SYNERGY SCHOOL OF ENGINEERING, DHENKANAL
DEPARTMENT OF CIVIL ENGINEERING

LECTURENOTEON: CONSTRUCTION MANAGEMENT

6TH SEMESTER

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CHAPTER-1 INTRODUCTION

- Aims andobjectiveofconstructionmanagement
- Functionsofconstructionmanagement
- Theconstructionteamcomponents
- Resourcesforconstructionmanagement

ConceptOfManagement

- Thetermmanagement hasdifferent sensesofuse.Sometimesit isused inthesenseof anorganisation inwhichdifferent classofpeople worktogetherto provide qualitative andeconomicalproduct bytheuseofhumanbeingsandotherresourceslike machine, money and material.
- Or sometimes it may be defined as the process consisting of planning, organising, activitingandcontrollingtheperformanceto determineandaccomplishtheobjective by the use of men, machines, materials and money.

1.1Aim&ObjectivesofConstructionManagement

The followingarethemainobjectivesoftheconstructionmanagement.

- Theworkshouldbecompletedwithinestimatedbudgetandspecifiedtime.
- Thereshouldbethemotivationto workingpeopletogivetheir levelbest withintheir capacities to complete the work.
- Thereshouldbequalified andtrained staffto supervisethework properly.
- Theexecutionofworkshould be doneasperspecification.
- Theexecutionofworkshouldbedoneasmosteconomically.
- Theworkingqualityandworkmanshipshould begood.
- Thereshouldbeaproperplanofworkanditshouldbeorganisedproperly.
- Thereshouldbeanawarenessofcreating anorganisationthatworksasateam.
- Theworkersshouldhavebeenprovidedwithsafeandsatisfactoryworkingcondition.

NecessityOfConstructionManagement

Constructionmanagementisnecessaryforthefollowingcauses.

- Therecanbeproperco-ordinationbetweenagenciesandcategoriesofpersonsusing the modern technique of equipment.
- Theworkingqualityandspeedofworkcanbe improvedbyusing modernequipments of construction.
- Thecompletionofwork canbedoneintheminimumpossibletimeduration

1.2FunctionsOfConstructionManagement

Thefollowingarethefunctionsofconstruction management.

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

Planning

- Itisdoneinthe office.
- Planningisaprocesswhichinvolves“Thinkingbeforedoing”.
- Time neededtocompletethewholeconstructionproject.
- Type, quantityand exacttimefordeliveryofmaterialsofconstruction.
- Type,numberanddurationofuseofdifferentmachinesandequipments.
- Categoryofstaffi.e.,Managers,skilledand unskilled workers required.
- Typeofuncertaintieslikelyto causedelayssuchasweatherconditions, shortage of supply, labour unrest and sub-judice land matter etc.
- WHATTODO
- WHENTODO
- HOWTODO
- WHOTODO

Organising

Aftertheplanning isinplace,amanager needstoorganize herteamand materialsaccording to her plan. This process involves:

- Toidentifytheworktoperform.
- Toclassifyorgroupthework.
- Toassignthese groupofactivitiestoindividuals.
- Todelegateauthorityandfixresponsibility.

Theorganisationstructureshouldbesimpleandflexible.

Staffing

- Staffingisfillingthepositionintheorganisationstructurefordefiningrecruitments.
- It isaveryimportantresponsibilitytoselect right personforright jobsina construction organisation.
- Staffingisnotonlyabouttherecruitment but alsotheirtraininganddeveloping activities.

Directing

- Amanagerneedsto domorethanjust plan,organize,andstaffherteamto achievea goal.
- Shemustalsolead.
- Leadinginvolvesmotivating,communicating,guiding,andencouraging.
- Itrequiresthemanagertocoach,assist,andproblemsolvewithemployees.

Controlling

- Aftertheotherelementsareinplace, amanager's jobisnotfinished.
- Heneedstocontinuouslycheckresultsagainst goalsandtakeanycorrectiveactions necessary to make sure that his area's plans remain on track.
- It isanimportant actionforensuringeffectiveandefficientworking.
- Itreviewstheworkplanto checkand rectifythedeviation.

Co-ordinating

- Itmeansdeveloping harmonybetweenemployeesandgroupofemployees forsmooth and efficient functioning of construction work.
- Theworkisdividedintodifferent departments inthelargeorganisation.Sothereisa great importance for good coordination.

Communicating

- Itisaprocessoftransmittingreceivingandunderstandingthe ideasbyothersforthe purpose of effective desired results.
- Therearevariousmethodsofcommunicationlikeverbal, writtenorders, reportsetc.
- Ineffectivecommunicationleadstoconfusionandmisunderstandingetc.

1.3TheConstructionTeamComponentsO

wner

- Theownerofaconstructionproject maybeanindividual, groupofindividualsor public body.
- Theownerfinancestheprojectandalsorecognisestheneedforaproject.
- Inviewofallaspectstheownerhasthepowertotake majordecisionsregarding managerial, financial and administrative aspects.

Contractor

- The contractor executes various types of works and also makes necessary arrangementsforlabour,machinery, materials, inordertocompletetheproject inthe limited scheduled time.
- Insomeprojects,thecontractormayappointsub-contractor.
- ThereisarateorbidbetweenContractor&owner beforestarting anyproject.

Engineer& Architect

- Architectureistoassesstheclientsfundamentalrequirements.
- Architecture/Engineersupervisestheconstructionofthe project.
- Hethenpreparesplansanddesignstheprojectfortheowner.

- He deals withthecontractoronbehalfoftheowner.
- Heestimates the costofthe worktobe done&quantitysurveys.
- Hepreparedthe billofquantity(BOQ)and tenderdocumentsbefore tendering.
- Heworksasanadvisorand helpsinsolvingproblemswhichariseduringtheprogress of work.
- Hepreparesthefinalaccountoncompletionoftheproject.

1.4ResourcesForConstructionManagementM oney

- Moneyisthe first and foremostrequirement foranyproject.
- Itshouldbearrangedbeforestartinganyconstructionproject forsmooth implementation of a project.
- Ifthe financialresourcesareinsufficient thentheproject willnot becompletedwithin the specified time.

Material

- Sufficient quantityofmaterialsrequired forthecompletionofanyproject andshould also be available at the site.
- Materialsrequired forprojectareestimatedbeforestartingtheproject.
- Forexample-bricks,cement,stones,timber,watersupply,electricalfittingetc.

Machine

- Different typesofmachineriesandequipmentsarerequired foranyconstruction work.
- Althoughthecostofmachineryishighbut it workscontinuouslyunderanyadverse situation & it also reduces the high requirement of manpower.
- Forexample:Mixers,tractors,pumps,cranes,generators etc.

Manpower

- Manpowerisan importantfactorforsuccessfulcompletionofanyproject.
- Itmaybebothskilledandunskilled.
- Manpowerdealswithengineers,architects,supervisors,repairtechnicians, skilledor unskilled labour etc.

CHAPTER-2CONSTRUCTIONPLANNING

- ObjectiveofConstructionPlanning
- WorkBreakdownStructure
- ConstructionScheduling
- ClassificationofConstructionScheduling
- MethodsofConstruction Scheduling
- Bar Chart
- Bar ChartofaResidentialBuilding

2.1ImportanceofConstructionPlanning

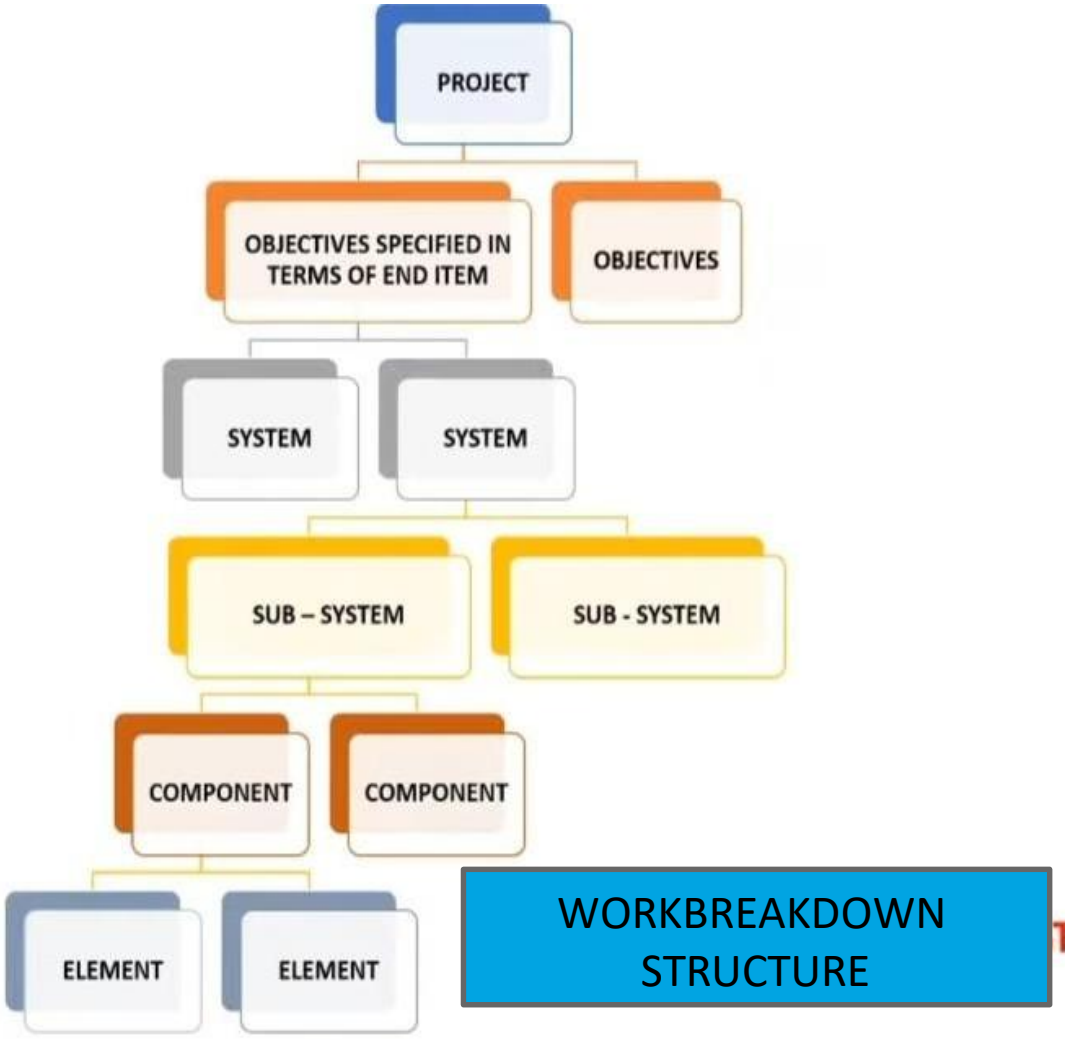
Importancesofconstructionplanning areasfollows.

- Theworkmaybecompletedwithin thescheduledtime.
- Theworkmaybeexecutedmosteconomically.
- Theworkwill bebothqualitative&quantitative.
- Thereshallbeminimumwastageduringconstructionwork.
- Theworkshould becompleted asperspecification.
- Therewillbeaminimumcost ofmaintenanceofmachinery&equipment.
- Therewillbe optimumuse ofavailable resources.
- Controllingofconstructionactivitiescanbepossible.

2.2WorkBreakdownStructure(WBS)

- Itistheprelimin arydiagramwhichshowingthebreakingdownaproject into sub-systems and each sub-systems into major components and discrete activities.
- InWBS,top-downapproachto planning isadopted. Suchanapproachensuresthat the total project is fully planned and all derivative plan contribute directly to the desired end objectives.
- WBSaids inthe identificationofobjectivesandallowstheplanner toseethetotal picture of the project.

- WBSisdevelopedbyconsideringtheendobjectiveandbreakingit intosmaller manageable units on the basis of size, duration and responsibility.



2.3StagesofConstructionPlanning

Constructionplanningcanbedividedinthetwofollowing stages.

1. Pre-tenderstage

2. Post-tenderstage/contractstage

1.Pre-tenderstage

- Thepretenderplanning iscarriedout bythecontractorafterthereceipt oftender notice and before submitting the tender paper.

- Inthisstage,thecontractorplanshisbest methodofconstructionforthe future contract & also makes plans &programmes for carrying out the work.
- Atthisstage,contractorprepareshimselfforcompletingtheworkinthestipulated time.
- Thisisanimportant stageforacontractortoseewhetherthecontractisprofitableor not.
- The first partofpre-tenderplanning istovisit tothesitebeforeacontract is undertaken.
- The pre-tender planning report by visiting to the siteofconstruction works represents totalinformationaboutthesitesuchasgeographyofthearea, localweather records& availability of resources.

Steps:

- At first,thereshouldbeacarefulstudyoftenderdocuments,drawingand specifications to identify the quantities of each item of work.
- Also thereshouldbeacarefulstudyoftenderdocument aboutthetime limit,i.e.the project should be completed within the stipulated period of time.
- Thereshould beasite investigationandsurveytodeterminetherateandavailability of resources.
- Theavailabilityofrequired materials nearsiteofworkshouldbedetermined&ifnot, also how these can be procured economically.
- Theselectionofmost suitable andeconomicalmethodshouldbecarefullydetermined for executing the work.
- Thequantitiesofdifferentitemsshouldbeestimated.
- Theoverheadandthe marginofprofit should bedecided &tenderprice finalized for the completion of the work within the stipulated period of time.

Post-tenderStage

- Thisstageisotherwisecalledascontractstage.
- Thisstageisstartsaftertheacceptanceoftender andextendstillthecompletionofthe contract.

- At this stage, contractor fully utilizes the pre-tender stage planning to organize the variousactivitiesofconstructionworksothattheworkmaybecompletedwithinthe scheduled time economically without delay & difficulties.
- Improper&inadequateplanningatthisstagemay causeheavylossofmoney&time.

Steps:

- Theselectionofmost suitable&economicalmethodoutofallthealternative methods considered at pre-tender stage should be carefully determined for execution of the work.
- The quantityof materials required at each stage ofthe work, locating sources oftheir supplies,theircomparativecostfromdifferentsourcesshouldbeworkedoutproperly.
- Inter-relationshipofvariousitemsofworkshouldbestudiedandthepropersequence of operation is finalized.
- Therequirementofconstructionlabour,supervisoryand managerialstaffsshouldbe finalized and their selection & recruitment should be arranged.
- Totalnumber ofrequirement ofmachinery&equipmentsat variousstagesofwork should be worked out & arranged.
- Repairing&maintenanceofmachinery&equipmentshouldbeproperlyarranged.
- Accommodationforlabour&staffalongwiththefacilitiesrequired forthem, temporary camp, office etc. should be planned& arranged properly.
- Theworkprogramme ofeachworkshould bedecided&itsstarting&completing date also be finalized.
- Agoodcommunicationsystembetweenthe membersofconstructionteamshouldbe established for the smooth running of project work.

2.4ConstructionScheduling

- Schedulingofaprojectisdoneafter itisproperlyplanned.
- Aschedule forconstructionactivityisagraphicalrepresentationwhichdetermines the time of starting and completing date of each activity in order to complete the whole construction project.
- Inotherwordsscheduling isthetimetable forexecutingeachandeveryactivitywith its fixed starting and finishing date.

Preparationofconstructionschedule

- At firstthewholeprojectisdividedintoasmallnumberofoperations.
- Thenthe inter-dependenceamongorbetweentheoperationsarecarefullystudiedand their sequence is decided.
- Thequantityofwork isto bedetermined which isto bedoneineachoperation.
- Thetotaltime to complete eachoperation&totalprojectisdetermined.

ClassificationofScheduling

Schedulescanbeclassifiedintovariousgroupssuch as;

- MaterialSchedule
- LabourSchedule
- EquipmentSchedule
- FinancialSchedule

MaterialSchedule

- Thistypeofschedule ispreparedformovingandstoringofmaterialin advance before starting of construction schedule acts as a guide for preparing materials schedule.
- Thisscheduleisdonetoavoiddelayintheexecutionofthework.
- The materialsshouldbedeliveredatsiteatleastoneweekbefore its use.
- Thematerialsatsiteshouldnotremainunusedforlong.
- Ifthematerials storedatsitelongbeforeitsuse, itis likelytodeteriorateinquality.
- Forexamplecement made itsstrengthby50% ifstoredfor6monthsandsteelmaybe attacked by corrosion due to long storage at site.

LabourSchedule

- Thelabourscheduleispreparedfordecidingtheactualnumberofskilledand unskilled labour which is required for the construction work.
- Withthehelpofthisschedulerequiredlabour canbearrangedintime.

- Ithelps inreducinglabourcost.
- Labourscheduleisimportant asit isdifficult andcostlytoarrangeskilledlabouras and when required.

EquipmentSchedule

- This type of schedule is prepared to decide the type and quantity of equipments as alsoonwhichdatetheequipment willbeneeded. Sothattheycanbearrangedwhen requirement.
- Theaimofthisschedule istoderive maximumadvantageoftheequipment whenit is required and remove it from the site when the job is over.

FinancialSchedule

- Financialschedule ispreparedto estimatetheamountofmoneythat owneror contractor has to spend as finance for the project work.
- In maximum construction project the owner will paya stated percentage of the value tothecontractorforthecompletionofworkin eachmonth. it isabout 90%ofthecost at the completion of the work & rest 10% is retained.

Financeforsmallworks:

- Theestimatedamount ofmoney, whichtheownerorcontractorhasto provideto finance the project can be obtained from construction schedule.
- Inmostofthecasesofconstructioncontracts, it is specifiedthattheownerwillpay about 90% cost of the completed work during each month for each job to the contractor.

2.5Methodof Scheduling

Dependinguponthesizeoftheproject,schedulingisdonebydifferentmethods.

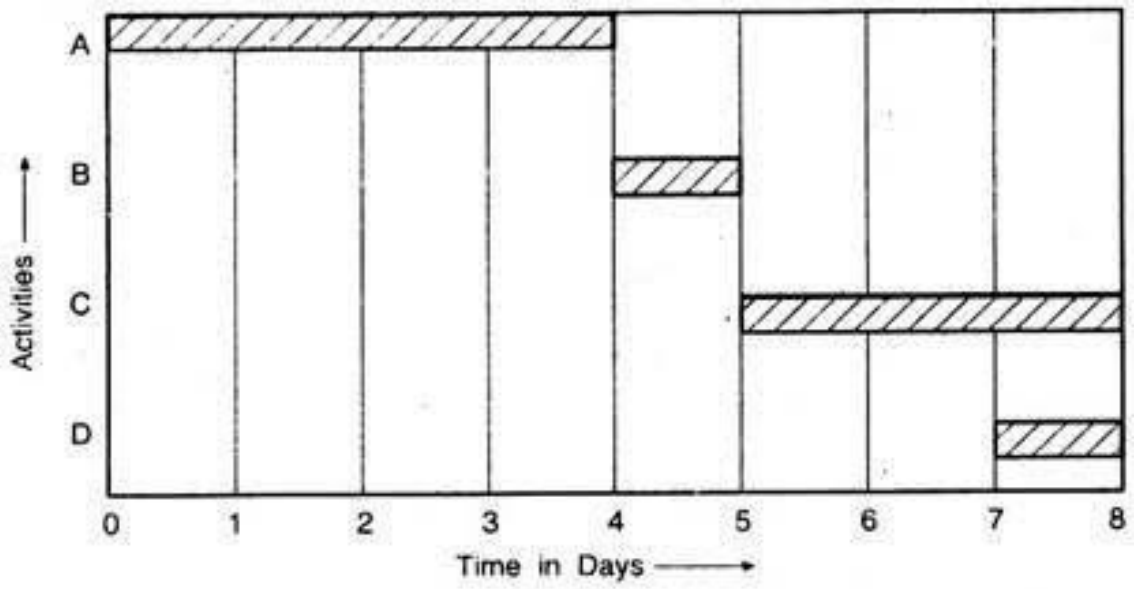
1. Bar chart orgnattcharts.
2. Networkanalysis(CPM,PERT)

BARCHARTS

- Barchart isagraphicalrepresentationofvariousactivities ,theirduration,startand period of a project.
- Thismethod wasdevelopedbyHenryGanttaround 1900.
- Inabarchart,therearetwoco-ordinateaxes, i.e. x-axis(Horizontal)&y-axis (Vertical).
- Along x-axis, timerequired forthecompletionofworkisrepresented&along y-axis, the activities are represented.
- Inabarchart,the activities arerepresentedbythickcrossed horizontallines.
- Timerequiredfor completionoftheactivitymay berepresentedindaysorweeks.
- Thischart isknownasbarchart becausetheactivitiesarerepresentedbynumberof parallel bars in it.
- The lengthofeachbar indicatethedurationoftimerequiredtocompleteaparticular activity.
- Thebar chart/gnattchart representsthescheduleofaproject.
- Alsobarchart representsthe actualprogressofthe work bythickdarkbars.
- Adailyrecordshouldbe maintainedbythesupervisor abouttheprogressofthework and handed over it to the sectionalofficerwho in turn will handover it to chief- supervisor or engineer for finalizing it, so that the progress of the work can be completed within a particular period of time.
- Soabar chart givesaclearer pictureoftheprogressofworkwithout studyany detailed report.
- Wecanalso check theaccuracyofwork and cancomparetheactualprogressofwork with the schedule.

Stepsinpreparingabarchart

- Inpreparingaconstructionschedule bybarchart,at firsttheproject issubdivided into various objectives.
- Namethevariousactivitiesinalist.
- Determinethe inter-relationshipamongtheactivities.
- Arrangingtheactivities inasystematicmanneroneafteranother.
- Determinethequantityofwork&requirementoftimetocompletethe work.
- Thendrawthebarchart.

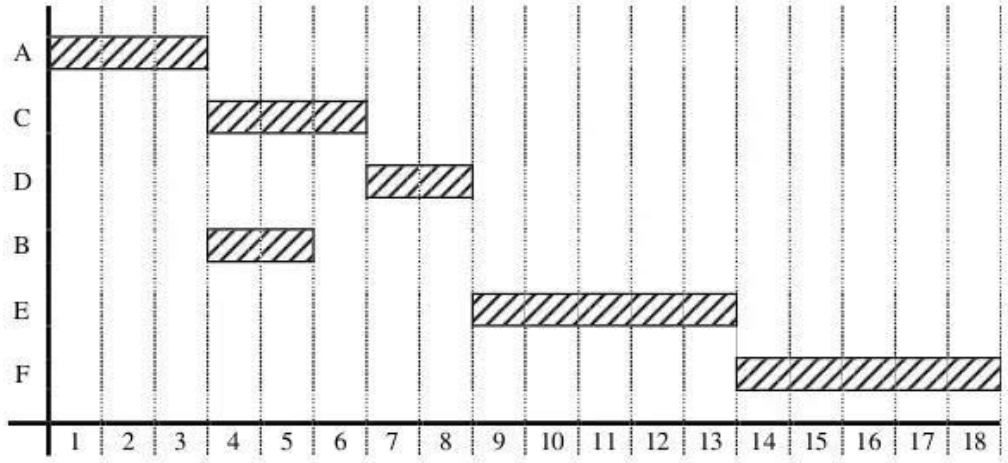


Barchartofaresidentialbuilding

- 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



AdvantagesofBarChart

a) Verygraphical.

b) Easytounderstand.

c) Mostwidelyused .

d) Thereisnorequirementoftrainedorskilledpersonstodrawthischart.

DisadvantagesofBar Chart

a) Difficulttoupdate.

b) Difficulttofindthecriticalpath.

c) Difficult tosetupandmaintainalargeproject becauseit isessentiallyamanualgraphical procedure.

2.6LimitationsofBarChart

a) Ifthetimeschedule ischanged,thenit isdifficult toreadjustthe length&positionofthe bar.

b) Barchartcanonlybeapplicableforsmallprojectsbutnotsuitableforlargeprojects.

c) Thebarchartdoesn't showclearlytheinter-dependenceamongthevariousactivities.

d) Thebarchart doesn't showtheactualprogressoftheworkasitonlyrepresentsthe estimate time. So the actual progress of the work can not be monitored.

e) Thebarchart givesno ideaaboutthe maximumprogressnecessaryforit'scompletion.It gives the information only about the rate of progress.

f) The barchart doesnot helptheworkofcontrolling,monitoringandupdatingtheproject. These limitations of bar chart may be discussed under the following heads.

a) Inabilitytoshowinterdependencyofactivities

The bar charts fails to indicate clearlythe interdependencies among suchactivities ofcourse, simply drawing the bars of activities, parallel to each other, does not provide complete idea whethertheyarerelated/independentorcompletelyindependent.Interdependencymeansone work cannot be started before completing the previous work.

b) Inabilitytoindicatetheprojectprogress

Abarchart cannotbeusedasacontroldevicesince,it doesnot indicatetheprogressofthe project.

c) Inabilitytoaccommodateuncertainties

Thisisthemost importantlimitationofbarchart becauseit cannot effecttheuncertaintiesor tolerance in the time schedule of various activities of the project.

Example:Researchwork

2.7NETWORKANALYSIS(CPM,PERT)

Network:symbolicrepresentationofessentialcharacteristicofaproject.Inother words, the phase diagram or sequential arrangement of various events and activities.

CPM(CriticalPathMethod)

- CPMisanactivityorientednetworki.e. basedondeterministic approach.
- Usuallysuitable for repetitivetypeprojectslikethoseofconstruction, manufacturing & maintenance.
- Example:
  a) Manufacturingofanewcar
  b) Buildanewbridgeover ariver
  c) Constructionofamulti-storeybuilding
- WiththehelpofCPM,aplanningengineercomestoknowthesequenceto various activities of the project.

DifferenttermsusedinCPMEVENT

- Aneventiseitherstartorcompletionofanactivity.
- Itdoesn’trequiretimeorresources.
- Itisrepresentedbynodeusuallycircle.

ACTIVITY

- Itisactualperformanceofa task requiredforcompletionofthe project.
- Itconsumestimeand resources.
- Itis representedbyanarrowonthenetwork.

- Thetailofthearrowindicatingthestartoftheactivities &head indicatingtheendof the activity.

DUMMYACTIVITY

- Thisactivityneitherusesanyresourcenoranytimeforitscompletionbut isrequired in the logical sequence of network is called a dummy activity.
- Itmay berepresentedbya dotted arroworsolid arrowwithzero timeduration.

EarlyStartTime(EST):-Theearliest possibletimeat whichanactivitymaystartis called its early start time.

EarlyFinishTime(EFT):-It isthesumofESTofanactivityandtimerequired for its completion i.e. EFT= EST+t

LateStartTime(LST):-Thelatest possibletimeat whichanactivity may start without delaying the date of the project.

LateFinishTime(LFT):-ThesumofLFT ofanactivityand thetime required for its completion i.e. LFT= LST+t.

Total Float:-The difference between the maximum time allowed for an activity and estimateddurationiscalledtotal float. It isthedurationoftimebywhichanactivitycanbe startlate,withoutdisturbingthetotalprojectschedule.

FreeFloat:-The durationoftime bywhichthe completionoftimeofanactivitycanbe delayed without affecting the start of the succeeding activity.

CriticalActivities:-Theactivitieswithzero float arecalledcritical activities, which are required to be completed onschedule.

CriticalEvents:-Thestartandendpointsofcritical activities.

CriticalPath:-Thepathofnetworkjoiningthecriticaleventsalong with no float is called critical path of network.

ProgrammeEvaluationandReviewTechnique(PERT) :-

- Itisaneventoriented network,developed byU.S.Navy
- ItismoreaccuratethanCPM.
- Itispreferredforprojectsthat arenon-repetitiveandinwhichtime for various activities cannot be precisely pre-determined.
- Itisaprobabilisticmodel.
- Itfollowsnondeterministicapproach.

Example:-

- Launching ofa satellite.
- Research&Developmentofanewproject.

DifferenttermsusedinPERT:-

1. **Optimistictime:-**
    - The minimumpossibletimewhichanactivityrequiresforitscompletion under ideal condition is called optimistic time.
    - Itdoesnotincludeanytypeofdelayatanystage.
    - Itisdenotedby"t_o".
2. **Pessimistictime:-**
    - The maximumtime that may be takenbyan activityif there is delayat every stageexcept naturalcalamitieslikeearthquake, floodetc.iscalledpessimistic time.
    - Itisdenotedby"t_p".
3. **Mostlikelytime:-**
    - The most realisticestimateoftimewhichanactivitymaytakeforits completion under normal condition is called most likely time.
    - Itisdenotedby"t_m".

4. Expectedtime:-

Itistakenastheweightedaverageofthetimeestimatesi.eoptimistictime, pessimistictimeand most likely time.

- Itisdenotedby"t_e".

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

5. Earliestexpectedtime(T_E)

- Theearliest expectedcompletiontimeofevent isequaltothesumofthe expected times of the preceding activities.

6. Latestallowabletime(T_L)

- Thelatest possibletimeanevent cantakewithoutdelayingthefinal completion date of the project is called latest allowable time.

7. Slacktime

$$Slack=T_L-T_E$$

8. LengthoftheProject

- Thesumoftheexpected timesofalltheactivities along thecriticalpathofthe network of a project.

9. Varianceofanactivity

$$V_t=(t_p-t_o/6)^2$$

10. Standarddeviationofanactivity

$$S_t=(t_p-t_o/6)$$

11. Varianceoftheproject

- Thesumofthevariancesofalltheactivitiesalong thecriticalpathiscalled the variance of the project.

12. Standarddeviationoftheproject

- Thesquarerootofthetotalvarianceofaproject whichiscalculatedalongthe critical path of its network is called standard deviation of the project.

DifferencebetweenCPM&PERT

SLNo.	PERT	CPM
1.	ItsfullformisProjectEvaluationand Review Technique.	ItsfullformisCriticalPath Method.
2.	Itiseventorientedtechnique.	Itisactivityorientedtechnique.
3.	Itisaprobabilisticmodel.	Itis adeterministicmodel.
4.	Basedupon3timeestimatesto complete an activity.	Baseduponsingletimeestimateto complete an activity.
5.	Natureofthejobisnon-repetitivein nature.	Natureofthejobisrepetitivein nature
6.	IthasNon-repetitivenatureofjob.	Ithasrepetitivenatureofjob.
7.	There is no chance ofcrashingasthere is no certainty of time.	There maybe crashing because of certain time boundary.
8.	Itdoesn’t useanydummy activities.	It usesdummyactivities for representing sequence of activities.

CHAPTER-3MATERIAL&STORE MANAGEMENT

• Introductionand Objective

• Classificationofstore-storageofstock

• Issueofmaterials(indent,invoice, bincard)

• Storesaccounting procedures

• Inspectionofstores

• Procedureofwriteoff

INTRODUCTION

- Materialmanagementisanintegralfunctionofdifferentsectionsoftheorganisation.
- Itdealswiththesupplyofmaterialandotherrelatedactivitiesandaimsat minimum expenditure on materials.
- Material management deals with the overall activities of materials such as type, amount ,movement,purchase,location,timingofvariousmaterialswhichareused in anorganisation. Sostoreandmaterialmanagement isanintegralfunctionofdifferent sections of the organisation.

OBJECTIVESOFMATERIALSMANAGEMENT

- Toselecttherightquality
- To meettheproductionrequirements
- Selectionofsuppliers
- Limit thewastages
- Productenhancement
- StandardizationProcess
- Minimizesthecostofproduction

3.1Classificationof stores

Storescanbedividedintofourcategoriesaccordingtopublicworkdepartment.

1. Stock

2. Tooland plants

3. Roadmetals

4. Materialchargeddirectlytoworks.

Stock

- Thestockisthestorewhichisrequired forgeneralworkandkept undersuspense head and finally issued for the work.
- The itemswhichare incommonuse intheconstructionactivityfortheexecution of different works are kept in stores.
- Suchmaterialsofgeneralusesuchascement,timber,bricks,aggregates, steels, paints etc are kept in store are called as stock.

Reservestocklimit

- The maximumamountofmaterialsthat canbekeptinastockin adivisionis fixed and is known as the reserve stock limit.
- Thelimit isfixedbytheGovernmentkeepingintoconsiderationthenormal requirements of stock in the division.
- Thereservestocklimit canbe increasedduringtheperiodofspecialurgency, This increased limit is termed as temporary reserve limit.

Subheadofstocks

Thevariousmaterialsofsimilarnaturegroupedunderdifferent headsto facilitatetheproper maintenance of stock account are known as sub-head of stock .

Thefollowing aresomeofvarioussubheadsofstocks

1. Smallstores(likenails,screws,hinges,bolts,etc.).

2. Buildingmaterials(likecement,aggregates,bricks,lime,etc.).

3. Timber(likedeodar,chirr,plywood,sal,teak,plywoodetc.).

4. Metals(likemetalsteelbars,rolledsteelsectionsetc)

5. Fuel(likekerosene,fuelwood,firewood,coal,etc.).

6. Painter'sstores(likepaints,varnishes,linseedoil,turpentineoiletc.).

7. Housefittings(likebathroomfittings,washbasin,mirroretc.).

8. Miscellaneousstores(likebasket,emptybags,drumsetc.)

9. Lands,kilns,etc.(likecoal,machinerysheets,mouldsetc.)

10. Manufacture(i.e.manufacturinginGovernmentworkshops).

11. Storage(i.e.paymentmadetochokidar,rentofgodownetc.)

3.2 Issueofmaterials

- Thestorekeepercanissuethe materialsto differentdepartmentsuponthereceipt ofa withdrawal form with proper authority and it is called as material issue requisition form.
- Dependinguponthenatureandamountofmaterialto bewithdrawnfromstoresthe material requisition is prepared in duplicate by the manager.
- Boththecopiesaresenttothestorekeeperwho issuesandrecordsthe materials distributed.

IndentandInvoice

- Materialsareissuedfromstockondemandinproperformcalledindentform.
- Indentformconsistintriplicateofcounterfoil,indentandinvoice.
- Thecounter foilsandindents partoftheindentformfilledbytheIndenting officer.
- Thenthis formwithblank invoicesenttotheissuing officer inchargeofthestock who issues the stores as per availability of stock.
- Thentheissuingofficercorrectstheindentandfillsuptheinvoice.
- Thentheissuingofficersendsit backtotheindentingofficerto signtheinvoiceand they return it to him as an acknowledgement.

Rulesforpreparingindentandinvoice

- Thereshould bedescriptionofunit ofsupplyandquantityofmaterial indented written clearly.

- Thecostofmaterialsoftheheadofaccountshouldbespecified.
- Thenameofworkshouldbegivenwhenthematerialisissued.
- Fulldetailsofdepartment , divisionandanyotherpersonforwhichthe materialis issued should be given.

Bin Card

- Bincard isacardwhichmaintainsthedetailsofquantitiesofeachtypeofmaterial received, issued and on hand each day.
- Thematerialandother itemsarekeptinappropriatebins, drawersetc.
- Thestorekeeper maintainstherecordonaBinCard.Abinor shelfisattachedto each bin card.
- Bincardsare made induplicate. Oneisattachedtothebinandanotheris forthestore keeper.

Procedureforstoreaccounting

Finalhead

Thecostofacquisitionofstoresisdebitedtotheparticular workfor whichtheyarerequired. This is known as final head of account.

Suspensehead

- Suspense head includes the temporary booking of expenditure incurred for the purchasingofmaterialsfortheexecutionofworkis debitedtotheminorhead i.e. suspense expenditure.
- Theprocedureforstoreaccounting isdoneseparatelyforvariousclassesofstores such as stock, tools and plants, road metals and other miscellaneous material.
- Whenthe stockis placed thenthe store is debited to suspense head .Whenthe stock materialis issued fortheexecutionofaparticular workthenit isdebitedtothefinal head.
- Thesupplyoftoolsandplants inthedivisionanditsexpenditure isdebitedtothe 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.

- Forcertainroadtheroadmetalisrequired fortheconstructionitscostisdebitedtothe 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.
- Similarlyforothermaterialsifthe materialsarepurchased forgeneralrequirement then the cost is debited to the suspense head.
- The initialaccountofallreceiptandissuesis maintainedbythesectionofficer.
- Afterclosingthe monthlyaccount sectionofficer forwardsitstothesubdivisional office.

PhysicalVerificationAndInspectionofstoresNecessity

Inspectionofstoresanditsphysicalverificationis essentialforfulfilment offollowing.

- Toensurethecorrectnessofstockheld bycomparingthemwiththebalanceshownin the store ledger or bin cards.
- Toavoidshortageofmaterialsinthestock.
- Tocheck lossesininventorydueto pilferage, improperstorageormisplacement, deterioration etc.
- To correct and updatestorerecords.
- Tocalculatethevaluesofthestockcarried forthebalancesheet andprofit and loss account.
- Tocalculatethe rateofturn-overofanitem.
- To ensuremaximumeconomyinstockcarrying.

MethodofPhysical StockVerification

1. AnnualphysicalVerification
2. PerpetualInventoryandContinuousStockTakingSystem.

Annualphysicalverification

The followingprocedureisadoptedfor carryingouttheannualphysicalverification.

i) Bythe end ofthe year, the stores are closed for a few days; no material etc. is issuedto anyproject work/shopintheplant.Incaseit leadsto plant shut down,

theactivitiessuchasrepairandoverhaulingofequipment and machineriesare resorted to.

ii) A team of stores inspectors or stores verifying officers physically check and count eachandeveryitemlying intheentirestore.It istalliedwiththequantities marked on bin cards and store ledgers.

iii) Step(ii)above mayleadtotheformationofa list ofsurplusandshortitems. Damaged and obsolete items may also be traced and recorded.

iv) Inspectorscheckanumberofitemseverydayasperapre plannedscheduleand finish the complete work within a few days.

Advantagesinthesensethat allthe itemsarecheckedatonetimesothere isno confusion about any item being left unchecked.

Perpetualinventoryandcontinuousstocktaking

Perpetualinventoryand continuousstocktaking systemisa more appropriated method for largeplant withhuge inventorieswhichrecordsstorebalancesaftereveryreceipt and issue and facilitates regular checking.

i) Under this system, store items are checked continuously throughout the year; a numberofitemsarecounteddailyorat frequent intervalsandcomparedwith the bin cards and stores ledger.

ii) Discrepanciesfoundifany,owingtoincorrectentries,breakage,pilferage,over issue, placing of items in the wrong bin etc. are investigated and corrected accordingly.

iii) Thismethod islesscostly.

iv) Inthismethodonlyfew itemsarerequiredto checkeverydayascomparedto annual physical verification.

Procedureforwriteoff

- 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.)-15giving fullparticularsoftheirvalue,dateofpurchaseandreasonsfortheir becoming unserviceable.

- Thesurveyreport issubmittedtothecompetent authorityforapproval. Asageneral practice, the articles which are written off are destroyed in presence of a gazette officer.
- Asregardsthearticlesofstock, whichget deteriorated,anestimate forthelossof stock isprepared. The toolsand plantsarticlesare writtenoffafter preparationof survey report.
- DFR-DocumentFilingandRetrievalForm

Example

PrepareaWriteoff inrespect offollowingArticlesoftoolsand plants.

- Name ofthesubdivision-Killamaidan
- NameoftheDivisionandCircle-Cuttack
- 10no's, ofmetallictapes30mpurchasedon6.5.2004for Rs. 5000/04nos.ofbrass pad locks 7.5cm size purchased on 2.6.1999 for Rs. 1200/
- 1timepiece(AjantaMake)purchased forresthouseOMPsquareon3.10.2006400/ these articles became unserviceable through fair wear and tear.

NOTE:

WhatisCostIndex?

- Costindexisasimpledevicewhichshowstherelative changes inthecostofspecific or group of items over a certain period of time.

Differencebetweenstoreledgerandbin card:-

Bincard	Storeledger
Itimpliesaquantityrecordofthereceipts, issue & balance of materials in stores.	It implies to a subsidiary ledger, that keeps trackofeachandeverytransactionrelatingto thematerialsinthestores.
Keptinsidethestockroom.	Keptoutsidethestockroom.
Containsquantitativedetails only.	Containsbothquantitativeandmonetary details.
Transactionsarerecorded individually.	Summarizedtransactionsarerecorded.

CH-4CONSTRUCTIONSITEMANAGEMENT

4.1JobLayout:

Joblayout isdrawingthepreparedplanofconstructionsitebythesiteengineer in-chargeof the project. The arrangements made at the construction site for different camps and the area around it is known as job layout.

OR

Joblayout isascaleddiagramoftheproposedconstructionsiteshowingalltherelevant featuressuchas,Entrypoint ,Exit point Storageareasofmaterials,Temporaryservices Contractor'ssiteoffice Areasforkeepingequipmentssuchasmixers Barbendingarea, Labour Housing etc.

Objectiveofpreparingjoblayout

Followingaretheobjectiveofjob layout.

- Itsavestimeindeliveringtheconstructionmaterialsatthe site.
- Thebestmethodofworkingmaybeadopted.
- Ithelpsto completethework withintheminimumuseofequipments.
- Themaximumoutputfromlabourandmachines canbetaken.
- It providessafetytothe workers.
- Ithelpsto avoiddamagetothenearbypropertiesdueto constructionwork.
- Itplansfortheconstructionmaterialstobeplacedasnear aspossibletothework.

ReviewPlan

- Beforepreparinga joblayoutthedetailsofdifferent plans fortheexecutionofthework should be studied carefully.
- Siteplan
- Workingdrawing
- Specification

Siteplan

Thesite planshowsthefollowingdetails.

• Theboundariesofthesite

• Theadjacentareaofthe boundaryofthe constructionsite.

• Locationofanyexistingbuildingstandingnear site.

• Spaceleftaroundthebuildingtosecureverificationorfreeair condition.

• Spaceleftaroundthebuildingforcleaningandadmissionoflight.

• Positionofanynaturaldrains,rivers,Wellslocatednear thesite.

• Anyotherinformationwhichareconsideredtobe necessary.

Workingdrawing

• Theworkingdrawingconsistsofthebuildingplansandotherworkstobeconstructedatthe site. The working drawing includes;

• Floor planofthebuildingwithcoveredarea,sizeoftheroom, openingofdoors& windows, structural members, staircase ,lifts Etc.

• Elevationofallsidesareshown.

• IndicationofdirectionofNorthlineinthe planofbuildings.

• Indicationofrejectedpersonsbeyondthepermissiblebuildingline.

• LocatingexactlyoftheessentialserviceslikeWatercloset,sink ,bathetc

• Showingsectionaldetailsdrawingoffootingthicknessofworldcurrent slabswiththeir material.

Specifications

Specification indicates the details of the types and grade of the material to beused in constructionwork.It isanimportantdocument intheconstructionindustrywhichhelpsthe designer to communicate his thought and ideas to the other construction team members.

TypesofSpecifications:

Standard Specification:-TheSpecificationpreparedforthe generaluseoftradee.g.Indian standard specification.

Outline Specification:-These are the specifications used at the time of biding & prepared usuallytoaccompanythepreliminarydrawingsofthe work. It providesthebasic information about the type & grade of the materials to be used for construction work.

ProjectSpecification:-It ispreparedforaparticularproject takingintoaccountforthe special requirement.

GuideSpecification:-It ispreparedtoguidethespecificationwhichispreparedtheproject originally.

Manufacturer'sSpecification:-Thesearethespecificationswhicharepreparedbythe manufacturers to specify the quality of the product manufactured by them.

UseOfSpecification:

- Topreparetheestimateforsubmissionoftender.
- Itisuseful forthecontractortoorderthematerialsforexecuting the work.

Factorsinfluencingselection,design&layoutatconstructionsite:

i.Nature of theproject

ii. Location of project

iii. Services

iv. Availabilityofmaterial&equipments

v. Availabilityofmanpower

vi. Medicalfacility

vii. Availabilityofspace

viii. Othermiscellaneousfactors

I)Natureof the project

The nature ofthe project plays an important role in its layout process. The camp layout dependsonthenatureandtypesofproject.Forexamplethe layoutofcamp for ahighway construction project will differ from that of a building.

II)Locationofproject

Location ofthe project also plays an important role in job layout plans. The location ofthe project should be properly chosen such that there will be no difficulty for anytype of transportation.Sotransportationfacilitytotheconstructionsite isanimportant factorforjob layout.

III)Services

Thereshould beproperserviceofwatersupply, sanitationandelectricity. Iftheseservices are not available then it will be badly affect the job layout.

IV)AvailablityofMaterial&Equipments

Thereshould besufficient availabilityofmaterialsandequipmentsattheconstructionsite.If the materials and equipments are not available locallythen it will create problem in storage which will affect the shape of job layout.

V)Medicalfacility

Iftheproject isforalongtime it isessentialto haveafield medicalaid facilityforthe workers.

VI) Availabilityofmanpower

Manpowerisanimportant resourceinanyconstructionsite.Thearrangementofmanpower at construction site should be made locally otherwise it will be a great difficulty for their shelter .Solabour should be arranged locally.

VII) AvailabilityofSpace

Iflessspace available at the constructionsite, then it willbe difficult for job layout because thestorageshouldhaveto belocatednearest tothe workingsitesuchthatthe regularsupply of material & equipment is possible as required.

VIII) Othermiscellaneousfactors

Thereshould beavailabilityofeducationfacilities likeschooling forthechildrenoflabours 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 ofthe project.

Layoutofequipments

Thesearesomeofthepointswhicharetobeconsideredatthetimeof preparing layout of equipments.

- Theequipmentsshould beplaced asnear astotheplaceofmaterials.
- The maintenance, repairing &fuelfillingofequipmentsshould bearrangedatthe construction site.
- Thereshouldbearrangementofsecuritystaffforthesafetyofmachinery.
- For removal&shiftingofequipmentstoworkplace,thereshouldbeavailabilityof sufficient space.
- Thereshouldbeadequatespaceavailablefor parkingofthetransportvehicles.
- Temporaryshedsshouldbeprovidedtosafeguardthecostlyequipments fromany type of weather condition.
- The mainentranceoftheproject work&the mainofficeofthe establishment should be nearer to each other ,so that no visitors have to cross the work site.
- No materials canpassoutoftheproject workwithouttheproper checkbythesecurity check posts.
- Thereshould beprovisionofadequatesafetymeasuresand fireprevention equipments in the work site.

4.2LocatonofEquipment

Whyequipmentsarerequired?

- Asthereisa increasedcostoflabour,theuseofmore&moremechanicalequipments becomes necessaryfor constructionwork because the availabilityof manpower is not sufficient for the completion of construction work within stipulated time, so it is essential to use mechanical equipments along with the available manpower for the construction activity.
- Itisessentialto choosecorrectandwelloperated equipmentsforaconstruction project.
- It isnot possible foranyownerorcontractorto purchasealltypesofequipments which are needed for the job.
- Sotheownerorcontractor maypurchasesomeoftheequipmentsandsomeother they will hire.

Forlocationoftheequipmentsfollowing pointsaretobeconsidered.

(i) Equipmentsshould benearertotheconstructionwork.

(ii) Equipmentsshouldbeneartothematerials.

(iii) Theownedequipmentsmaybeprovided neartheentrancesothattherewillbe no requirement of any additional guard.

(iv) Thehiredequipmentsshouldbeplacedinsuitableplaces.

(v) Thereshouldbeprovisionfortherepair oftheequipments.

Organisinglabouratsite

- Organizing labourproperlyattheworkingsite isanimportantresponsibilityofthe supervisory staffs.
- The laboursaredivided into different groupsbythesupervisorundertheguidanceof effective leader who has the quality to control the labours.
- Inanyconstructionwork,the laboursaredivided intogroupswiththe instructions for different works.
- So, labourorganisingshouldbedonebythesupervisor insuchawaythattherewill be no wastage of manpower.

Therearesomepointswhichareto beconsidered whileorganisinglabourat construction site.

- Supplyofmaterialshouldbesufficientasper requirementoflabour.
- Laboursupplyshouldbeuninterrupted.
- The materialsshouldbetakenonce forthewhole dayfromthe godown. Itreduces the frequent movement of labour.
- Increasinganddecreasingoflabourshouldbedoneasper necessity.
- Toavoidwastageoftimeoflabour,minimumfacilitiesshould be madeavailable at the site.
- Drinkingwaterfacilityshouldbe madeavailable atthesitetosavetimeofthe labourers.
- Arecordshouldbemaintained abouttheprogressofthelabour.
- Recordmaintenance willhelptocomparetheprogressofworkwiththecompletionof work at right time.

4.3 Joblayoutfordifferentconstructionsite

Preparationofjoblayout:

• The construction plans, specifications, contract documents and other available material describingthe jobshould bestudiedcarefullyinorderto getthe ideaofthenatureandextent of the work.

• Ascaled drawing withascaleof1 in100 should beprepared showing theoutlineofthe work or job to be constructed.

• Also thepositionofentryand exit pointsaswellastheareasoftemporaryfacilitiesshould be marked on it.

Moreoverfollowing informationshouldbecollectedfromtheabovestudy.

• Area needed for accommodation:Thisarea includestheareare quired foroffice, storesand residential accommodation for officers, staff and labour.

• Areare quired formachines,sheds,repairshopsandworkshopsetc.

• Area forsecurityandfirefightingfacilities.

• Areare quired forconstructionwork.

• Areaformiscellaneousamenitiessuchascanteen,toilets, dispensaryetc.

• Lengthofperiod forwhichareamaybeavailable.

Joblayoutplansofmulti-storeyedbuilding

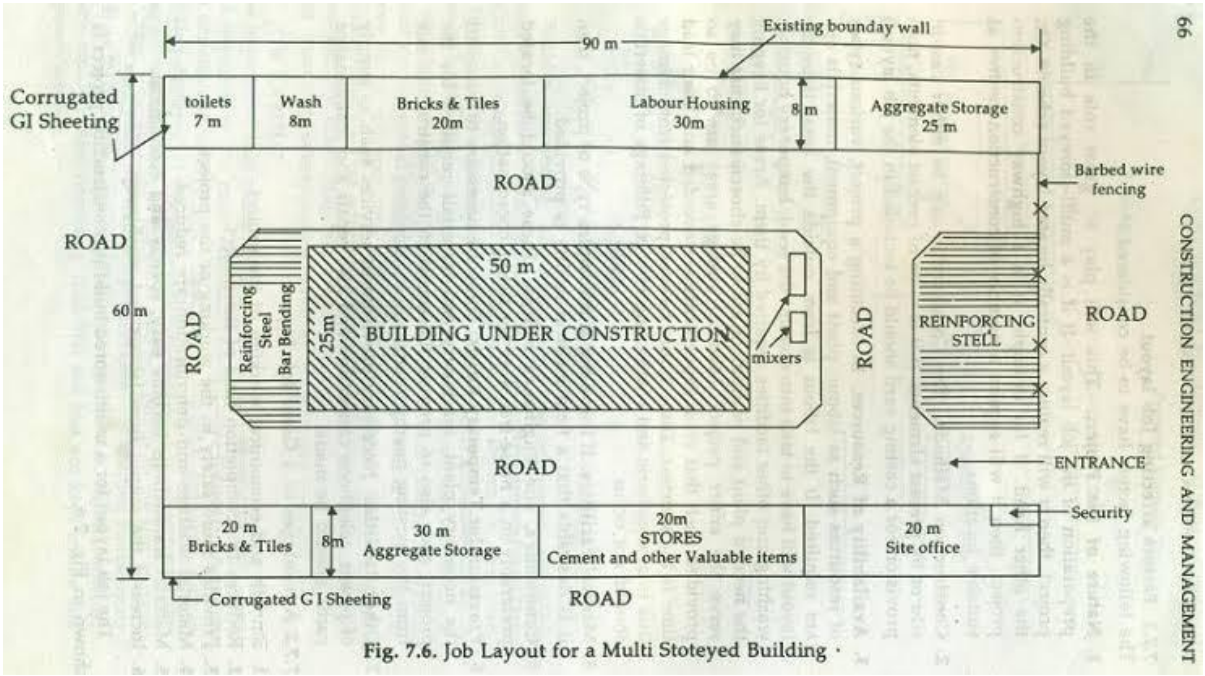


Fig. 7.6. Job Layout for a Multi Stoteyed Building ·

4.4Principlesofstoringmaterialsatsite

The materialsshouldbestoredinpropermanner attheconstructionsite.

a) Materialsshouldbestoredatconstructionsitesoastopreventmixingofforeign matter.

b) Materialsshouldbestoredinsucha mannerastoprotect it fromanyweatheringagent like rain, sun and wind.

c) Materialswhicharesuspectedtoget fireeasilyshouldbepreventedfromfirehazardsi.e. the products like petroleum & explosives should be stored properly.

d) Precastbeams, piecesoftimber and slabswhicharelikelyto beaffectedbythesoilor support should be stored with properly adopted measures.

e) Materials likecement bagswhichareeasilyaffectedbythecontactofmoisturearetobe stored with special precautions.

f) Thematerialsregularlyusedistobeplacedrelativelynearertotheplaceofuse.

g) Thereshouldbeaproperarrangement offire-extinguisher&fire bucketswherever necessary for the safety measure.