stage, the contractor plans his best method of construction for the future contract & also makes plans & programmed for carrying out the work. At this stage, the contractor prepares himself for completing the work in the stipulated time. This is an important stage for a contractor to see whether the contract is profitable or not. The first part of pre-tender planning is to visit to the site before a contract is undertaken.

The contractor is to be required to visit to the site of construction work. A pre-tender planning report describes the complete circumstances of the work and it also describes the conditions under which the work is carried out. The pre-tender planning report by visiting to the site of construction work represents a total information about the site such as geography of the area, availability of resources like man, machine, material etc. in Pre-tender planning

Stages of pre-tendering:

(i) At the first Step, there should be a careful study of tender documents, drawing & specifications to identify the quantizes of each item of work.

(ii) Also there should be a careful study of tender document about the time limit, i.e. the project should be completed within the stipulated period of time.

(iii) There should be a site investigation & market survey to determine the rates and availability of materials, man power & machinery.

(iv) The availability of required materials near the site of work should be determined and if not, also how these can be procured economically.

(v) The selection of the most suitable & economical method out of the alternative methods should be carefully determined for executing the work.

(vi) The quantities of different items should be estimated.

(vii) The overheads and the margin of profit should be decided and the tender price finalized for the completition of the work within the stipulated period of time.

(ii) Contract stage / Post tender stage Planning

Contract stage is otherwise by called as post tender stage. This stage is starts after the acceptance of the tender and extends till the completion of the contract. At this stage of, the contractor fully utilizes the pretender stage planning to organize the various activities of construction work so that the work may be completed within the scheduled time economically without delay & difficulty. Post tender planning is used to check out the details for execution of the project. Improper and inadequate planning at this stage may cause heavy loss of money and time. Delay in execution of the work may also result in for heavy loss. Also benefits from the project may also be dropped drastically.

Steps in Post-tender Planning

(i) The selection of most suitable & economical method out of all the alternative methods consider at pre-tender stage should be carefully determined for execution of the work.

(ii) The quantities of materials required at each stage of the work, locating sources of their supplies, their comparative cost from different sources should be worked out properly.

(iii) Inter-relationship of various iterns of work should be studied and the proper sequence of operations is finalised.

(iv) The acquirement of construction labour, supervisory & managerial staffs should be finalised and their selection & recruitment should be arranged.

(v) Total number of requirement of machinery & equipments at various stages of work should be worked out & arranged.

(vi) Also repairing & maintenance of mechinery & equipment should be properly arranged.

(vii) Accommodation for labour & staff along with the facilities required for them, temporary camp office, roads etc. should be planned and arranged properly.

(viii) The work programme of each work should be decided and it's starting & completing date also be finalized.

(ix) A good communication system between the members of the construction team should be established for the smooth running of project work.

2.4. Construction scheduling by Bar charts-preparation of Bar Charts for simple construction works.

Methods of Scheduling:

I. Bar chart or Gantt chart

2. Network Analysis.

Bar chart

Bar chart is a graphical representation of various activities, their duration, start and period of a project. When a project is sub-devidcd into various activities, bar-chart shows the completion of various activities graphically. This method was developed by Henny-Gantt around 1900.

In bar chart, there are two co-ordinate axes. One is x-axis & another is Y-axis. Along x- axis time required for the completion of work is represented and along Y-axis, the activities are represented.

In a bar chart, the activities are represented by thick crossed horizontal bars. Here time required for completion of the activity may be represented in days or in weeks. This chart is known as Bar chart because the activities are represented by number of parallel bars in it. The length of each bar indicates the duration of time required to complete a particular activity. The bar chart or the Gantt chart represents the schedule of a project. Also bar chart reprents the actual progress of the work by thick dark bars.

A daily record should be maintained by the supervisor about the progress of the work and handed over it to the sectional officer who in turn will handover it to chief-supervisor or engineer for finalizing it, so that the progress of work can be completed within a perticular period of time.

So a bar-chart gives a clearer picture of the progress of work without studing any detailed report.

Symbols of Bar chart

Following symbols are used in a bar chart.

(i) In bar chart, various activities are shown by thick crossed horizontal bars. (ii) The planned programme is represented by a thick line.

(iii) The length of bar chart shows the time required to complete the work.

(iv) So the starting and finishing of an activity are represented by a small vertical line. (v) Actual progress of work is represented by a hatched line.

(vi) In bar charts, float is represented by doted horizontal lines which represents the flexibility range of an activity with which starting and finishing time can fluctuate.

(vii) The vertical dotted line represents the dependency of one activity on another activity.

Steps in Preparing of bar chart

The following steps are involved in preparing a bar chart.

1. In preparing a construction schedule by bar chart, at first the project is sub-divided into various activities name the various activities in a list.

3. Determine their inter-relationship among the activities.

4. Arranging the activities in a systematic manner one after another.

5. Determine the quantity of work & requirement of time to complete the work.

6. Draw the bar chart.

So a bar chart different operations to be performed and the period required for the execution of each operation. Actual progress of each activity is also shown by this chart. The actiuties are not in the actual progress well, some the arrangement has to be made to speed up the

2.5. Preparation of schedules for labour materials, machinery, finance for small works

These are the procedures for preparing a construction schedule.

1. At first the whole project it divided into a small number of operations.

2. Then the inter-dependence among or between the operations are carefully studied and their sequence is decided.

3. The quantity of work is to be determined which is to be done in each operation.

4. The total time to complete the each operation and total project is determined.

Classification of Scheduling

Schedule can be classified into various groups.

1. Material Schedule

2. Labour Schedule

3. Equipment Schedule

4. Financial Schedule

(1) Material Schedule

This type of schedule is prepared for moving and storing of materials in advance before starting of work. Construction schedule acts as a guide for prepering material schedule.

The schedule should be prepared well in advance of the start of the work. Also, this schedule is to be prepared from the construction schedule. To avoid delay in the execution' of the work, all construction materials are required to reach the site of the work well in advance, at least before the start of the work. Of course, if the material is stored at site long before its use, it is likely to deteriorate in quality. For example, cement may lose its strength by 50% if stored for six months and steel may be attacked by corrosion due to long storage at site.

Therefore, at the time of preparing the material schedule, following points must be kept in mind.

(a) The materials should be delivered at site at least one week before its use.
(b) The materials at site should not remain unused for long.

(2) Labour Schedule

The labour schedule is prepared for deciding the actual number of skilled and unskilll labour which is required for the construction work i.e. the aim of this schedule is to decide the number of skilled and unskilled labour required for the execution of different operations on the help of this schedule, required labour can be arranged will in time. It is difficult as well as costly to arrange skilled labour as and when required. It helps in reducing labour cost. Generally, a labour schedule is prepared from the construction schedule. It also includes the nature and guanity labour the operations on different days for the execution Of the project work. One of the advantage of labour schedule is that it reduces the labour cost. Labour can be arranged well at the time of any operation. Also construction schedule may act as a guide for the prepation of labour schedule. Labour schedule helps for the arrangement of labour for the execution of work on different dates.

(3) Equipment Schedule

This type of schedule is prepared to decide the type and quantity of equipments as also on date, thse equipnrnt will be needed; so that they can be arranged when requird Construction schedule may act as the guide for the preparation of equipment schedule. Soartinrs the purchases a equipment for a particular project, and after purchaching the has to get a mark punched to identi$' the equiprnent from the others. When a purchase he should have knowledge about it like

(i) Cost of equipment

(i) efficiency of equipment

(iii) Expenditure required for it's repairing

(iv) Maximum duration for use of the equipment

(v) Quality of fuel consumed by the equipment

(vi) Servicing of the equipment

In order to decide the type, number and dates on which a particular equipment will be equipnzn use schedule has to be prqared before the start of the project, so that it is arrangd well advance and brought to the site as and when required- The aim ofthis scheduk is to &rive advantage of equipnrnt when at site and ramve it from the site wha its is ova and thus effecting economy.

(4) Financial Scheduling

Financial schedule;e is prepared to estirmte the ofrmn%' that a ouner or contract« has to as finance for project It is specified that in rmst of the constructicn projects, the 0%Er will pay a of value to the contractor for the cc*ed in ach nn-:th or ach week. AGO the will pay about 90% convlaion work and rest IWo is retained-

2.6. Limitation of Bar charts

There are certain limitations of the bar chart.

(i) If the time schedule is changed, it is difficult to readjust length & position of bar.

(ii) Bar chart can only be applicable for small projects; but not suitable for large projects.

(iii) Bar chart cannot show clearly the inter dependence among the various activities.

(iv) The bar chart does not show the actual progress of the work as it only represents the estimated time. So the actual progress of the work can't be monitored.

(v) The critical activities of the project is not shown in bar chart.

(vi) The bar chart does not reflect the uncertainties of time in activity duration.

(vii) The bar chart gives no idea about the financial aspects. It only gives the idea of the physical progress.

(viii)The bar chart gives no idea about the maximum progress necessary for it's completion. It gives the information only about the rate of progress.

(ix) It is difficult to find out the alternative course of action to complete the work in time in case of variation from planned programme.

(x) As the bar chart is a static representation, it doesen't indicate the dynamic happneings on the projects.

(xi) Obtaining of feedback from the bar chart is only approximate.

(xii) As various activities are shown by one chart, the sequence of operation is not clearly known.

2.7 Construction scheduling by network techniques-defination of terms ,PERT and CPM techniques, advantages and disadvantages of two techniques, network analysis, estimation of time and critical path, application of PERT and CPM techniques in sample construction works