BHUBANANANDA ODISHA SCHOOL OF ENGINEERING, CUTTACK

DEPARTMENT OF CIVIL ENGINEERING

LECTURE NOTE ON: CONSTRUCTION MANAGEMENT

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BOSE, CUTTACK

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CHAPTER-1 INTRODUCTION

• Aims and objective of construction management

• Functions of construction management

• The construction team components

• Resources for construction management

CONCEPT OF 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 material.

• 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.

1.1. Aim & Objective of constructionManagment.

The following are the main objectives of the construction management.

- The work should be completed within estimated budgect and specified time
- There should be the motivation to working people to give their level best their capacities to complete the work.
- There should be qualified and trained staff to suprevise the work properly.
- The execution of work should be done as per specification.
- The execution of work should be done as most economically.
- The working quality and workmanship should be good.
- There should be a proper plan of work and it should be organised properly.
- There should be an awareness of creating an organisation that works as a team.
- The workers should have been provided with safe and satisfactory.

FUNCTIONS OF CONSTRUCTION MANAGEMENT

The following are the functions of construction management ν Planning

- Organising.
- Staffing.
- Directing
- Controlling
- Co-ordinating
- Communicating.

PLANNING

• Time needed to complete the whole construction project

• Type, quantity and exact time for delivery of materials of costruction.

• Type, number and duration of use of different machines and equipments.

• Category of staff i.e.,Managers, skilled and unskilled workers required.

• Type of uncertainties likely to cause delays such as weather conditions, shortage of supply, labour unrest and sub-judice land matter etc.

- WHAT TO DO

- WHEN TO DO
- HOW TO DO
- WHO TO DO

ORGANISING

• After the planning is in place, a manager be needs to organize her team and materials according to her plan.

• This process involves To identify the work to perform To classify or group the work To assign these group of activities to individuals To delegate authority and fix responsibility STAFFING

• Staffing is filling the position in the organisation structure for defining recruitments.

• It is a very important responsibility to select right person for right jobs in a construction organisation.

• Staffing is not only about the recruitment but also their training and developing activities.

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• A manager needs to do more than just plan, organize, and staff her team to achieve a goal.

• She must also lead.

• Leading involves motivating, communicating, guiding, and encouraging.

• It requires the manager to coach, assist, and problem solve with employees.

CONTROLLING

• After the other elements are in place, a manager's job is not finished. He needs to continuously check results against goals and take any corrective actions necessary to make sure that his area's plans remain on track.

• Controlling is an important action for ensuring effective and efficient working.

• It reviews the work plan to check and rectify the deviation.

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CO-ORDINATING

• It means developing harmony between employees and group of employees for smooth and efficient functioning of construction work.

• In large organisation the work is divided into different departments. So there is a great importance for good coordination. COMMUNICATING

• Communication is the process of transmitting receiving and understanding the ideas by others for the purpose of effective desired results

• There are various methods of communication like verbal return others reports instruction result .

• Ineffective communication leads to confusion misunderstanding Etc.

OWNER

- The owner of a construction project may be an individual, group of indivduals or public body. The owner finances the project and also recoginses the need for a project.
- in view of all aspects the owner has the power to take major decisions regarding managerial financial and administrative aspects

CONTRACTOR

- 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.

RESOURCES FOR CONSTRUCTION MANAGEMENT Money

• Money the first and foremost recruitment for any project and it should be arranged before starting any construction project for smooth implementation of a project

• If the financial resources are insufficient than the project will not be completed within the limited scheduled time period Material

• Sufficient quantity of materials required for the completion of any project and should also be available at the site.

• Material required for project rest method before starting the project

• For example- bricks ,cement ,stones ,Timber ,water supply electrical fitting etc Money

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Machine

• Different type of machineries and equipments required for any construction work

• Although the cost of machines are high but reduces the high requirement of manpower

• For example mixers, tractors , cranes ,pumps,generators excavators etc.

Man power

• Successful completion of any project manpower is an important factor

• It may be bahut skilled and unskilled.

• Man power deals with engineers architects supervisors repair technicians skilled or unskilled labour,etc.

Chapter 2 - CONSTRUCTION PLANNING

- Objective of Construction Planning
- Work Breakdown Structure
- Construction Scheduling
- Classification of Construction Scheduling
- Methods of Construction Scheduling
- Bar Chart
- Bar Chart of a Residential Building

IMPORTANCE OF CONSTRUCTION PLANNING

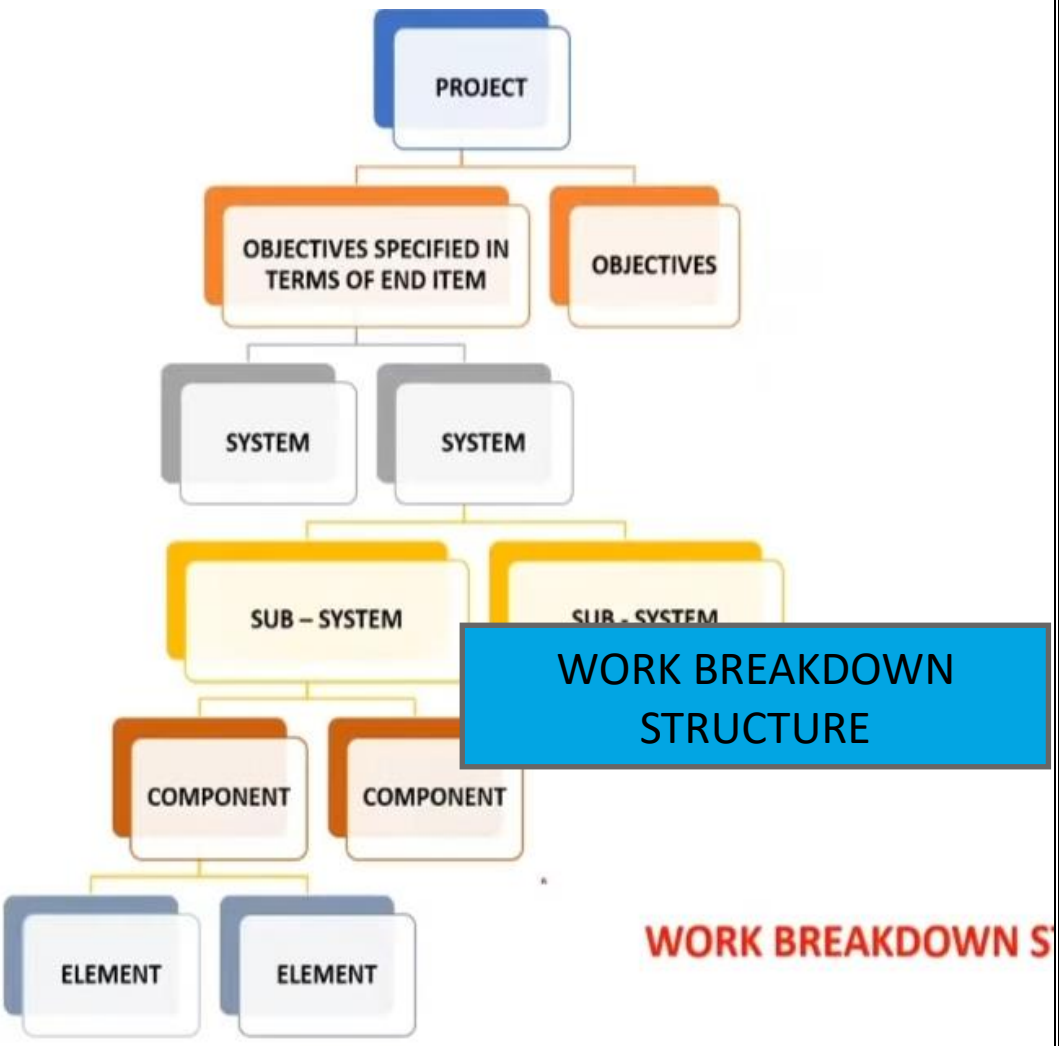
Importance of construction planning are as follows.

- The work may be completed within the scheduled time.
- The work may be executed most economically.
- The work will be both qualitative & quantitative.
- There shall be minimum wastage during construction work.
- The work should be completed as per specification.
- There will be a minimum cost of maintainance of mechinery& equipment.
- There will be optimum use of available resources.
- Controlling of construction activities can be possible.

WORK BREAKDOWN STRUCTURE

- It is the preliminary diagram which showing the breaking down a project into sub-systems and each sub-systems into major components and discrete activities.
- In WBS, top-down approach to planning is adopted. Such an approach ensures that the total project is fully planned and all derivative plan contribute directly to the desired end objectives.
- WBS aids in the identification of objectives and allows the planner to see the total picture of the project.

- WBS is developed by considering the end objective and breaking it into smaller manageable units on the basis of size, duration and responsibility.



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- In other words scheduling is the time table for executing each and every activity with its fixed starting and finishing date

CLASSIFICATION OF SCHEDULING

Schedules can be classified into various groups.such as;

- Material Schedule
- Labour Schedule
- Equipment Schedule
- Financial Scedule

MATERIAL SCEDULE

- this type of schedule is prepared for moving and storing of material in advance before starting of construction schedule acts as a guide for preparing materials schedule.
- This schedule is done to avoid delay in the execution of the work
- The materials should be delivered at site at least one week before its use
- The materials at site should not remain on used for long
- The materials stored at site long before its use it is likely to deteriorated in quality.
- for example cement made its strength by 50% if stored for 6 months and steel may be attacked by corrosion due to long storage at site.

LABOUR SCEDULE

- The labour schedule is prepared for deciding the actual number of skilled and unskilled labour which is required for the construction work
- With the help of this schedule required labour can be arranged in time
- It helps in reducing labour cost.
- Labour schedule is important as it is difficult and costly to arrange skilled labour as and when required.

EQUIPMENT SCHEDULE

- This type of schedule is prepared to decide the type and quantity of equipments as also on which date the equipment will be needed.So that they can be arranged when requirement.
- The aim of this schedule is to derive maximum advantage of the equipment when it is required and remove it from the site when the job is over.

FINANCIAL SCHEDULE

- Financial schedule is prepared to estimate the amount of money that owner or contractor has to spend as finance for the project work.
- In maximum construction project the owner will pay a stated percentage of the value to the contractor for the completion of work in each month. it is about 90% of the cost during each month.

METHOD OF SCHEDULING

Depending upon the size of the project scheduling is done by different methods.

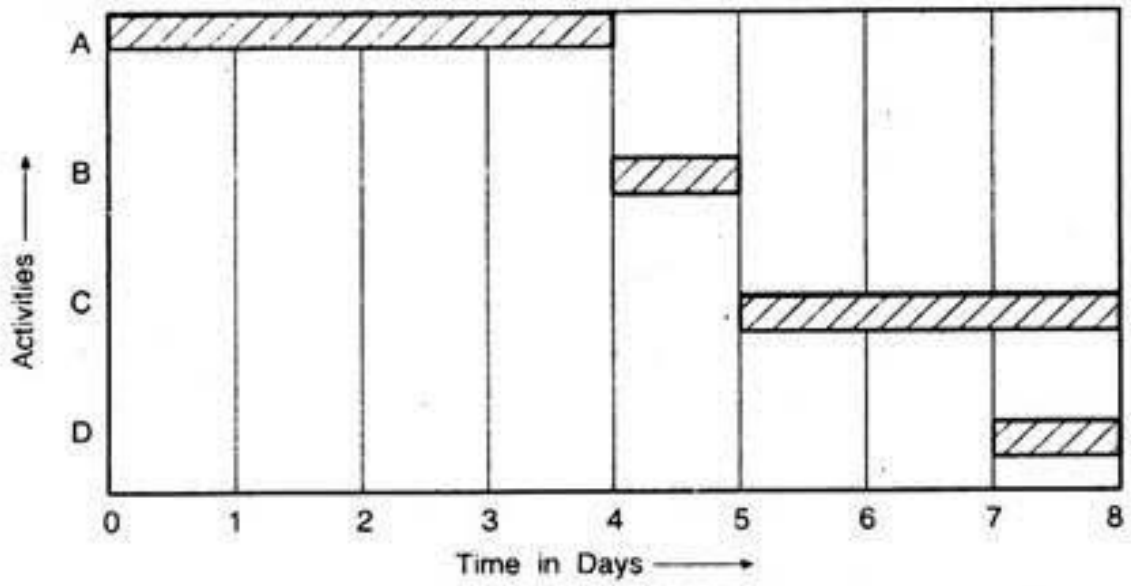
Following are the methods of scheduling.

1. **Bar chart or gantt charts.**

2. **Network analysis (CPM ,PERT)**

BAR CHARTS

- Bar chart is a graphical representation of various activities their duration start and period of a project.
- This method was developed by Henry Gantt around 1900.
- They consists of 2 co-ordinate axis, i.e., horizontal and vertical.
- Horizontal axis is used to represent the time required for the completion of activity and vertical axis is used to represent the activities required for the completion of the project.
- The start and end point of bar represents the time of start and finished time of the activity hence the length of bar represents the duration of activity.
- The bar chart or gantt chart represents the schedule of a project also represent the actual progress
- We can also check the accuracy of work and can compare the actual progress of work with the schedule.

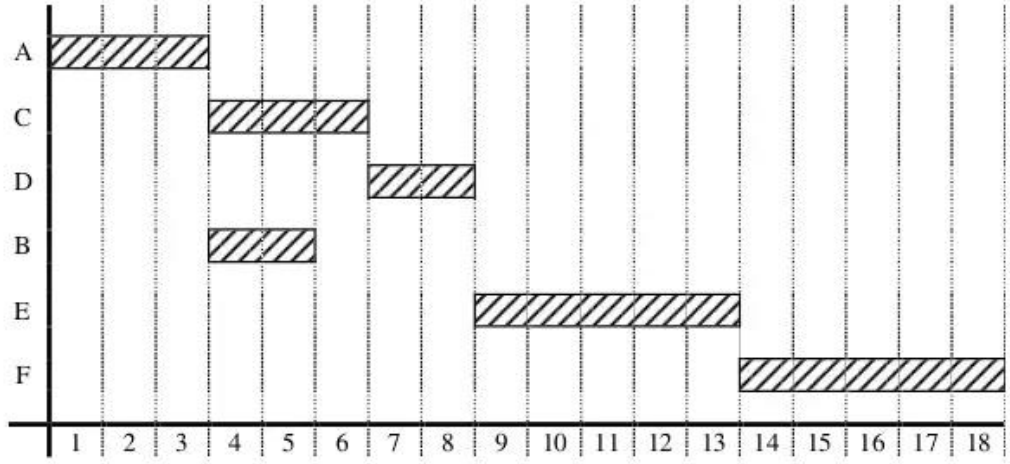


Bar chart of a residential building

- Example:

Activity ID	Activity Description	Dependency	Duration
A	Excavation	–	3
C	Foundation	A	3
D	Column	B, C	2
B	Moving the soil out	A	2
E	Wall	C, D	5
F	Roof	E, D	5

Solution



Advantages of Bar Chart

- Very Graphical
- Easy to understand
- Most widely used

Disadvantages of Bar Chart

- Difficult to Update.

- Difficult to find the Critical Path
- Difficult to setup and maintain a large project because it is essentially a manual graphical procedure.

Chapter – 3 Material And Store Management

Contents

- Introduction and Objective
- Classification of store-storage of stock
- Issue of materials(indent , invoice , bin card)
- Stores accounting procedures
- Inspection of stores
- Procedure of write off

INTRODUCTION

For the execution of different kinds of works in public work department,different types of material and equipments required.

it is necessary to maintain a store of various types of construction material at one or more place in a division so that the execution of work will be efficient.

Before start of any work material should be arranged well in time.

So store and material management is an integral function of different sections of the organisation.

It deals with the supply of material and other related activities and aims at minimum expenditure on materials.

Material management deals with the overall activities of materials such as type, amount ,movement, purchase ,location ,timing of various materials which are used in an organisation. So store and material management is an integral function of different sections of the organisation.

Objective of material management

- To select the right quality
- To meet the production requirements
- Selection of suppliers
- Limit the Wastages
- Product enhancement
- Forecasting
- Standardization Process Objective of material management

• To select the right quality

• To meet the production requirements

• Selection of suppliers

• Limit the Wastages

• Product enhancement

• Forecasting

• Standardization Process

Classification of stores

Stores can be divided into four categories according to public work department.

1. Stock

2. Tool and plants

3. Road metals

4. Material charged directly to works.

Stock

The stock is the store which is required for general work and kept under suspense head and finally issued for the work.

The items which are in common use in the construction activity for the execution of different works are kept in stores.Such materials of general use such as cement, timber , bricks ,aggregates,steels, paints etc are kept in store are called as stock.

Reserve stock limit

The maximum amount of materials that can be kept in a stock in a division is fixed and is known as the reserve stock limit.

The limit is fixed by the Government keeping into consideration the normal requirements of stock in the division.

Note

'Stock' is a suspense head of account. When an item of stock is purchased, its cost is debited to the suspense head 'Stock'.

When the item is issued for use in a work, the cost of the item issued is credited to the suspense, head 'Stock' and debited to the final head of the work concerned.

Subhead of stocks

The various materials of similar nature grouped under different heads to facilitate the proper maintenance of stock account are known as sub-head of stock .

The following are some of various sub heads of stocks

1. Small stores (like nails, screws, hinges, bolts, etc.).

2. Building materials (like cement, aggregates, bricks, lime, etc.).

3. Timber (like deodar, chir, plywood, hardboard, etc.).

4. Metals (like mild steel bars, rolled steel sections etc)

5. Fuel (like kerosene, coal, etc.).

6. Painter's stores (like paints, varnishes, etc.).

7. House fittings (like bathroom fittings, pelmets, etc.).

8. Miscellaneous stores (like cord, wood preservatives, fertilisers, etc.)

9. Lands, kilns, etc. (like road metal quarries),

10. Manufacture (i.e. manufacture in Government workshops).

11. Storage (i.e. charges incurred on the storage of articles, such as rent of godowns, payment to work charged store establishment **Issue of materials**

- The store keeper can issue the materials to different departments upon the receipt of a withdrawal form with proper authority and it is called as material issue requisition form.
- Depending upon the nature and amount of material to be withdrawn from stores the material requisition is prepared in duplicate by the manager.
- Both the copies are sent to the store keeper who issues and records the materials distributed.

Indent and Invoice

- The material from the stores are procured by the process of indenting.
- Materials received from the stock on demand in a proper form called indent form.
- Indent form consist in triplicate of counter foil ,indent and invoice.
- The counter foil and indent part of the indent form filled by the Indent officer.
- Then this form with blank invoice sent to the issuing officer in charge of the stock.

• Invoice is an indent having list of articles actually should and giving price and particulars of the articles.

• Then the issuing officer corrects the indent and fills up the invoice. • Then the issuing officer sends it back to the indenting officer to sign the invoice and they return it to him as an acknowledgement.

Rules for preparing indent and invoice

• There should be description of unit of supply and quantity of material

• The cost of materials of the head of account should be specified

• The name of work should be given when the material is issued.

• Full details of department ,division and any other person for which the metro Brijesh should should be given.

Bin Card

• Bin Card is a card which maintains the details of quantities of each type of material received issued and on hand each day .

• The material and other items are kept in appropriate bins, drawers etc. The store keeper maintains the record on a Bin Card.

• A bin or shelf is attached to each bin card.

• Bin cards are made in duplicate

• One is attached to the bin and another is for the store keeper.

Procedure for store accounting

Final head

The cost of acquisition of stores is debited to the particular work for which they are required.This is known as final head of account. **Suspense head**

Suspense head includes the temporary booking of expenditure incurred for the purchasing of materials for the execution of work is debited to the final head of the expenditure is debited to the minor head i.e suspense expenditure.

a. The procedure for store accounting is done separately for various classes of stores suchas stock, tools and plants, road metals and other miscellaneous material.

b. When the stock is placed then the store is debited to suspense head .When the stock material is issued for the execution of a particular work then it is debited to the final head.

c. The supply of tools and plants in the division and its expenditure is debited to the minor head sometimes for general use special items of tools and plants are not required but for a specific work they are debited to that work.

d. For certain road the road metal is required for the construction its cost is debited to the estimate of that road construction and once the road metal is required for the maintenance of the road it is debited to the sub head under minor head.

e. Similarly for other materials if the materials are purchased for general requirement then the cost is debited to the suspense head.

f. The initial account of all receipt and issues is maintained by the section officer.

g. After closing the monthly account section officer forwards its to the sub divisional office.

Physical Verification And Inspection of stores

Necessity

Inspection of stores and its physical verification is essential for fulfillment of following

(i) To ensure the correctness of stock held by comparing them with the balance shown in the store ledger or bin cards.

(ii)To avoid shortage of materials in the stock.

(iii) To check losses in inventory due to pilferage, improper storage or misplacement, deterioration etc.

(iv) To correct and update store records.

(v) To calculate the values of the stock carried for the balance sheet and profit and loss account.

(vi) To calculate the rate of turn-over of an item.

(vii) To ensure maximum economy in stock carrying.

(viii) To effect insurance covers.

Method of Physical Stock Verification

• Annual physical Verification

• Perpetual Inventory and Continuous Stock Taking System.

Annual physical verification

The following procedure is adopted for carrying out the annual physical verification.

(i)By the end of the year, the stores are closed for a few days; no material etc. is issued to any project work/shop in the plant. In case it leads to plant shut down, the activities such as repair and over hauling of equipment and machineries are resorted to.

(ii) A team of stores inspectors or stores verifying officers physically check and count each and every item lying in the entire store. It is tallied with the quantities marked on bin cards and store ledgers.

(iii) Step (ii) above may lead to the formation of a list of surplus and short items. Damaged and obsolete items may also be traced and recorded.

(iv) Inspectors check a number of items every day as per a preplanned schedule and finish the complete work within a few days.

Advantages in the sense that all the items are checked at one time so there is no confusion about any item being left unchecked.

Perpetual inventory and continuous stock taking

Perpetual inventory and continuous stock taking system is a more appropriated method for large plant with huge inventories which records store balances after every receipt and issue and facilitates regular checking.

(i) Under this system, store items are checked continuously throughout the year; a number of items are counted daily or at frequent intervals and compared with the bin cards and stores ledger.

(ii) Discrepancies found if any, owing to in correct entries, breakage, pilferage, over issue, placing of items in the wrong bin etc. are investigated and corrected accordingly.

• This method is less costly

• In this method only few items are required to check every day as compared to annual physical verification.

Procedure for write off

• The articles of tools and plants get worn out by continuous use and become unserviceable. They can be written off only with the approval of the competent authority. A survey report of all the unserviceable articles is prepared on D.F.R. (P.W.)-15 giving full particulars of their value, date of purchase and reasons for their becoming unserviceable.

• The survey report is submitted to the competent authority for approval. As a general practice, the articles which are written off are destroyed in presence of a gazette officer.

• As regards the articles of stock, which get deteriorated, an estimate for the loss of stock is prepared. The tools and plants articles are written off after preparation of survey report.

• DFR- Document Filing and Retrieval Form

Example

Prepare a Write off in respect of following Articles of tools and plants.

• Name of the sub division- Killamaidan

• Name of the Division and Circle-Cuttack

• 10 nos, of metallic tapes 30m purchased on 6.5.2004 for Rs. 5000/ • 04 nos. of brass pad locks 7.5cm size purchased on 2.6.1999 for Rs. 1200/

• 1 time piece (Ajanta Make) purchased for rest house OMP square on 3.10.2006 400/ These articles became unserviceable through fair wear and tear.

CH-4 - CONSTRUCTION SITE MANAGEMENT

CONTENTS

- JOB LAYOUT
- REVIEW PLAN
- FACTORS AFFECTING SELECTION,DESIGN,LAYOUT OF CONSTRUCTION SITE
- LAYOUT OF EQUIPMENT
- LOCATION OF EQUIPMENT
- PRINCIPLES OF STORING MATERIALS AT SITE
- ORGANISING LABOUR AT SITE
- DIFFERENT JOB LAYOUTS

JOB LAYOUT

• Job layout is drawing the prepared plan of construction site by the site engineer in-charge of the project. The arrangements made at the construction site for different camps and the area around it, is known as job layout.

OR

• Job layout is a scaled diagram of the proposed construction site showing all the relevant features such as, Entry point , Exit point Storage areas of materials, Temporary services Contractor's site office Areas for keeping equipments such as mixers Bar bending area , Labour Housing etc.

Objective of preparing job layout

Following are the objective of job layout.

- It saves time in delivering the construction materials at the site.
- The best method of working may be adopted.
- It helps to complete the work within the minimum use of equipments.
- The maximum output from labour and machines can be taken.
- It provides safety to the workers.
- It helps to avoid damage to the nearby properties due to construction work.
- It plans for the construction materials to be placed as near as possible to the work Following are the objective of job layout.
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- The best method of working may be adopted.
- It helps to complete the work within the minimum use of equipments.
- The maximum output from labour and machines can be taken.
- It provides safety to the workers.
- It helps to avoid damage to the nearby properties due to construction work.
- It plans for the construction materials to be placed as near as possible to the work

REVIEW PLAN

• Before preparing a job layout the details of different plans for the execution of the work should be studied carefully.

- Site plan
- Working drawing
- Specification

Site plan

The siteplan shows

- The boundaries of the site
- The adjacent area of the boundary of the construction site.
- Location of any existing building standing near site.
- Space left around the building to secure verification or free air condition.
- Space left around the building for cleaning and admission of light.
- Position of any natural drains, rivers, Wells located near the site.
- Any other information which are considered to be necessary Site plan Thesiteplan shows

Working drawing

- The working drawing consists of the building plans and other works to be constructed at the site. The working drawing include ;
- Floor plan of the building with covered area ,size of the room, opening of doors & windows, structural members, staircase ,lifts Etc
- Elevation of all sides are shown.
- Indication of direction of North line in the plan of buildings.
- Indication of rejected persons beyond the permissible building line.
- Locating exactly of the essential services like Water closet ,sink , bath etc
- Showing sectional details drawing of footing thickness of world current slabs with their material.

Specifications

Specification indicates the details of the types and grade of the material to be used in construction work which was signed duly the authority or engineer and shall be available at the working place before start of any work.

Specification is an important document in the construction industry which helps the designer to come and get It is thought and ideas to the other construction team members.

Factors affecting selection ,design& layout at construction site

i. Nature of project
ii. Location of project
iii. Sevices
iv. Availability of material &equipments
v. Availability of manpower
vi. Medical facility
vii. Availability of space
viii.Other miscellaneous factors

I) Nature of the project

The nature of the project plays an important role in its layout process. The camp layout depends on the nature and types of project. For example the layout of camp for a highway construction project will differ from that of a building.

II) Location of project

Location of the project also plays an important role in job layout plans the location project should be properly chosen such that there will be no difficulty for any type of climatic situation and transportation. So transportation facility to the construction site is an important factor for job layout.

IV) Services

There should be proper service of water supply ,sanitation and electricity. If these services are not available then it will be badly affect the job layout.

V) Availablity of Material &Equipments

There should be sufficient availability of materials and equipments at the construction site. If the materials and equipments are not available locally then it will create problem in storage which will affect the shape of job layout.

VI) Medical facility

If the project is for a long time it is essential to have a field medical aid facility for the workers.

VI) Availability of man power

Man power is an important resource in any construction site. The arrangement of manpower at construction site should be made locally otherwise it will be a great difficulty for their shelter . So labour should be arranged locally.

VII) Availability of Space

If less space available at the construction site, then it will be difficult for job layout because the storage should have to be located nearest the regular supply of material & equipment.
Urgent availability of material may not possible as required.

VIII) Other miscellaneous factors

There should be availability of education facilities like schooling for the children of labours and staff ,daily necessities of life and other welfare facilities for the workers. If these facilities are not available then it will also tend to change the layout of the project.

Principles of storing materials at site

The materials should be stored in proper manner at the construction site.The following are the important principles which are to be considered for storing materials.

- Materials should be stored at the construction site so as to prevent mixing of foreign matter.
- Materials should be stored in such a manner as to protect it from any weathering agent like rain , sun and wind.
- Materials which are suspected to get fire easily should be prevented from fire hazards i.e the products like petrolium and explosives should be stored properly.
- Precast beams pieces of timber and slabs which are likely to be affected by the soil or support should be stored with properly adopted measures.
- Materials like cement bags which are easily affected by the contact of the moisture are to be stored with special precautions.
- The material regularly used are to be placed relatively nearer to the place of use.
- There should be proper arrangement of fire extinguisher and fire buckets wherever necessary for the safety measure.

Location and layout of equipments

Why equipments required?

As there is a increased cost of labour, the use of more & more mechanical equipments becomes necessary for construction work very often the available manpower is not sufficient for the completion of construction work with in stipulated time, so it is essential to use mechanical equipments along with the available manpower for the construction activity. So there should be a careful consideration for correct choosing at right equipment. For a

construction project to be completed with in the scheduled time economically, it is essential to choose the correct and well-operated equipments.

For the location of equipment following points are to be considered.

(i) Equipments should be nearer to the construction work.

(ii) Equipmements should be near to the materials.

(iii) The owned equipments may be provided near the entrance so that there will be no requirement of any aditional guard.

(iv) The hired equipments should be placed in suitable places and the vacant place may be left where it can be accomodated.

(v) The maintenance ,repairing and fuel filling of equipment should be arrenged at the construction site

(VI) There should be adequate space available for parking of the transport vehicles like trucks tractors etc.

(VII) temporary sheds should be provided to safeguard the costly equipments from any type of weather condition.

Organising labour at site

Organizing labour properly at the working site is an important responsibility of the supervisory staffs.

The labours are divided into different groups by the supervisor under the guidance of effective leader who has the quality to control the labours.

Proper way of organising of labours results the completion of work within the stipulated time period.

So it is very essential to organize the labours at the construction site.

For example Suppose 10 labours and one supervisor are put for beam casting the division of the labour may be.

(i) For bringing the aggregates, three labourers are put.

(ii) For mixing the ingredients one labour is put.

(iii) Four labourers are put on some other work.

(iv) For compaction purposes two labours are put.

There are some points which are to be considered while organising labour at construction

(i) Rehandling of material unnecessarily should be avoided.

(ii) Supply of material should be sufficient as per requirement of labour.

(iii) Labour supply should be uninterrupted.

(iv) The materials should be taken once for the whole day from the godown. It reduce the frequent movement of labour.

(v) There should be some permanent labours as it is economical.

(vi) Increasing and decreasing of labour should be done as per necessity.

(vii) To avoid wastage of time of labour, minimum facilities should be made available

(viii) Also to save wastage of time of labourers, drinking water facility should be made available at the site.

(ix) A record should be maintained about the progress of the labour.

(x) Record maintain once will help to compare the progress of work with the completion of work at right time at the site.

Preparation of job layout

• The construction plans, specifications, contract documents and other available material describing the job should be studied carefully in order to get the idea of the nature and extent of the work.
• A scaled drawing with a scale of 1 in 100 should be prepared showing the out line of the work or job to be constructed.
• Also the position of entry and exit points as well as the areas of temproray facilities should be marked on it.
• In job layout plan
Moreover following information should be collected from the above study.
• Area needed for accomodation: This area includes the area required for office. stores and residential accomodation for officers, staff and labour.
• Area required for machines, sheds, repair shops and workshops etc.
• Area for security and fine fighting facilities.
• Area required for construction work.
• Area for miscellaneous amenities such as canteen, toilets, dispensary etc.
• Length of period for which area may be available.

Ch – 5 Construction Organisation

CONSTRUCTION ORGANISATION

CHARACTERISTICS AND STRUCTURE OF ORGANISATION

IMPORTANCE OF ORGANISATION

TYPES OF ORGANISATION

LEADERSHIP AND ITS IMPORTANCE

STYLES OF LEADERSHIP

ORGANISATION

For any sucessfulbusiness , a sound organisation is highly essential.

Better the organisation the more is the achievement of the common business objectives.

Organisation is the foundation upon which the business management is dependent.

Organisation is a large group human association united together for the attainment of business objective.

Structure of an organisation

Organisation structure specifies the various job tasks and shows how job tasks are formally devided ;grouped;and co-ordinated.

Organisational structure covers the overall arrangement of an organisation.

It provides an appropriate framework for intra relationship and also indicates the hierarchy of authority and the reporting relationships.

So organisational structure coordinates the relationship between the various positions in the organisation.

There are some elements with which each member of the organisation should be similar with following are the main elements

Members of the organisation should understand about the well defined goal of the organisation.

They should be familiar with the rules ,regulation, policies, procedures of the organisation.

They should know with whom they have to work.

They should understand their duties and responsibilities towards the organisation.

They should understand the delegation of the authority and responsibility.

Importance of organization

- For a successful business, a sound organisation is highly important.

- Organisation enbles a large group of people working effectively together for a common goal.
- Only a sound and well designed organisation can maintain the co-ordination between the managgment and administration.
- Organisational diversification or expansion of organisation can only be possible by a well-planned &welldesigned organisation.
- Effective use of man power can also be possible by a sound organisation.
- A sound organisation makes an optimum use of rawmaterials and resources.
- Wastage and expenditure is less in a sound organisation.
- A sound organisation always stimulates the people for better, creative and innovative ideas.

Types of organisations

There are different types of organise structure have been developed and the following are more common

- Line or military organisation
- Functional organisation
- Line and staff organisation
- Matrix organisation.

Line or Military Organisation

- Line or military organisation is the simplest and earliest form of organisation.
- This system of organisation is based upon the scalar principle.
- According to this principal when the level of authorities arranged in the structure from the chief executive at the top to the workers at the bottom the system is known as scalar principle.
- In this line structure the authority and the responsibility flows directly from the manager to foremen and from foremen to workers.
- In other words authority and responsibility should flow directly in a line vertically from the highest level of the organisation to the lowest level of the organisation.

- Line organisation is also called as military administration or military organisation.

Advantages

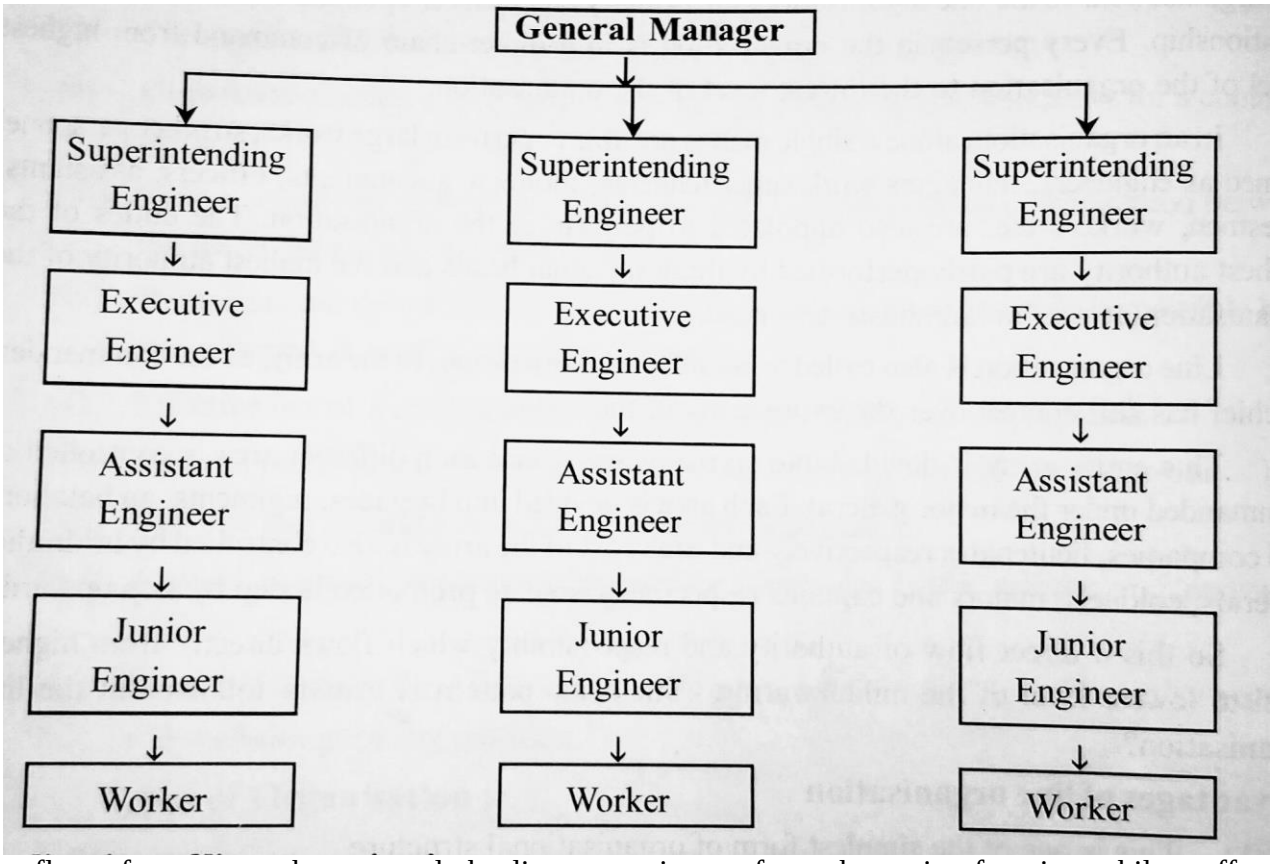
- Because of its simple logic and common sense appeal this type of organisation is most widely used.
- It makes use of specialist to give expert advice to workers .
- It also provides opportunities for promotion and career development.

Disadvantages

- It is difficult to maintain discipline in the organisation
- It makes the complex industrial relationship
- It is difficult to know who is the 'boss' of whom.

Line and Staff Organisation

- As the name suggest this type of organisation is the combination of the line and functional organisation.
- Here the line of authority remains the same as it does in the line organisation i.e authority



flows from top to bottom and the line executive perform the major function while staff responsibilities carried out by the functional specialist with their knowledge and experiences.

- The staffs are constituted by the specialists in the organisation who are expert with long experience.

- In this system staffs are are divided into functional staff and line staff as shown in the figure below.

Advantages

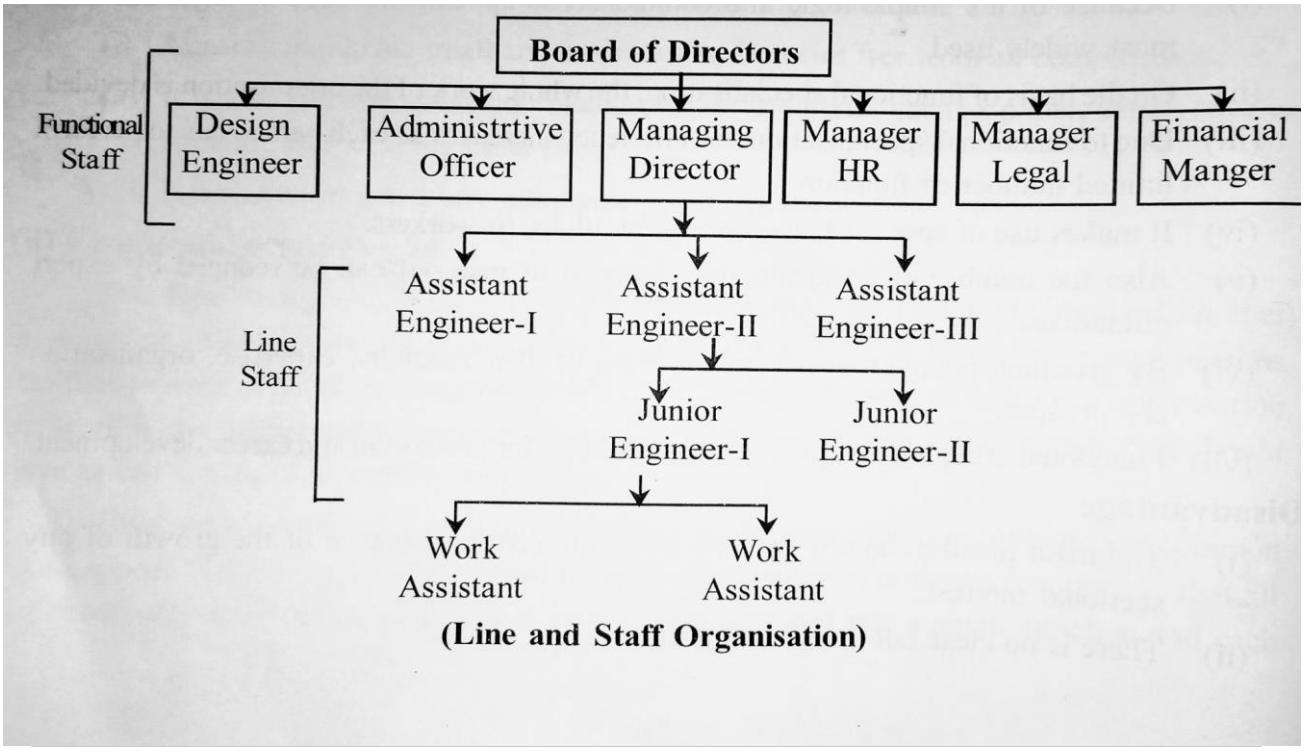
- Line and staff organisation possesses all the advantages of the line and functional organisation
- Discipline is maintained by the line authority.
- It improves quality of product.
- It enables availability a greater variety of jobs.

Disadvantages

- Due to high salary of the staff executive the product cost will increase.
- There may develop jealousy between staff executives
- Line staffs do not have direct authority to enforce their decision and implement their ideas

Matrix Organisation.

- Matrix structure is the combination of two departments. One is functional and another is product responsibilities. Product manager is also known as project manager.
- In this system every group of employees have two bosses one is there functional department manager and another is there project manager.
- The matrix structure allows for an efficient use of resources because teams include specialists from various departments.



(Line and Staff Organisation)

Advantages

- It ensures the effective utilisation of the services of the people with highly specialised skills.
- Communication improves by direct contact with different functional specialist.
- Employees can develop new skills
- Disadvantages
- decision making process may be slowed down.
- too much work can cause overload.
- Measuring employee performance might become difficult

LEADERSHIP

- Leadership is the ability of a manager to build up confidence among the subordinates
- Leadership is a process of influence in a group in specific setup circumstances which encourages workers to work willingly to achieve organisation objective.
- when a group of employees in a project have a common goal performance objective then some sort of leadership is essential there to build up confidence among the employees.

Importance of Leadership

- It leads the group to a higher level of performance.
- It implies a motive power to group efforts.
- Leadership acts as an way of influencing,inspiring , taking actions by the authority.
- Effective leadership creates a better understanding between the subordinates and the management.

Styles of Leadership

According to the attitude and behaviour patterns, leaders are classified as the following

1. Autocratic or authoritarian style
2. Laissez-faire or free-rein style
3. Democratic or participative style leader
4. Paternalistic style leader.

Autocratic or authoritarian style

- This type of leader is the absolute power with himself.
- Here the subordinates are completely obedient to the leader and the leader also centralised all the powers decision making in himself
- Here the subordinates have to follow the leader's orders,rules and regulation blindly or forcefully without any question.
- There is a threat of penalties and punishment to the subordinates in case of deviation.
- So this types of leader is not a real leader.
- Liassez-faire or free-rein style.
- This type of leadership maintains a good relationship between sinordinates and its leader because under these type of leadership the sinordinates allowed there maximum freedom.
- They are given the capacity to decide their policies and programs with their own style and take their independent decisions.
- But this type of leadership rarely exists because in these type of leadership the subordinates must be required to be competent ,sincere and self disciplined.
- Democratic or participative style.
- This type of leadership is the exactly middle position between two extremes of the autocratic and freerein style of leader.
- By this process of decision making the subordinates are encouraged to make suggestions while taking decisions.
- Subordinates are given chance to explore their potential in strength to complete the challenging responsibilities.
- It creates a friendly working atmosphere and reduces conflicts like strikes ,industrial unrest
- ,employees complaints etc
- Peternalistic style or functional style.
- Under these style of leadership the subordinates become dependent upon the leader.
- Here the sentiments and emotions are given more priority
- And and the leader looks after is subordinates like a father looks after his children and family.
- He is supposed to help, guide and protect his subordinates.

Chapter 6

Construction Labour & labour Ianagement

Introduction: Construction industry is one of the largest industry En india, where about four Crones of workers are employed and most of them are unskilled labourers. In general construction Labourers are Classified as unskilled anal skille of and semi skilled Persons. The labourers employed in construction industry are paid wages on daily basis as the construction work is temporary. Hence the job in Construction industry is also temporary and Workers have no job security. There fore, construc -tion labourers can easily be shifted from one Place to another.

6.1 Labour schedule міймит

A labour Schedule can be prepared from the construction Schedule and the objective of this Schedule is to decide, the number of skilled and unskilled labour required for the execution of different operation on different dates.

* With the help of this schedule required labour can be arranged well in time.

It is difficult and costly to arrange skilled labour as and when required It helps in reducing the labour cost.

6.2 Essential steps for Optimury labour output мини in in m + Labour output is a major concern for employers and it is desirable to have higher level of Productivity in any organization. For achieving this, a lot has to be done with the environmentat work Place and the work conditions along with a Series of factors that define the work couture. The employers have to implement wide spread changes in theire set up to improve the out put or

Productivity of their work

A few factores that help to improve the employee Productivity on Labour out put at the work place ane!

1. Accountability.

Every employee needs to be well aware that he is accountability for this actions and decisions and he can neither pass the bulk or pass the

blame to someone else. of This will help him to work more meticulously. Hake cautions rather than reckless decision, and not take advantage of his place, position or relationship with his superions

2. Follow up

→ Every target on milestone set needs to be followed up as well to see if the progress is sufficient and if not, whether any interim measures can be taken before it is too late to salvage a situation.

→It also keeps the employee on track ensuring no Fod consistent efford there time of the Project.

3. Management without micromanagement of course, the pool of employees does need to be Managed, provided direction and given assistance.

But side by side.they must also be trusted, given freedom to operate in their own style and adopt measures which they think are the best to deliver results4. Encourage Motivate reward and recognize

~w 2

The employers Must ensure that on this part he always has the words of encouragement for his

It helps them move forward and do even better and Make the worker feel happy. Innovative way of motivating them spurs them even more. For EX: holidays or conferences paid

for by the company have been found to motivate

employees immensely.

5. Reach out to employees by seeking them

→ Every employee loves to feel he has the ears of the management who will recognize him and Listen to what he says. of me

Display of interpersonal skills in which the boss appears humane and one of them rather than a larger than life, distant figure, helps to have employees warm up to him and feel happy working of him.

6. Demand realistic targets

→ •Employers need to set realistic goals that are within the limits of achievement. → while an aggressive employer may want his people

to out streetch themselves to achieve fare fatched goals, it may also burn them out."

7. Teary Work

→ Team work always helps in increasing workplace Productivity since there is more input in the from of More ideas and minds at work.→ working alone is not always the happiest situation

either especially in the fields.

8. Ensure that people enjoy their work The best performing employee, is the happy employee and the employer has to find ways of Making his people happy.

→ Besides working conditions and the work culture Implemented, he has to devise way of making the work seem challenging and interesting rather than mundane and boring.

9. Break the monotony

and

rotate

→ while employers assign tasks according to an employee's core competence, even with the task they are best at, can make an employee bored and

this work Seery monotonous.

This Monotony can be broken with rotation and giving people new tasks and exposure to other divisions.

10. Courses and Emprovement options.

→ Employees are delighted when they can enhance their skills and get additional larning opportunities Sponsored by the employer. om

This help them learn feel indebted for the? money being spent on them, which also adds to their resume and are obliged to perform better by applying all the knowledge gained in these Courses11. Spend less time on meetings and more an action →The current trend to have more meetings and discussion more time in rather than spending more time in working to achieve results leads to Precious Productive time loss.

→ Meetings for reviews and Sharing of ideas can be Limited and kept short. Employees should have more time to show results.

12. Tool and equipments to raise Productivity.

The workplace should have the best of Machinery devices and equipments that yield error free results in the minimum possible time

→ Efficient electronic equipment with no connectivity ssues and breakdowns will in saving Precious time. help

→ They should take the place of paper work

and yield fast results was an e 6.3 Labour Characteristics!

1. Labour is original and indispensable factor of Production. 2. Labour is an active factor of Production

3. Labour is Perishable than any other ARTH Commodity 4. Labour can not be separated from the labourer

5. Labour is less

6. Labour supply is inelastic

7. A Labour sell has labour and not himself. 8. Laboure has weak barganizing power.

9. Labour is both the beginning and the end of Production.10. Efficiency of labour differs.

1. Labour can not be engaged continuosly in production Like Machine

19. Labour Creates capital: labour is more important in the process of production than capital because Capital is the result of the working of labour.

13. Tt is difficult to calculate the cost of production

of labour

14. Labour has not tangible form: Labour has not reserve price. Labourer can be seen, can be touched but labour can not be seen.

6.4. Wages Payment To Labour:

→ Payment made to labour is generally referred to as wages. It can be time-rated on piece rated. It can be nate per hour, per day, per week, per Month Or per year.

This is the renumeration paid to to workers for the actital work they do.

The wages can be paid to ordinary skilled, unskilled Or semi-skilled workers as daily basis, on week weekly basis.

The wages are both monetary and non-monetary.

→ The monetary wages are money paid to workers as wage. But non-Monetary payment may are known as

fringe benefits.

6.4.1 Types of wages

wages are generally of two types.

iy Time wages.

how to desig

iy Real wages Hos at 40 cortom
Py Time wages:

When payment of wages made to labour is in the form of money for the work done on the basis of Per hour, Per day, per week, per month ore per year it is often called as time wages.

iiyReat wages:

After Satisfying the basic needs of a worker and for improving the standard or uving of a worker wages given in the form of lawny and comfort On extra security, is often known as real wage.

The real wages sepeify the amount of goods and. Services that the money wages will buy.
6.4.2 Method of wage

Wages can be calculated on the basis of the Out Put Errespective of the time taken in completing

14. → Efficiency may bea factor which varies from individual to individual.

The efficient worker may creat more out put than Other so wages can be calculated on the basis of the work irrespective of the time.

Also a good wage payment system establishes a good relationship between worker and employeer. The payment of wages can be classified into two method.

iy Time on day rate system to

iiy piece work on piece rate system. Вран 1. Time on day rate systems

In this Method of wage payment, the worker is Paid a fixed renumeration as per his unit of time which can be rate per hour, perday, per week, Pear month or per year.This is one of the oldest method of wage. payment adopted in india.

As in this method, workers don't get extra benefits except their weekly leave, they have no special intrest to work hard for the Optimum Profit of the organization. Merits!

iy This Method is suitable work can not be. Masured directly.

iiy By this method of wage payment, worker f ensures regular employment and greater security. of service.

y Here Skilled, unskilled and semi. Skilled all The workers get the same wages of one class.

The calculation of wage can be done easily by Method. where measurement of output is not feasible, this

Method is specially useful.

viy As workers have no tendency to show increased Out Put the quality of work is good. قانون

vii) Also this method can be understood by all class of workers easily. con of vigane

Demerits!

iy As the workers don't get entra benefits encept their weekly leave, they have no such interest to work hand for the organization.

iiy There is no inspiration of competition among the workers and hence there is no chance of extra Profet.

ily By this method, a skill employee becomes intrest -less to Produce more than the unskilled workers.ivy A regular Supervision is required for this the"" work to extract work from the labour. vy The workers are assured of their wages to theire

out put is low.

vix cost control can't be ensured effectively due to varying Production. 27 Piece work one piece rate system.

→ In this system according to the worker's output

their payment is decided. Of course payment is made

at the agreed rate. → In this method, an efficient worker can earn Money by increasing his out put.

→ Here Payment &&Purely based on production on output of workers → Payment is decided at the actual quantur of work

done by the work.

Advantages to

12 23 bon

ix Suitable incentives are given to efficient workers in proportion of their output or production.

iiy There exists a healthy. atmosphere among the employer and employees.

ii) Higher wages are given to worker with higher Output on Production na R Prok 200000

ivy less supervision is required. 14, 2

vy In this system, a good worker can make more 202.00 money by increasing his out Put.

vix By this Method, unefficient and unskilled yees are pointed out. employeesviiy As effort of workers increases, the over all Production of the organization increases similarly there are some demerits of piece-work system of wage payment as given below.

Disadvantage:

by workers are not careful about the quality of work. They have to any how increase the out put of the Organization.

ily over time work causes sickness to health. iiiy Sometimes no work no pay situation arises 107 because during the period of sickness or absence there will be no payment as the output will be there.

ivy It causes a competitive f jealous atmosphere. among the workers of organization.

65 Motivation

6.5

Labour incentives

→ Labour incentives refer to those incentives that Supplement a salary and are given to the employees of a company fore their excellent Performance

Most often that not incentives are what attract the employees to keep working Company and go an extra mile to achieve something they are set to do.

6.6 Motivation:

→ Motivation is an important factor which encourages persons to gives their performance and help them in reaching the enterprise goals. Motivation is one of the most important factor

affecting human behaviour.→It helps the individual towards the fulfilment of

durable objectives. 14 Ex o complene force that is responsible for Starting and keeping a person at work in an it

Organization.

→ Motivation is something that mobilises a person to to work.

Defination

Motivation is an inspiration that simplers and Person to expand energy to achieve a goal on Areward.

→ Motivation is acts as a driving force by conich 1000 521 the human being achieve their goal.

→ In other words Motivation is the stimulation of emotion or desire and an inner state that activates On directs the behaviour towards achiveing the goals.

6.6.1 Classification of Motiverne masque

When a Manager wants to get more this Sub-Ordinates Motivate them for 230 work from then he will have to improving their mance.

This Motivation may be in the form of an anyalim on incentive or bonus no 13th B mo? NS150 OF

There are two types of motivations.

Ey Internal Motivation 201

External Motivation. Ant ofi Internal Motivation

Internal Motivation Motivates people internally and 24 meters to motivation by interest on enjoyment.in doing the task itself.

Internal Motivation emists within the individual rather than any external intuence. ANTS → Need to get an accomplishment of good job, and

the illusion of self- determination and freedom

are the examples of the internal Motivation.

ify External Motivation.

Enternal Motivation comes from outside of the individual.

Common external Motivations are rewards Like money. grades, pay, incentives, threat of punishmement or praise, in

ALSO Motivation can broadly be classified into two broad types as follows: ay Positive Motivation.

when the employees are offered the incentives they try to improve their performance wil willingly.

Positive Motivation or incentive motivation is, ww bask based on reword. - مهلوان

The incentives may be in the form of More pay, Promotion, recognition of Job etcrop get born work, more responsible

Positive Motivation is achieved by the Co-operation of the employees to do andain and they have a feeling of happiness. avit of an nomepinnalby Negative Motivation.

Negative motivation is based on force or fear. → Fean causes the employees to do certain job.

→ It they do not do accordingly then they may be Punished with demotions on lay-offs.

This types of motivation causes anger and funestration because the employees do not work willingly rather they want to avoid the Punishment. 40

6.6.2 Different Approaches to motivation

The Motivation differ from time to time, place, to place, situation to situation and person to Person.

→ so it is difficult to set a specific theory which will be universally accepted. WHOM OLIA

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w's Need Hierachy theory ish bond f

Maslow's

olay Herzberg's two-factor theory. By Alden for's ERG Ttheoryhemal to try

1. Maslow's Need Hierachy theory This theory includes the hie Abraham Maslow. hierarchy of need by

+ Maslow's theory is one of the most widlydiscursed theories of motivation.

→ Motivation is influenced by the needs of a Person A.H. Maslow an American social scientists has developed the hierarchy of needs consisting of five hierachic Classes

Maslow categoried human needs into five categories

97
ty Basic Physiological Needs

These needs are most essential for the survival and Maintenance of human life,

These needs include satisfaction of the needs of hunger, and shelter, drinking water, clothing, rest," etc. اده

Self actualisation

Top (self-fulfilment) Esteem need/ Ego needs (Prestige, status, self-respect Social needs.

(Affection, friendship, belongings

Safety and security needs

(Protection, onder, stability) Basic Physiological needs. (food, water, air, Shelter)

iix Safety Needs:

Once Physiological needs are stais tied, the human being want the assurance of maintaining a given economic level. 197

These are the needs to be free from Physical dangers, and fear of jobs Property, Sheller, etc. 10

→ Every person would like to be free from worries like loss of job, sickness, old age pension, physical safety like accident and fire.

Social Needs: Once the individual esSatisfid with social needs, they are concerned about the next level.

Being a social being people belong to be accepted all

by others voskedalTherefore the man is intrested in conversation. Sociability, exchange of feelings and grievances,

Companionship and belongingness.

ivy Esteem on Ego Needs! 7863 → These needs are concerned with

self-respect. self-confidence, feeling of being unique recognition etc. Satisfaction of these needs bring confidence, power,

control and prestige achievment, independence

competence, knowledge & → The individual have to learn on acquire these only through his intelligence and hard work.

etc.

&Hanxberg's Two factor Theory:

vy self-actualisation self-actualisation need is the need for self fulfillment of wants of a person considered to be mission of his life.

+ self-fulfillment is the highest need in

Maslow's

hierarchy and then to These needs which help an individual to devlop his potentialities.

self-fulfillment needs gives satisfaction to the person concerned and gives a tendency of capability of doing of self-development

2. Herzberg two-factore

or Theory

→ This theory was devloped by frederick in 1959. y's two factor theory is also known as → Herzberg's Motivation-hygien theory of Motivation.

→ Herzberg and his associates concluded a of need satisfaction of 200 engineers and accountants in an Organisation. StudyThese person were asked to describe a few Previous job experiances in which they felt exceptionally good or enceptionally bad about the jobs.

The satisfaction of some need may not have Positive effect on motivation but their non-satisfac -tion on may act as a negative factor.

These factors operate to build strong motivation and high job satisfaction and their absence affects both satisfaction and Motivation.

ix Hygiene factor: These factor are responsible for reasonable level of satisfaction and are called Maintenance or hygiene factor.

→ The hygiene factor Ex just like hygiene; the Presence will not make the employee healthy but its absence causes a deterioration of health.

There are factors concerned with the company Policy and administration, teennical supervision, winter personal relations with Supervisor, inter personal relations with peers, inter-personal relations with Subordinates, Salary, Job security, Personal Life, work relations with subordinates and status.

These are the maintenance factor conich are necessary to maintain a reasonable level of Satisfaction.

→ These factor are not responsible for growth of motivation in workers but the absence of these factors Creates problem ostaliy Motivation factor

These factors create high motivation and job Satisfaction in their Presence.

The absence of these factors do not cause.

dissatisfaction. → According to Herzbeng, there are six factor

which give positive satisfaction. → These six factors are recognition, advancement. work itself. possibilites of personal growth,

achievment and responsibility.

It is essential to increase these factor for increasing the motivation of employees.

3. ERG Theory:

→ This theory was introduced by Aldenter. T Aldenten's ERG theory is the expanded form

of Maslow's hierarchy of need theory and

Herzbery's two factor theory of motivation. He found some over- lapping between Physiollo - gical need security need and social needs.

He classified the various needs into three main categoriesitten your attoTomogr

iy Existence needs.

y Relatedness needs atom all wa

Growth needs.

iy Existence needs:

infotem of gove

This need of ERG Theory includes both Physiological and safely needs of an individual

in Maslow's Model.These needs include the basic Servival needs of human beings like food, clothing, Shelter and drinking water.

These are the Primary to fulfill this. try to needs, human being

ily Relatedness Needs This need of ERG theory is the combination of the social need and esteem need of Maslow's

Model.

These needs are the emotional needs of the human being for Love, affection, warmth and friendship. These needs give human being ego sats faction

so combining these two needs of maslow relatedness need is derived. iliGroth Needs; plus no 29t

These needs are same as the Maslow's self

actualisation needs.

These needs satisfy the human being for nis personal development and achivement.

When the individual wants to do something Challenging, the samse of achivement gives him a satisfaction.

This need satisfies all desires of the individu -al to increase and develop his potential."

CHAPTER – 7 EQUIPMENT MANAGEMENT

(The cost of equipment in a project varies from 10 to 3% of the total cost on ne project, depending upon the extent of mechanization. In modern fully mechanized projects, the cost of equipment may vary in the range of 25% to 30%.) However, proper planning, selection, procurement, installation, operation, maintenance and equipment replacement policy plays an important role in equipment management for the successful completion of the project. With the growing use of the machinery, it has become necessary for the construction engineers to be thoroughly familiar with the construction application and up keep of the wide range of the modern equipment.

(The aim of the equipment management is to reduce down time, achieve optimum equipment utilization and increase production at minimum cost. There is a need for a rational planning, proper selection and judicious deployment of equipments so as to achieve optimum utilization. Of course, the equipment management integrates and continuously interacts with human, technical, financial and production system in order to achieve top efficiency and cost effectiveness.

7.1 PREPARING EQUIPMENT SCHEDULE

The equipment use schedule has to be prepared before the start of the project in order to decide the type, number and dates on which a particular equipment will be needed so that it is arranged well in advance and brought to the site as and when required. The aim of this schedule is to derive maximum advantage of the equipment when at site and remove it from the site when its job is over. This is most likely to result in economy.

After the purchase of the equipment for a particular project, the owner gets a mark punched or painted on the equipment or machine to identify it from others. The owner should have full knowledge of the equipment purchased by him. Usually following information is sent to the owner:

1. Cost of the equipments.
2. Efficiency of each equipment or machine.
3. Record of their repair.
4. Details of expenditure on repairs. Duration of effective use of the equipment.
5. Details of fuel consumption by the equipment.
6. Details of servicing of the equipment.

With the above information, the efficiency and working capacity of the equipment can be compared with the figures supplied by its manufacturers. This schedule is very useful at the use of purchase of new equipments.

SELECTION OF EQUIPMENTS

Identification and selection of proper equipment is of paramount importance for the speedy and economical completion of a construction project. The problem of selection of a particular equipment or identification of different alternative equipments is a difficult task because of availability of variety of equipments in the market by different manufacturers. For proper selection of equipments considerable field experience in their operation and maintenance is required. Previous records of operation, maintenance and actual output under comparable conditions of similar projects comes to great help in deciding the choice of equipments.

Basically, following two aspects are considered for the selection of construction equipments in a project. While the first aspect deals with the type, size and other particulars of the equipment, the second aspect decides wheather it is to be purchased, hired or to be procured under hire-cum-purchase arrangement. But in all cases, the following factors must be taken into account before having a final choice.

(i) **Suitability for job condition**

The equipment selected or identified must satisfy the requirements of work, climatic and working conditions

(ii) **Size of the equipment**

The size of the equipment should be such as to be compatible with other matching units. If the chosen equipment is of larger size, it is likely to remain idle for most of the time or shall work on part loads leading to rise in the cost of production / work. On the other hand, if the equipment selected is of smaller size than that is required, it may not be compatible for matching equipments, in which case, the other equipments will have to either remain idle or to be allowed to work on part loads, which will again be uneconomical.

(iii) **Standardisation**

It is desirable to have the same type and size of the equipment in a project which will ensure lesser spare parts reserve, better interchangeability of parts, easy understanding of operators and efficient maintenance and repair as the mechanics become adept by handling the same type of equipment.

(iv) **Ease of availability in the market**

The equipment selected should be easily available in the market but side by side it is also to be ensured that the equipment is of reputed company and likely to be continued to be manufactured in future also. This is essential for future standardization and ensuring spare parts supply as well as for disposing off such equipment after completion of the project.

(v) **Availability of spare parts**

The availability of spare parts at reasonable price throughout the working life of the equipment is all the more important while selecting a particular type or make of the equipment. It is desirable that the down time of the equipment for want of spare parts should not be more. This is very important in case of imported equipments.

(vi) **Versatility of equipments**

There are certain type of equipments that are not fully utilized for a particular function. In that case, they should be capable of performing more than one function so that it is not layedidle and has multi-purpose use.

(vii) **Availability of know how**

The equipment selected should be capable of being handled satisfactorily by the available operators and mechanics. Therefore, a sophisticated equipment that gives excellent performance but difficult to handle and maintain should be avoided.

(viii) **Possibility of use in future projects**

When selecting an equipment that completes only a part of their useful life in a project, its use in future projects should be kept in view before it becomes obsolate.

(ix) **Economic aspect**

While selecting any equipment, it should be ensured that the cost of unit production is minimum.

(x) **Reliability and support service**

The equipment selected for the project must be reliable one. In addition, support service should be available in the area of project where the equipment is to be used. After sales service should be a major criteria for the selection of equipments.

(xi) **Operating equipment**

The equipment selected should be easy for operation and maintenance, user friendly to the and should have lesser fuel consumption.

Satisfactory past performance While procuring an equipment of new make and model, it is desirable to enquire about its cory performance from other users, who are using the make and model for quite some

Besides these, the other points that are to be taken care of are reputation of the acturer, warranty or guarantee offered, use of standard components in the equipment adequacy of drive mechanism or power of the prime mover. use of However, versatility of the equipment should be given due priority. Multipurpose achine promises extra profit due to following reasons. Allows one machine to do the job of several machines and thus cutting into ownership and operating costs associated with additional plant and labour.
It increases the utilization enabling a machine to earn money when it might otherwise be idle.(increases the utilization enabling a machine to earn money when it might otherwisehe idle. Generally, there are provisions of fitting and changing the attachments of such machines with the help of couplers. Thus, a balance between reliability, investment cost and operating

cost should be worked out, since a policy of selecting only the lowest priced equipment may lead to overall higher costs.

OWNING AND OPERATING COSTS

The principles of engineering economics are made use of while selecting and planning of finances for the procurement of construction equipments. Economics of construction equipment mainly deals with the study of working of the equipment and computation of the unit cost of production, which comprises of the following components:

a) **Owning cost by Operating cost**

The cost of possession of an equipment is called the cost of owning while the cost of fael and lubricants for running the equipment is known as operating cost. These two combined so gather when estimated on hourly basis represent the amount by which an equipment should be hired. Of course, it is exclusive of labour cost. There are several methods of determining the probable cost of owning and operating of a construction equipment but there is no guarantee that similar equipment will have similar cost if used under different conditions. Past records of use of equipment may often serve as a guide but it must be adjusted as per the prevailing situation to arrive at the realistic value.

The following factors affect the owning and operating cost.

1. Initial cost of the equipment and its delivery.

2. Severity of the conditions under which it is used.

3. No of hours it is used per year.

4. The care with which it is maintained and repaired.

5. The salvage value of the equipment after its useful period.

6. Useful life or service period of the equipment in years.

When detailed cost records based on past performance of an equipment is not available, it is analyzed from the first principles. The following costs constitute the cost of owning and operating.

1. Investment cost (including interest, insurance and storage)

2. Maintenance and repair cost

3. Depreciation cost

4. Fuel or energy consumption cost

5. Cost of lubrication

1. **Investment cost**

The owner has to invest money in order to own an equipment. This is a kind of fixed cost and is incurred, wheather the equipment is used or not. Investment cost comprises of the following:

a) Interest on the money invested in the procurement of the equipment

b) Various taxes on the equipment

c) Insurance expenses

d) The cost of storage

The chance of earning the interest on the amount spent on the purchase of equipment is a loss to the owner. In addition to this, all type of taxes assessed against the equipment, insurance premium and storage charges have to be paid. Therefore, it is desirable that these costs must be realized during the life of the equipment. Sometimes, a fixed percentage of the original cost of the equipment is charged towards the cost of investment each year equally which is much higher than the actual, because the insurance, taxes etc. are usually paid on the depreciated value of the equipment and the amount of interest charged also should be based on the book value of the equipment instead of its original cost. So, the owner must deduct from its earnings an amount equal to the annual cost of depreciation to get the book value of the equipment and the realistic value of investment cost of a particular year will be some percentage of the book value of that year. But, this process being cumbersome, the average value of the equipment is used in determining the annual cost of the investment. Generally, annual investment cost 10 to 15% of the average annual cost of the equipment.

Maintenance and repair cost

The annual cost of maintenance and repair is based on the experience obtained from the operation of the equipment under average conditions. The actual cost varies with the conditions under which it is used and the care with which it is handled. Of course, it varies with the type and quality of equipment. The annual cost of maintenance and repair may be expressed as a percentage of the annual cost of depreciation or it may be expressed independent of depreciation. But in any case, it should be sufficient to meet all maintenance work including cleaning. washing, checking of component units, instruments, ropes, adjustment of component units as well as routine and major repairs. Normally, annual repair and maintenance cost- 50 to 100% of annual depreciation but 100% of the fair value.

Depreciation cost

Depreciation is the loss in value of the equipment resulting from wear and tear or obsolescence. The owner of the equipment must recover the loss in value of the equipment during its useful life by way of depreciation. There are different methods of determining the cost of depreciation.

Generally, standard equipments are preferred in construction industries. However, special equipments also may be considered provided the economic analysis justifies its selection. So, for all equipments used in the construction, if the equipments do not suffer from the danger of obsolescence, the annual depreciation cost of the equipment may be obtained by Initial value-Salvage value

Annual depreciation Useful life of the equipment (in years) Thus, at the end of the useful life, the value obtained because of the disposed of the equipment may be in terms of salvage value or scarp value. 4. Fuel or energy consumption cost

Construction equipments require fuel in the form of gasoline oil, diesel, electrical energy and lubricating oil, which is considered as operating cost. Although, the amounts consumed depends upon the type of equipment, its rated horse power, location, temperature 615erie pressure and the conditions under which it is used as well as other factors but the working condition is the most significant to estimate the realistic consumption of the fuel per hour. These working conditions of the engine are defined by engine factor i.e. extent to which the engine will operate at full power all the time and the time factor i.e. that the actual time that the engine will operate in one hour.

Then operating factor Engine factor x Time factor.

A common value of operating factor for an engine during a construction equipment may be taken as 0.6 if detailed information regarding its engine factor and time factor are not available.

Cost of lubrication

An engine requires lubricating oil for its smooth functioning and getting more output minimum loss on account of frictional force in the machine. The quantity depends upon the size of the engine, the capacity of the crank case, the condition of piston rings and the number of hours between oil changes. However, it is common practice to change the oil every 100 to 200hrs. The empirical formulae may be used to estimate the quantity of lubricating oil and the factor of 0.6 may be assumed in those formulae when sufficient data is not available for the purpose.

7.4 INSPECTION AND TESTING OF EQUIPMENT

Inspection is taken to mean observation of work environment, work practices, equipment used, work posture or reported hazard which may be generic or it may be specific to assess a particular risk, task or part of occupational health and safety management systems. Testing means use of standardised tests to check the equipment, plant operation, process control, and effectiveness.

The purpose of inspection of an equipment is to identify whether the equipment can be operated, adjusted and maintained safely with any deterioration detected and remedied before it results in the health and safety risk. Not all work equipments need formal inspection to ensure safety and, in many cases, a quick visual check before use may be sufficient.

However, timely inspection is necessary for any equipment where significant risks to health and safety may arise from incorrect installation, reinstallation, deteroration or any other circumstances. Usually, the need for inspection and inspection frequencies are determined through risk assessment.

the need for inspection and inspection frequencies are determined through risk assessment.

The equipment should be inspected if the risk assesment identifies any significant risk (for example, of major injury) to operators and others from the equipment's installation use. The result of the inspection should be recorded and such records must be preserved until the next inspection of the equipment. The records need not be necessarily in writting but if kept in any other from (e.g. on a computer), these should be held securely and made available on request by any enforcing authority.

Equipment that demands inspection should not be used, unless required inspection has taken place. When equipment is transfered or returned, it should be accompanied by the physical evidence of last inspection such as an inspection report or for small equipments, some from of tagging, colour coding or lebelling system.

Where the safety of the equipment depends on the installation conditions, it should be invariably inspected after installation and before the first use and after reassembly at the new site or location at suitable internals, where the equipment may be exposed to conditions causing deterioration liable to result in dangerous situations.

The scope of inspection will depend on the type of equipment, its use and conditions to this exposed. This should be determined through the risk assessment and take full account manufactures recommendation. The inspection should concentrate on those parts which ecessary for the safe operation of the equipment and, in some cases, this may require sting and dismantling. However, not all safety critical features on a particular equipment may pre important same intervals. Rather, an inspection may vary in its extent such as quick chess before use. weekly cheeks and more extensive examinations under taken every few ths or longer, Records need not be maintained for the simple pre-use cheeks. The frequency nection may vary depending on environmental conditions and your own experience, Intervals the inspection may be increased if the inspection history shows negligible deterioration a shortened where experience shows this is necessary to prevent danger.

The equipments should be inspected by competent persons who has sufficient knowledge d experience of it. Of course, the necessary level of competence will vary for inspections, cording to the type of equipment and how/where it is used.

Agencies who conduct the testing of equipments must have required competency and tification in this regard. They may inspect and test an equpment following a report of ancident and check if corrective action has been taken on factors contributing to the incident. Thus, testing and inspection may consist either of a scheduled programme to meet the requirements of legislation and standards or on an adhoc basis which is initiated because of

an sue that arises requiring testing to diagnonise the cause or source and resolve the safety problem.

Persons responsible for coordinating inspection and testing of equipments are generally sponsible for maintainance and security of such records. Inspection and test results should be made available to the manager of the area concerned. It is also important that the inspection and testing results are discussed with the safety committee to ensure all possible solutions. Procedures must be reviewed to ensure relevance, currency and corrective action on nonconformance found during inspection or testing procedures. **EQUIPMENT MAINTENANCE**

Maintenance of an equipment is the operation of keeping its various components in their original form as far as possible with a view to ensure that safety as well as production in operation do not deteriorate. It includes servicing, inspection and adjustment, small repairs in field, major repairs and over hauls in main workshops and proper case of laid up machine. The objectives of maintenance are:

i) To maximize the availability of machinery needed for smooth production.

ii) To minimize down time due to break down of machinery

iii) To ensure longevity of the machinery to avoid high rate of depreciation of capital.

7.5.1. Types of maintenance

There are mainly four types of maintenance: a) Reactive maintenance / Break down maintenance / Corrective based maintenance)

b) Predictive maintenance and Reliability centered maintenance (condition based maintenance)

c) Preventive maintenance/Schedule maintenance (Time based maintenance)

d) Pro-active maintenance (Advance maintenance technique)

7.5.1.17 **Reactive maintenance**

Reactive maintenance is based on the principle of "run it till it breaks" mode of maintenance. No efforts are mode or no actions are taken to maintain the equipment as intended by the designer, either to prevent failure or to ensure that the designed life of the equipment is attained. Of course, reactive maintenance is still the predominant mode of maintenance in the Indian construction scenario, accounting for about 65 to 70% of the maintenance programme.

The advantages of reactive maintenance are:

(1) It has lower initial costs

(ii) It requires fewer maintenance staff

However, the disadvantages of this approach to maintenance are

(i) Cost escalation due to unplanned down time of the equipment.

(ii) Increased labour cost, especially towards over time for untimely repairs and replacement.

(iii) Increase in cost associated with sudden requirement of repair or replacement of equipments.

(iv) May result in possible secondary equipment or process damage from equipment failures.

(v) Leads to in efficient use of staff resources.

7.5.1.2 **Predictive maintenance**

The predictive maintenance approach aims at detecting the onset of equipment degradation and addressing the problem as soon as they are identified. This allows stressors to be eliminated or controlled, prior to any significant deterioration in the physical state of the component or equipment. It leads to both current and futurefunctional capabilities. Of course, predictive maintenance techniques provide data that define required servicing and inspection periods so that maintenance departments can determine in advance when the equipment must be shut down for over haul. Statistical evidence proves that these programmes, when properly minimize equipment and system breakdowns resulting in a major reduction in tenance and operating costs. It accounts for about 2% of the maintenance programme for diagnostic tools in predictive maintenance programme .

The following are the six major diagnostic tools in the predictive maintenance programme cularly scheduled basis.

wear particle analysis Vibration analysis

Infrared thermography Electrical testing

Ultra sonic/acousticProcess variables / inspections / non-destructive The advantages of predictive maintenance are:

1. Increased component operational life and availability.
2. Allowance for pre-emptive corrective actions
3. Decrease in equipment and/or process downtime
4. Lowering of cost for parts and labour
5. Better product quality
6. Improvement of worker and environmental safety
7. Rise in morale of the workers
8. Increase in energy saving

The disadvantages associated with it are:

1) Increase of investment in diagnostic equipment.
2) Increase in investment of staff training.
3) Non-availability of immediate savings potential by the management.

15.1.3 **Preventive maintenance**

It refers to a series of actions that are performed on either a time-based schedule or a schedule based on that of machine-run time. These actions are designed to detect, preclude or stigate degradation of a system (or its components). The goal of preventive maintenance proach is to minimize system and component degradation and thus sustain or extend the riodic inspection of equipment to uncover conditions leading to production break downs or seful life of the equipment. The basic activities involved in the preventive maintenance are i) mful depreciation and ii) Upkeep of equipment to minimize down time and break down conditions while they are still in a major stage. It accounts for 30% maintenance programme in India. Application of preventive maintenance technology

The preventive maintenance technology is applied in respect of the following:

a) Lubrication

b) Cleaning

c) Replacement

d) Inspection

The advantages of preventive maintenance are as follows

i) Cost effectiveness in capital intensive processes and equipment

ii) Flexibility in the adjustment of maintenance periodicity.

iii) Increase in component life cycle.

iv) Generation of energy savings.

v) Reduction in equipment andor process failures.

vi) Cost saving (around 15%) over that found in a reactive maintenance progremme.

The disadvantages of this approach are

i) Inability to eliminate catastrophic failures.

ii) More labour intensive.

7.5.1.4 **Pro-active maintenance**

Although predictive maintenance uses online condition monitoring to help predict the occurrence of failure, it often fails to identify the root cause of failure. That is where the proactive maintenance is called for. Of course, proactive maintenance relies on information provided by predictive methods to identify problems and isolate the source of failure.

Now a days, the old ideas on the machine maintenance being discarded in major industries throughout the world. Moreover, the cost saving trend is towards a maintenance programme

that targets the root causes of machine wear and failure. Thus, proactive maintenance methods have been able to save quite sizable amount on machine maintenance every year in various industries and construction organizations. Intact, in many companies, it often exceeds annual net profit.

Thus, equipment maintenance is not simply either preventive maintenance or lubrication which is an important aspect or function of maintenance. Also, it is not a hasty rush to repair a broken machine part or replace a faltering bearing, although these are essential maintenance activities. Rather equipment maintenance is a science, an exercise in economics and an art as 11/15 philosophy. Broadly maintenance encompasses all these aspects and too many wholly as are of its components.

maintenance planEquipments

The maintenance plan necessarily embodies the quality of maintenance work. An aspect of maintenance activity is the difficulty in accessing the quality of work ip executed maintenance work may lead to a breakdown. Because of the intervening becomes very difficult to judge wheather the breakdown was attributable to errors or defective parts. In other words, the quality of maintenance must ensure work itself. In order to accomplish this, each individual member of the maintenance possess a sense of responsibility and consider the methods for preparing, executing ading his or her own work. From efficiency point of view, the works planned in advance can be accomplished compared to the work done in case of abrupt failure. With a view to raise the ading his or her efficiency point of view, the works planned in advance can be accomplished compared to the work done in case of abrupt failure. With a view to raise the tenance, quality and efficiency, it is imperative to create a maintenance plan and cpus preparation before it execution. The work ethics of the maintenance staff mat curbing the breakdown. However, the following are the benefits of adopting plan.

The number of operational steps can be repeatedly utilized. Advance planning of human resources can be made for availability of required personnel.

Prevention of errors in procurement of materials, spare parts and sub contractingwork is possible.

Facilitates checking of quality and procurement of better material.

Schedules can be set so that work detail plans are coordinated with production plans. Repair cycles can be identified to take measures in a timely fashion Standardization pattern of repair work can be adopted enabling the work to be done efficiently Makes possible simultaneous devising of repair plans.

- Peoples sense of responsibility are encouraged.
- Large volume of work can be handled more efficiently.
- Precautionary measures for maintenance
- Before carrying out maintenance

- Failure notification should be given to appropriate authority having thorough knowledge of the equipment.

7.5.2 **Equipments maintenance plan**

The maintenance plan necessarily embodies the quality of maintenance work. An important aspect of maintenance activity is the difficulty in accessing the quality of work de. A poorly executed maintenance work may lead to a breakdown. Because of the intervening time lag, it becomes very difficult to judge wheather the breakdown was attributable to maintenance errors or defective parts. In other words, the quality of maintenance must ensure the quality of work itself. In order to accomplish this, each individual member of the maintenance crew must possess a sense of responsibility and consider the methods for preparing, executing and validating his or her own work.

From efficiency point of view, the works planned in advance can be accomplished more quickly compared to the work done in case of abrupt failure. With a view to raise the level of maintenance, quality and efficiency, it is imperative to create a maintenance plan and make tenacious preparation before it execution. The work ethics of the maintenance staff should aim at curbing the breakdown. However, the following are the benefits of adopting maintenance plan.

(i) The number of operational steps can be repeatedly utilized.

(ii) Advance planning of human resources can be made for availability of required personnel.

(iii) Prevention of errors in procurement of materials, spare parts and sub contracting work is possible.

(iv) Facilitates checking of quality and procurement of better material.

(v) Schedules can be set so that work detail plans are coordinated with production plans.

(vi) Repair cycles can be identified to take measures in a timely fashion.

(vii) Standardization pattern of repair work can be adopted enabling the work to be done efficiently.

(viii)Makes possible simultaneous devising of repair plans.

(ix) Peoples sense of responsibility are encouraged.

(x) Large volume of work can be handled more efficiently.

7.5.2.1 **Precautionary measures for maintenance**

(A) **Before carrying out maintenance**

(i) Failure notification should be given to appropriate authority having thorough knowledge of the equipment.

(ii) Warning tags indicating not to operate must be tied to the equipment to avoid inadvertent use.

(iii) It must be cleaned before inspection and maintenance.

(iv) The work place must be kept clean and tidy.

(v) Care must be taken to stop the engine before carrying out inspection and maintenance .

(vi) Establishment of five fighting arrangement and prevention of smoking must be ensured .

(vii) Presence of proper rigging tools and repair tools are to be ascertained before taking up maintenance work.

(B) **During maintenance**

(i) Only authorized persons should carry out the maintenance of equipments.

(ii) Attachments are to be stored in safe custody andaccess of unauthorized persons are to be restricted.

(iii) The equipment must be placed on the firm level ground while working under the machine.

(iv) When maintenance work is to be carried out with engine in running condition, operator must be seated to stop the machine in case of emergency.

(v) Care must be taken to see that no tools are left as it is inside the machine by mistake.

(vi) It is to be ensured that the machines are provided with personal protective equipments.

(vii) Repair should be under taken immediately as soon as abnormality is reported.

(viii)High level of alertness must be maintained while handling fuel high pressure hoses, high pressure oils and working at high temperature.

7.5.3 **General guidelines for maintenance**

Do's

(i) Keep the equipment clean and dry.

(ii) Be familiar with operation and maintenance manual of the equipment and be thorough with manufacturer's instruction.

(iii) Pay particular attention to

(iv) Keep all the nuts and bolts tight.

(v) Use only genuine spares.

(vi) Check the level of engine oil and radiator water regularly/daily before starting the equipment.

(vii) Attend periodic preventive maintenance.

(viii) Take steps to keep all meter and safety devices functional.

Do not's

(i) Avoid over loading the engine and equipment.

(ii) Don't run the engine in case black smoke is coming out of the exhaust.

(iii) While cleaning engine parts avoid using cotton waste.

(iv) Don't mix different brands of oils.

(v) Avoid storing fuel, oil in galvanized containers.

(vi) Don't observe economy only in the cost of maintenance.

CHAPTER -8(QUALITY CONTROL)

INTRODUCTION: Quality control in its simplest term, is ensuring quality aspect during manufacturing or production process. The aim of quality control is to ensure construction or production of items for their intended use without defects and variations from prescribed standards within allowable tolerance limits.

In the current concept of quality control, the meaning of quality is closely associated with cost and customer needs or performance standards. So, quality may simply be defined as fitness of purpose at lowest cost and highest performance level.

After all, the quality of a product depends upon the application of materials, men, machine and manufacturing conditions.

Thus, quality control may be broadly defined as a industrial management technique by of which a product of uniform acceptable quality are manufactured.

8.1 CONCEPT OF QUALITY IN CONSTRUCTION :

The basic elements of quality in construction are as follows:

(1) Quality characteristics –

The properties that define the nature of a product for quality control viz. strength, colour, Amension and temperature etc. are called quality characteristic. Eg-Cement concrete which 82 very common construction material now-a-days, the compressive strength, size of aggregate, sater-cement ratio, slump, surface finish etc.

(2) Design quality –

It is a fact that no design can produce absolutely perfect results, whatsoever good design it may be. Thus, the desired standards for characteristics such as strength, dimension etc.

(3) Quality of conformance –

The degree of quality of work found in actual construction work is known as quality of conformance. As in the case of design quality, the degree to which the quality is to be enforced in the field has to be considered along with the cost necessary for quality control.

- Factors affecting the quality of conformance :

The quality of conformance is affected by the following factors:

1. Construction method in the field:

The quality of materials used, skill of the workers and efficiency of machinery and equipments affect the quality of conformance.

2. Field supervision level :

The managerial control exercised in directing the workers to conform to the plans and specifications and the level of supervision enforced affects the quality of conformance.

3. Inspection and quality control procedure :

The inspection and the quality control procedure adopted also greatly influence the quality of conformance.

8.2 **Quality Standards- during construction, after Construction, destructive &non destructiveMethods :-**

In construction work, the following activities/works need effective quality control.

1.Concrete works

Concrete is a very important construction material possessing high compressive strength, whose quality is influenced to a great extent by its constituent materials, water-cement ratio, size of aggregate and their grading, rate of loading and curing conditions etc. The supervisor

should be well versed with the properties of concrete. So, to obtain a good quality concrete, the engineer-in-charge is required to be present throughout the operation of mixing, placing, compacting and finishing etc.

2.Steel works

Steel is a costly item and constitutes a major item of expenditure in most of the civil works. In RCC structures, it is used as reinforcement to take up tensile stress. Hence its tensile strength, proper binding, binding and placing etc. should be checked carefully while using it. The reinforcing bars should be free from rust, scales, oil, grease and other harmful coatings.

3.Form work

The shape and finished surface of concrete depends upon the form work. The form work must have smooth surface so that the finished concrete may require minimum amount of rendering. When the finished surface is not required to be plastered.

4.Masonry work

The bricks/stones to be used in masonry work should be of specified quality and grade, having requisite strength and water absorption capacity within permissible limits. The dimensions and verticality of masonry works are very important and care should be taken to maintain it.

5.Water proofing

Provision of damp proof coarses at plinth level and water proofing of roof and expansion joints etc. Hence proper care should be taken to have them properly installed.

6.Joinery and Timber work

For wood work, timber of specified quality should be used. The workmanship of wood work should be properly checked and maintained as per specifications. These are important aspects from the quality control point of view.

7.Services works

Water supply, electric fittings, sanitary air conditioning etc. are classified under this category. Therefore, these works need special attention of quality control.

8.3 QUALITY CONTROL METHODS (DESTRUCTIVE)

The following are the important quality control methods

1.Inspection

Inspection is the function to judge the quality of a product. To be more precise, it is the process of measuring the quality of a product or service in terms of established standards. Any defect noticed must be got notified before proceeding to the next stage of construction.

2.Testing

Testing is the examination of the material or product to check its conformance to the specified standards. The testing may be either destructive or non-destructive and can be performed at site or in the laboratory.

3.Sampling

The process of determining the quality of a large group by examining a part of the group that will be statistically representative to the whole group is called sampling. The reliability of the test results of the sample is determined by the reliability number. The reliability of the information obtained increases with the size of the sample used.

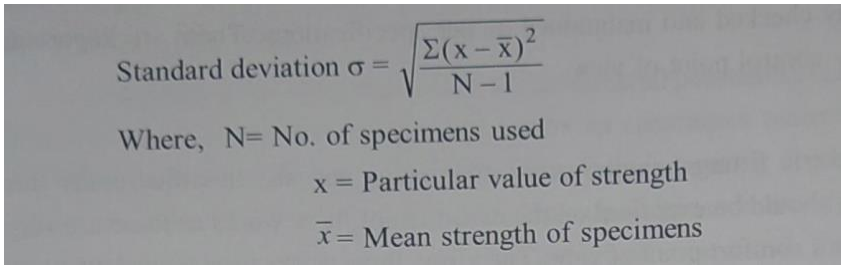
(a) Reliability Number - The reliability number is taken as the reliability of the test results of the sample. It is expressed as

Reliability number R = 100 –[(No. of defectiveunits)/ (no. Of unitstested)×100]

(b) Deviation

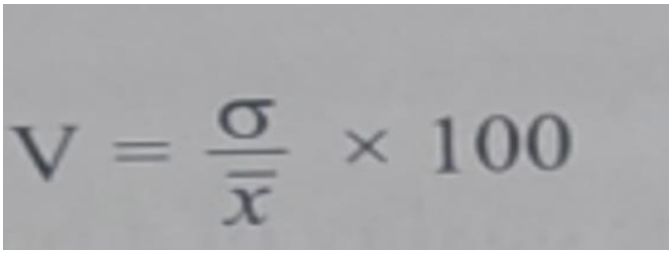
It is the root mean square of the deviation of all the results and is calculated as follows:
Standard deviation σ =

(C) Coefficient of variation



This is an alternative method of expressing variation of results and is a non-dimensional measure of variation. It is obtained by dividing the standard deviation by the arithmetic mean value.

Co-efficient of variation =



However, in India, the standard deviation is taken as the most reliable method of quality control. Standard deviation is an absolute measure of dispersion,where as the coefficient of variation is a relative measure of dispersion.

8.4 NON-DESTRUCTIVE METHODS OF QUALITY CONTROL:

The quality control tests or exercises conducted on a structure without causing slightest damage to whole or part of it are known as non-destructive methods. As per ISO-13822, the existing structure may be assessed for load bearing capacity and other structural properties by non- destructive testing and continuous monitoring process. The various stages of testing and monitoring are as under:

1. Load testing

It is done to test the structure or part thereof by external loading to evaluate its behavior or properties or to certain its load bearing capacity.

2. Inspection

On site non-destructive examination may be done to establish the present conditions of The structures.

3. Monitoring

It is an act of acquiring, processing and communicating information about a structure under operational conditions over a period of time with a high level of automation. Monitoring of structures is done continuously or frequently for observing or measurement of structural conditions.

Of course, non-destructive methods have been in use for about four decades and during this period, considerable development has taken place to such an extent that it has become a powerful method for evaluating existing structures with regard to their strength and durability apart from assessment and control of quality. In certain cases, the investigation of crack depth, existence of micro cracks and progressive deterioration are also studied by this method. For example, taking concrete as the material under consideration, some such properties are hardness, resistance to penetration, rebound number, resonant frequency and ability to allow ultrasonic pulse velocity to propagate through it. Further, certain electrical properties of concrete,

(I)Surface hardness test -

These are of indentation type, include the William's testing pistol and impact hammers and are

used only for estimation of concrete strength.

(ii) test-

The rebound hammer test measures the elastic rebound of concrete and is primarily used for the estimation of concrete strength as well as for comparative investigations.

(iii) Penetration and pull out tests-

These include the use of Simbi hammer, spit pins, the Windsor probe and the pull out test. They measure the penetration and pull out resistance of concrete and are primarily used for strength estimations. However, they can also be used for comparative studies.

(iv) Dynamic or vibration tests-

These include resonant frequency and mechanical sonic and ultrasonic pulse velocity methods. These are mainly used to evaluate the durability and uniformity of concrete including estimation of strength and elastic properties.

(v) Combined methods-

The combined methods involving ultrasonic pulse velocity and rebound hammer may be effectively used to estimate the strength of concrete.

(vi) Radioactive and nuclear methods-

These include the X-Ray and Gamma-Ray penetration tests for measurement of density and thickness of concrete. Also the neutron scattering and neutron activation method are useFor moisture and cement content determination.

(vii) Magnetic and electrical methods-

The magnetic methods are primarily concerned with determining the cover thickness of reinforcement in concrete, where as the electrical methods, including, the micro wake absorption technique, have been used to measure moisture content and thickness of concrete.

(viii) Acoustic emission technique-

These techniques are mostly used to study the initiation and growth of cracks in concrete.

Chapter -10

SAFETY MANAGEMENT IN CONSTRUCTION WORK

10.1 IMPORTANCE OF SAFETY :-

Thus social concern and efforts are being made to adopt safety measures by creating safety conciousness among the wokers. Form a survey of occupational injury and illness accident, it is found that upto 14.5% workers suffer from these injuries. So sufficent care & though preventive measures should be taken for it, so that, accidents of any sort during the construction period can be avoided to some extent. Accident prevention should be considered is an essential activity in all construction sites.Inindia, construction industry covers the largest labour force after agriculture. With the advance of construction industry, the number accidents also is increasing and accident happens all of a sudden enexpectedly.

From economic reasons, the injured worker faces difficulty owing to medical expenses For the injury. It also causes the slow down in progress of work and decrease in productivity. Loss of confidence, and loss of administrative work due to accident.

10.2.1 **CAUSES AND EFFECTS OF ACCIDENT**-

There are many causes of accident in construction industry. These are classified broadly.

1.Physical

Physiological

Psychological

10.2.1.1PHYSICAL CAUSE:

The following factors may be grouped under physical cause. 1.Causes relating to machines:

(I)Due to obstruction free movement of man & machine is not possible & there may be inadequate working space for the machines.

(ii) to improper placing or adjusting of machines.

(iii) Accident may be caused due to unsuitable machines being used for the job.

(iv) Accident may be caused due to improperly guarded machines

(v) Accident may be caused due to improperly insulated electric motor on the machine.

2. **Causes Relating to tools &equipments**

1) Accident may be caused due to constant use of tools, which has been blunt and worn out.

2)Tools used for the job is being too small.

3) Sometimes due to brittle nature of tools, it breaks suddenly, accident may be caused.

4) The tools having handle too short or loose 5. Use of unsuitable tools for the work may be a cause for accident.

3. Causes relating to materials

1) Accident may be caused due to careless handling of explosives, petrolium products &Brittle materials.

2) At the time of use of road materials, there should be careful handling of too hot materials like tar or bitumen.

3) Accident may be caused due to use of materials being poisonous & dangerous as acid and some salts.

4) Due to not adopting proper precautions while handling materials emitting foul gases.Eg sewage in the maintenance of sewers.

4. **Causes relating to uniform**

1) uniform should not be loose.

2) The slippery and loose shoes may be used during the work time. 3)While working on welding job, no protective devices are being used. 4)Sleeves of the shirt being out of bottons.

5. Causes Relating to Environment

1) Poor lighting arrangement at the working site.
2) Poor ventilation & unhygienic conditins at the working place.
3) Loose electric cables & live conductors carelessly.
4) Obstacles in the working area.
5) Floors being slippery.
6) Use of unstable & unsafe ladder.

10.3 SAFETY MEASURES AT WORK SITES

Prevention of accidents is the prime concern at any construction site both from human life and financial considerations. Irrespective of the nature of construction projects, accidents are likely to take place resulting in physical injury, loss of property or even casualties.

(a) Excavation
(b) scaffolding
(C) Form work (d)Fabrication (e)Errection (f)Demolition

10.3.1 Safety measures of excavation:

The following safety measures are required to be adopted at Excavation sites .

(i) The excavation work should be carried out under the supervision of experienced and competent supervisor having responsibility for enforcement of safety rules and prevention of the use of defective and unsafe appliances.

(ii) It is essential to have a complete knowledge of under ground structures (such as sewers,Pipe lines, electrical conduits, gas mains etc) before commencement of the excavationWork and proper precautions should be taken to ensure safety of workmen as well as Public.

(iii) The workers should be advised to make use of safety appliances whenever required and safety helmet must be invariably used by the workers where hazards from falling stores, timber and other materials exist.

10.3.2 Safety measures for scaffolding :

The necessity of scaffolding/staging arises for all types of construction works carried out above ground level viz brick or stone masonry in super structure painting, repair mentainance of structures etc.

(I) ensure safety and stability, every scaffold should be securely supported or suspended and properly strutted or braced. Thus, all scaffolds and working platforms should be securely fastened to the building or structure. They should be braced or guyed properbly. If independent of a building.

(ii) The vertical standards of scaffolds should be embedded into the ground sufficiently deep so that these are capable of withstanding loads. On pucca floors or on black topped pavaments/streets, the standards could be supported in empty tar drums and packed with sand/stone bricks etc.

(iii) member of scaffolds should be free from defects and particularly the wooden Members should be free from dry rot & wet rot etc. The members should be thoroughly Tested for their strength and inspected before these are put to use for the second time or For any subsequent use.

(iv) Also the sizes of different members are properly designed for the loads that are intended to be carried. Lacings should be done securely for connecting the ledgers to standards and putlogs to ledgers. The rope used for tieing should be stout and thick.

10.3.3 **Safety measures for formwork :**

(i) The material of the formwork should be carefully selected as per relevant Indian standard. The members should be properly designed for adequate strength and the sections are generally worked out in consideration of the loads that are likely to be Taken up.

(ii) The formwork should be sufficiently strong and stiff to resist bending and deformation deflection after concrete is placed. Also, it should be capable of taking up all dead Load, live load and the impact to which it may be subjected to.

(iii) Partially seasoned timber should be used for formwork to minimize the effect of shrinkage, warping, bending or bulging under loads whenever, green timber is to be used, due allowance for bulging and shrinkage should be made while preparing the Surface.

10.3.4 **Safety in fabrication and erection:**

The following safety measures are adopted during fabrication and erection works.

(I) Periodical checking of all equipments required for fabrication such as gas cutter and welding sets, power hacksaws, drills, grinders etc. should be done to ensure their safe working.

(II) All workers engaged in gas cutting or welding operations should wear safety gloves And aprons and use proper welding.

(III) Moving parts of machineries or equipments should be invariably provided with safety guards.

(IV) Power cables of all equipments/machineries should be properly insulted and protected from damage and cuts against any mishap.

10.3.5 **Safety measures for demolition :**

The following are the various safety measures to be adopted at the time of any demolition work.

(I)Before the start of demolition process, the manner in which various parts of the structure are supported and the extent of demolition effect on the adjoining structures should be thoroughly studied.

(ii) A site specific systematic plan for the step by step demolition work should be prepared And strictly followed under the guidance of experienced foreman.

(iii) The demolition work should not be taken up at night or during stormy weather or heavy rains especially when the structure to be demolished is situated in an inhabited area.

10.4 DEVELOPMET OF SAFETY CONSCIOUSNESS :

Safety programme on each construction project is highly important so as to reduce the total number of accidents. So safety consciousness should be developed in the construction work. Also safety programme should be made an integral part of each construction company.Someimprotant aspects of safety programme of construction projects are as follows.

(I)A sefety committee should be set up to guide the operation of safety programme. Both worker and management should paticipate in it to give their opinion on safety measures.

(ii) The employees should secure full support of the top management, because the employers are not to be expected to maintain an intrest in the safety programme.

(iv) Before starting construction on a project, the safety director should analyse with foreman and superintendent about the safety programme.

10.4.1 **Safety Equipments :**

The workers while performing their duties, particularly while proforming difficult or hazardous or dangerous operations, there are some safety accessories which the workers must use. By using these accessories the accident hazards can be reduced to a great extent.

These accessory items are such as:

1.Safety shoes.
2.Goggles
3.Apron
4.Hand gloves
5.Helmets
6.Dresses
7.Gunboot
8.Safetybelts.
9.Portable light & lantern
10.Fire extinguisher etc.

10.5 **SAFETY LEGISLATION :**

There are some laws or legislations in connection with safety & wellbeing of the workers. Among
them the Workman's Compensation Act & Contract Labour Act are important.

10.5.1 **Workman's Compensation Act :**

In India the workmen compensation act was passed for the first time in 1923. But it came into force in 1924, and it was amended in 1958, 1976. This act regulates the payment of compensation to a worker who had injured in the course of employment. But before this act the payment of compensation to the injured worker was a lengthy & costly process. In case any accident occurring at the site of work, this act provides the payment of compensation to the workers.

OBJECTIVES:

The main objective of this act is to payment of compensation to the workers who had injured in the couse of employment. Another aim of this act is protect the worker & his family from hardly caused by the accident. Also by result of accident, the worker losses his earning capacity. This act forces the worker to work carefully while dangerous situations and also this act forces the employer to take all the safety measures which are to be provided to the workers.

10.5.2 Contract Labour Act :-

10.5.2.1 Aim of this Act

In order to provide all the facilities and to protect the contract labourers from the contractors engaged in the government and private works, the Government of India passed contract labour act. As this act was enacted in 1970, therefore it is also known as 1970 contract labour act.

10.5.2.3 Contract labourers:

As the know that in India construction industry is the second largest industry. Construction industry plays on important role not only in the development of infrastructure of our country but also it affects our economy. About five crores of labourers are employed under the construction industry. Most of the labourers employed in construction industry are unskilled. They are employed on daily wage basis.They are for carrying the constructional activities. The contractor who engages the labourers for construction of the government and the private works, decide the wages and other facilities to the labourers: When the construction work is over, then they are terminated. In order to seek employment, they are to shift to new construction sites. Thus, these labourers move from one site to another. They are paid wages and have to also work for long hours