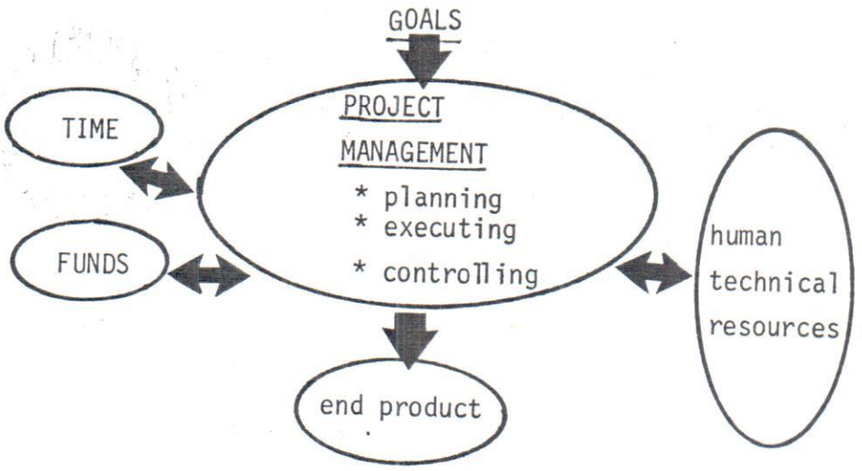
" استلام الموقع وتجهيزه بعد الترسيـــــــــة "

الدكتور / عبد الهادى حسنى

PROJECT PLANNING AND SCHEDULING

INTRODUCTION:

Project management may be described as the process of planning executing and controlling a project from start to completion in agiven time, at a given cost , within a given human and technical resources for a given end product.



The management process should be capable of accepting possible alteration at any stage that may result from:

* Basic assumptions change.
* Original estimates are no longer valid.
* New facts, changes and restrictions occur which could not be anticipated.

In general the management process must be dynamic, its most important goal is not necessarily completion of project exactly as planned the principle aim should be to achieve the intended bjectives of the project in the best possible way and with the best possible result.

The following diagram shows the main activities of the dynamic cycle of the management process.

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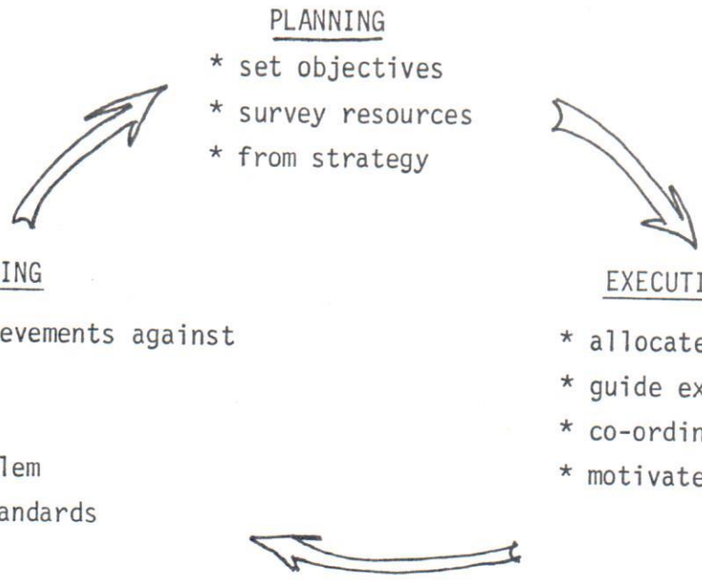
PLANNING
* set objectives
* survey resources
* from strategy
EXECUTING
* allocate resources
* guide executition
* co-ordinate ffort
* motivate staff
CONTROLLING
* Measure achievements against goals
* report
* resolve problem
* establish standards

.../..2

PLANNING

* Planning is the most challenging task faced by the "PROJECT MANAGEMENT".

Normally it involves all stages from briefing, designing, construction to commissioning.

Proper planning makes it possible to achieve the goals of the project completion in due time within the specified funds and time - by :

- Ensuring adequate resources are availble at the right moments(labour, materials, equipments).
- Ensuring adequate time is allowed for each stage in the process and that all various component activities start at the appropriate time.
- Ensuring the adequate funds are available in due time within the total budget.

PLANNING AND CONTROL TOOLS:

Planning and control are the major twin functions of the management responsibilities:

Characteristics of a good plan:

* It should be simple . the aim is to outline complex situations in a simple way.
* It should be flexible, it must be possible to alter certain elements of the plan without disrupting ~~disrapting~~ the entire plan and there must be a reasonable degree of slack built into the plan
* It should provide proper standards of expectations, by providing identified and quantified mile stones along the way so that easy control may be exercised.

PLANNING TOOLS:

There are many different tools and graphical techinques for the planning scheduling and control of operation and resources.

They range from , simple check lists and bar charts to sophisticated net work plans inculding inter-relation of different activities.

For almost all projects a bar chart is normally adequate.

Preporing the bar-chart planning we need to consider the following:

* Prepore a check list of the appropriate activities to be under taken.
* Analyse each item in the check list, considering when it needs to be carried out, and what length of time it requires.
* Indicate all activities on a bar-chart,all activities to listed in a col at left side of the diagram . A horizontal time scale extend to right of the list with line corresponding and each activity in the list.

Planning of project activities should cover the following major aspects:

* Time .
* Briefing and design capacity.
* Constructing and commissioning capacity.
* Supply of equipments and materials.
* Allocation of funds.
* Staffing.

- Global planning for realistic time-schedule is to be prepared by the project manager from the very begining of the early propect, stage. This will serve as basic framework within which all by activitities(mileston events) can be indicated.

Detailed time-schedule are prepared for all other different stages by the team respunsible of each stage.

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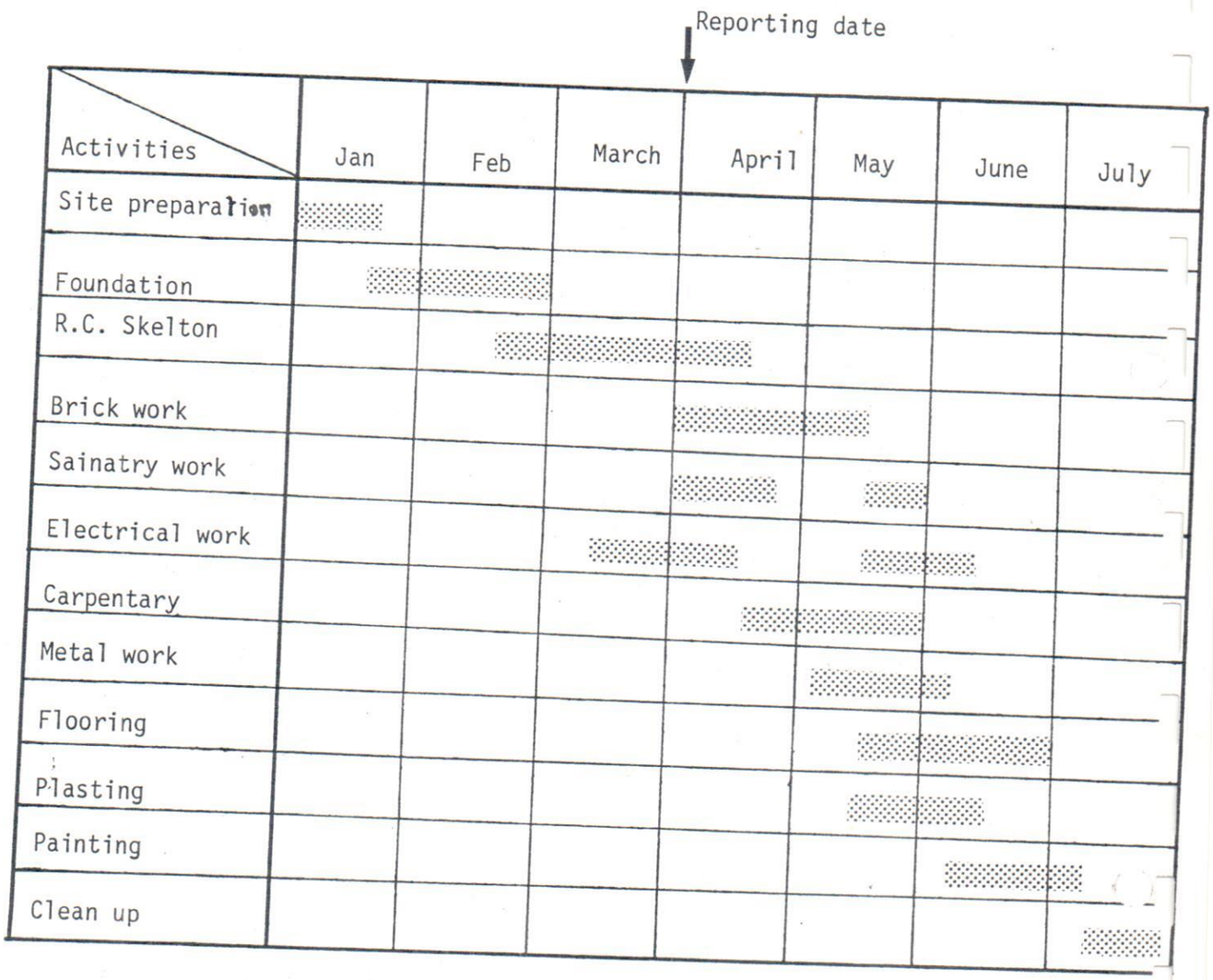
BAR CHART:

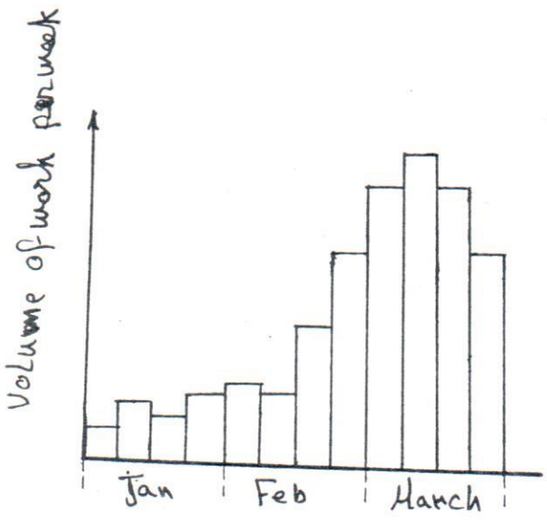


Simple form of bat chart

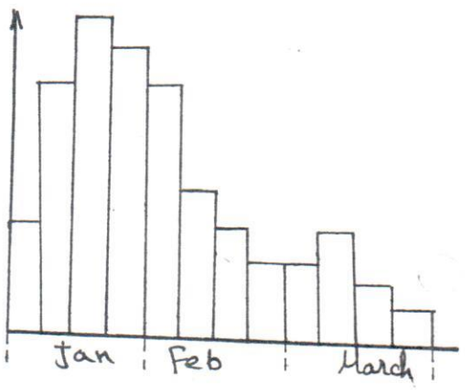
linear time-scaled for planning -(Linear progress-scaled for reporting).

Bar chart-time scaled for planning- variable progress for reporting.

Volume of work for any activity may not be evenly distributed over the period allocated. Bulk of work may be scheduled either late or early as shown in fig.



BULK OF WORK SCHEDULED LATE
Late



BULK OF WORK SCHEDULED EARLY
early

ADVANTAGES AND LIMITATION OF BAR CHARTS:

ADVANTAGES:

* Simple graphical form results in relatively easy general comperhension.
* equire less revision and up dating than more sophisticated systems.
* Very helpful in the turbulert early stages of the project when frequent revision are a fact of life.

LIMITATION:

* Because of their brood planning ,they become cumbusome as the No. of activities increases and required more streets.
* Logical inter connection and constiaints of the various activties in the project is not expressed in the diagtam .
* It is different to recognize sequence constraints unless subrtantial amount of documentation is included in the chart.

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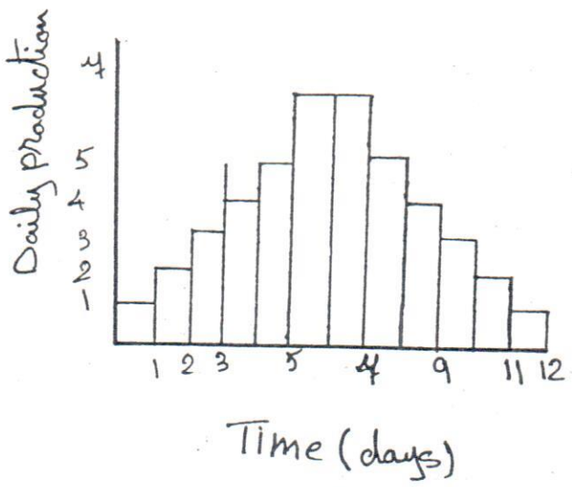
* It is difficult to usefor forcasting the effects that changes in particular activitiy will have on the ~~anual~~ overall schedule , or even to project the progress of an indivdual activtiy.

It is therefor limited on a control tool.

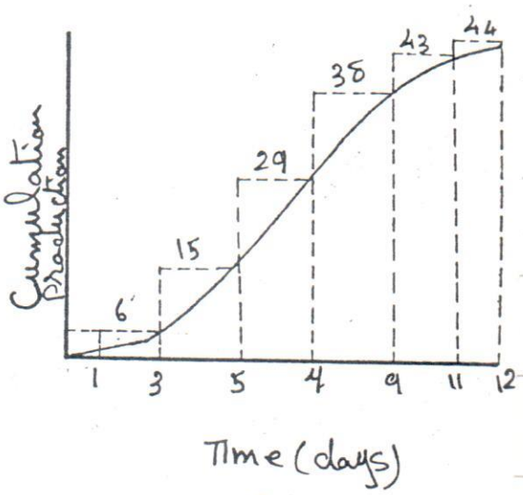
Progress urves can express some aspects of project plans.

Progress can be measured in terms of money expended, quantity of work , man hours expended, or any other measure which makes sense. This can be expressed in terms of actual units(pounds, per m2 ..etc.) or as a percentage if the estimated total quantity to be measured.

The shape of a typical progress curve, also called S curve result from integrating progress per unit of time(day, week, month) in order to obtain cumalative progress.



(1)



(2)

On most project volume of work per unit time tends to start slowly, built up to apeak, then taper off near the end . This is known as the boll shape distribution, fig (1) . The corresponding cumulative curve is the S curve.

Basic concepts of planning ,reporting and projecting progress are shown in the following fig.

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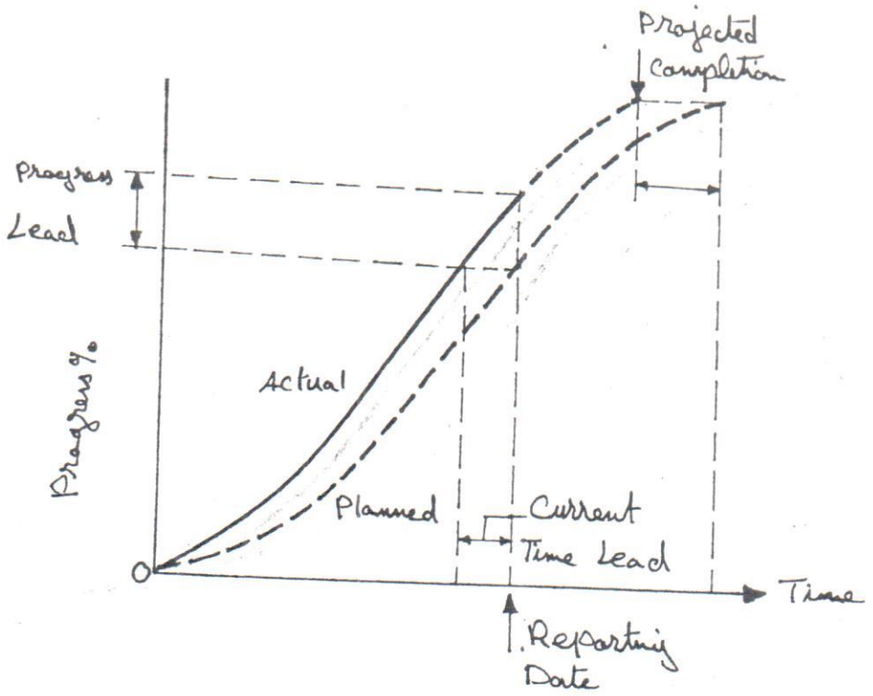
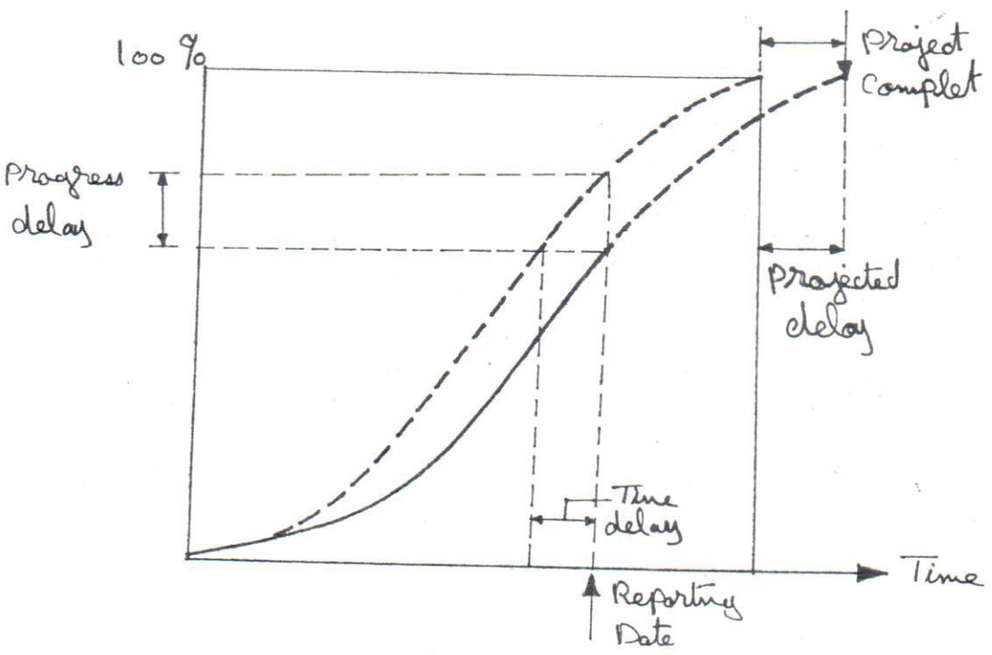

Projected completion
Progress
Lead
Progress %
Actual
Planned
Current
Time Lead
Time
Reporting
Date


100 %
Project
Complet
Progress
delay
projected
delay
Time
delay
Time
Reporting
Date

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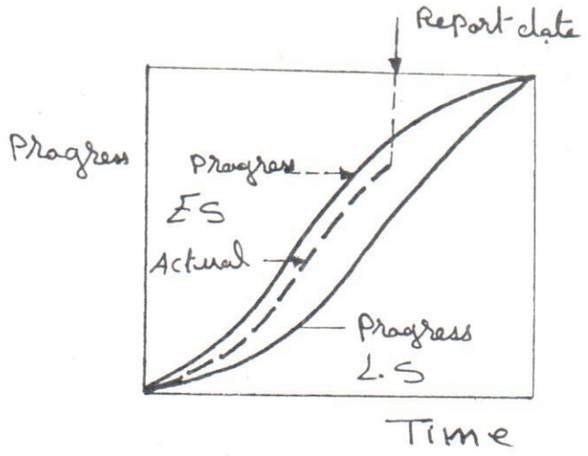
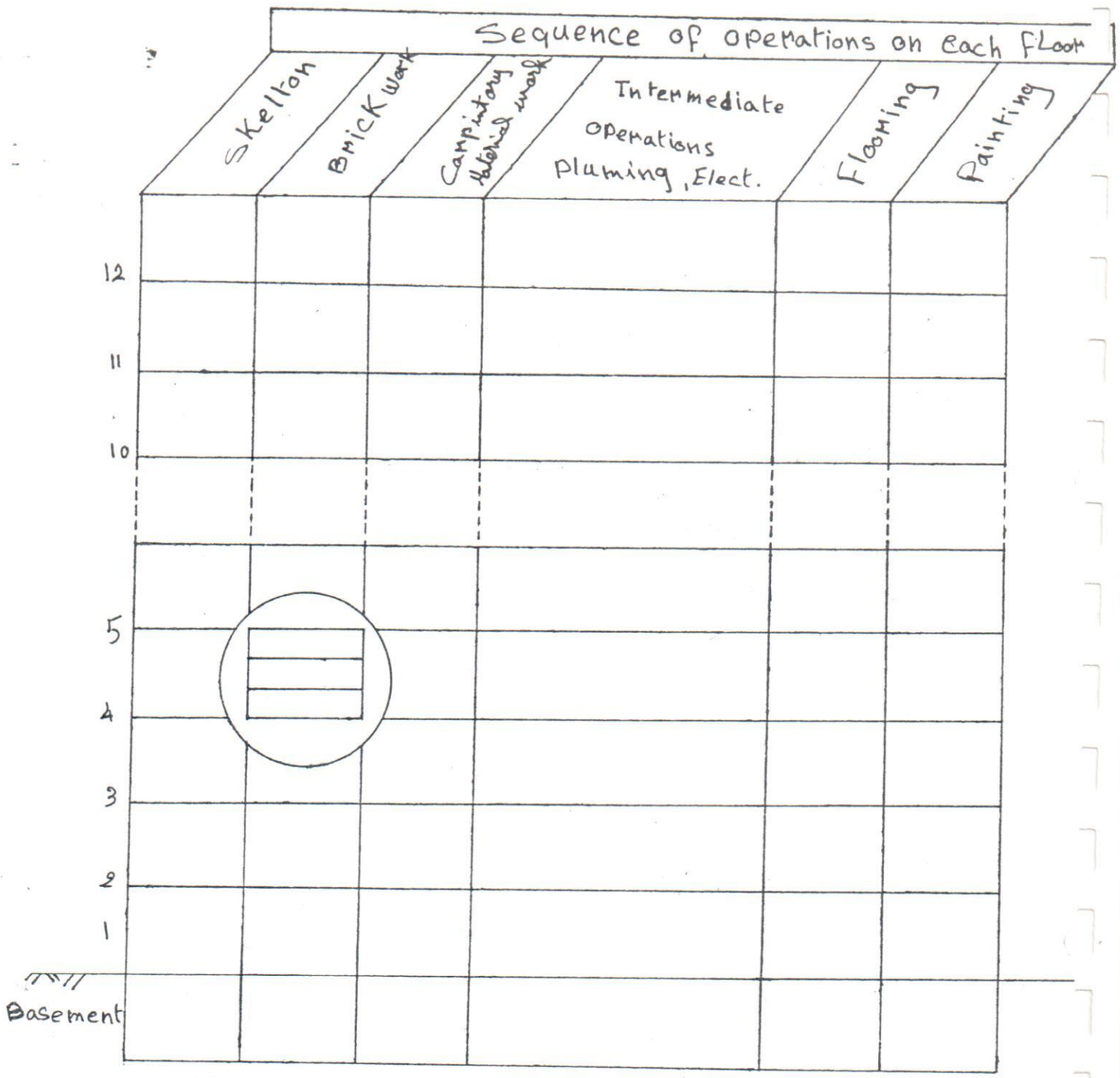
Progress curves may also be planned by considering early and late start, this will produce two S curves with the same start and end phints.



MATRIX SCHEDULE:

For projects containing repotying typical operation this matrix schedule is the simplest and quite effective for documenting and communicating a plan. It is fairly common on high-rise building .

...4.10



Scheduled start	14 - 4 - 81	20 - 4 - 81	Actual start
Scheduled finish	21 - 4 - 81	25 - 4 - 81	Actual finish
duration	4	5	duration

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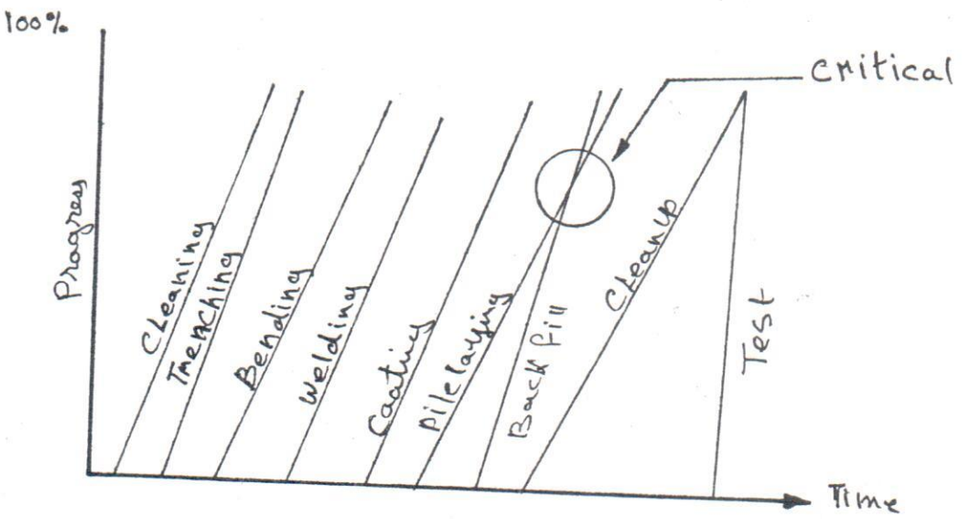
LINEAR BALANCE CHARTS:

This technique is also called vartical production method"VPM" and it is similar in concept to the line balance chart used by indutrial engineers for optimizing output on manufacturing production lines.

This method applies best to linear and repetitive operations such as pipelines, high ways, tunnels.

The cumulative progress of each trade, subcontract is plotted on the vertical axes; The horizontal axis plots time



For project with lenear sequence- as long as the slope of the following operation is the same or less the project should proceed satisfactory.

NET WORK - BASED SCHEDULES:

Beside the four alternative methods discussed for planning , the critical path net works and their related techniques for schedule, resource and cost analysis are still by far the most powerful analytical tools that we have for project planning and control.

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NET WORK CONCEPTS:

Essential eleinets in almost all project networks are:

Activities, thier duration and logical interrelationships among them. For each activity one can compute

Early start — Late start
" finish — " finish

Total float (slack),
free float.

From these computation, one can get the expected duration and focus attention upon the most critical activities and hence the critical path .

The CPM. (critcal path method) for construction management is a very useful and powerful tool for planning and control functions.

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Summary of CPM notations and equations .

NOTATIONS:

$D(x)$ = estimate of duration for activity x
$E^s(x)$ = earliest (expected) start time for activity x
$E^f(x)$ = " " finish " " " x
$L^s(x)$ = latest allowable start time " " x
$L^f(x)$ = total float for activity x
$FF(x)$ = free " " " x
S = project start time
T = target project completion time.

EQUATIONS FOR CALCULATING THE CPM PARAMETERS:

Forward pass

$ES_{(x)}$ = S for begining activities or
= max.(EF (all predecessors of activity x)
$EF_{(x)} = ES_{(x)} + D_{(x)}$

Backward pass

$LF_{(x)}$ = T for ending activities or
= Min (LS (all followers of activity x))

$LS_{(x)} = LF_{(x)} - D_{(x)}$

Floats

$TF_{(x)} = LS_{(x)} - ES_{(x)}$
$= LF_{(x)} - EF_{(x)}$
$FF_{(x)}$ = Min. (ES (all immediate followers of activity x)) - E.F $_{(x)}$.

Critical path is a continuous chain of activities with the min. total float value. By summring activity durations, it is the longest duration path through the net work.

There may be more than one critical parts of the net work.

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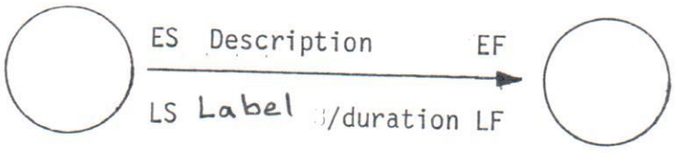
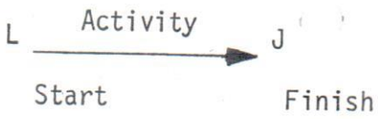
GRAPHICAL REPRESENTATION:

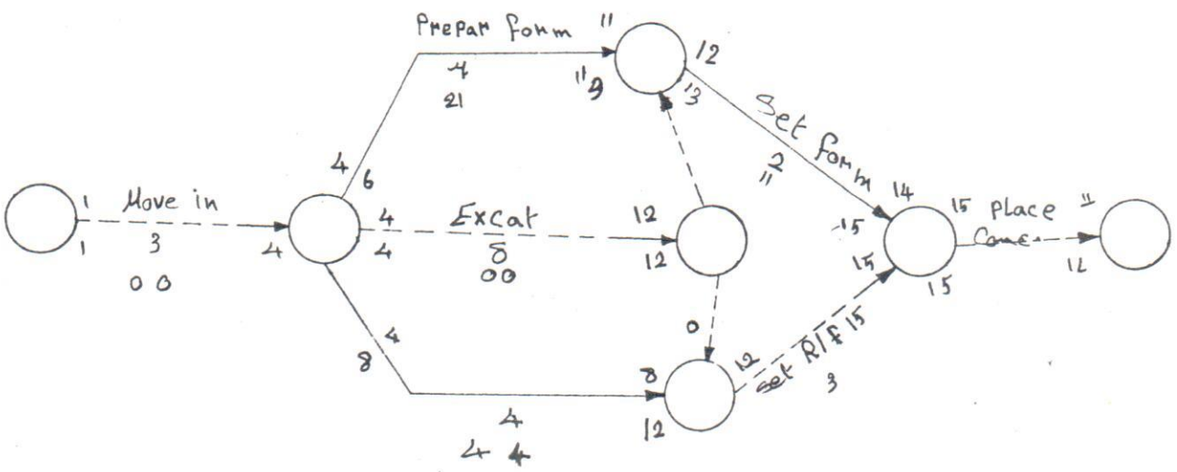
CPM has two basic types of graphica representation.

* Arrow or L,J notation.
* Precedence notation.

Arrow is L,J notation.







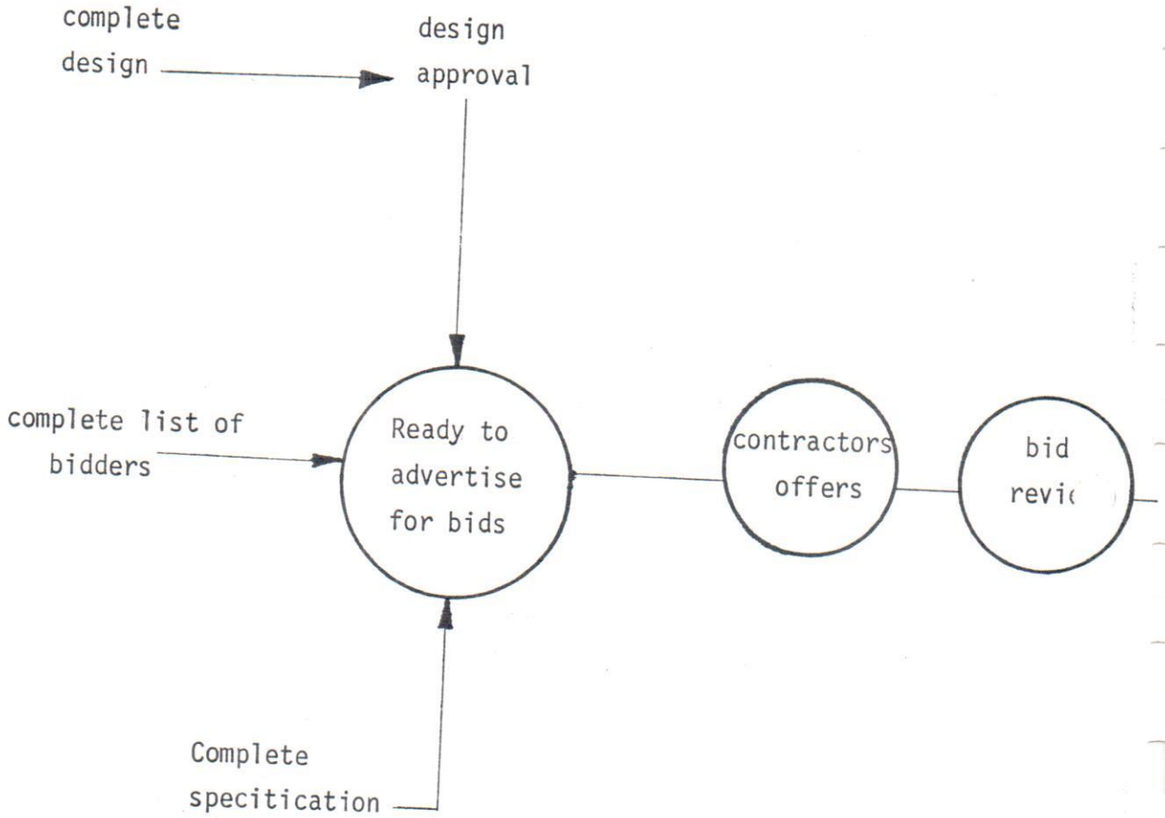
---- CRITICAL PATH

EVENTS:

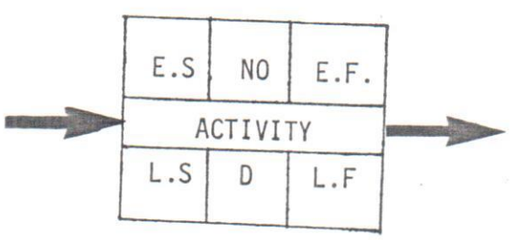
The intersection of two or more activity airows is termed an events.

All activities leading into an event must be completed befor any of activities leading out of the event can be started .

Certain key events are called milestones events.



PRECEDENCE DIAGRAM



PREPARING AND NET WORK:

- A good planner include the needs of users.
- There are strong parallels between estimating and net work planning, they are interdependent functions.

The general procedure to prepare and net work may be listed as follows:

1- Begin by learning all you can about the project itself, Study plans specifications, site reconnaissacne . Seek input from all key parties known to be involved in planning or execution of the project. These can be the owner's representative, designer, contractors, and sub. contractors, major suppliers, labour organization, local regulations, and of course the professionalconstruction manager's own staff designatedfor the project.

2- Make a preliminary listing of some key activities and milestones events.

3- Put a key activity on the diagram, (any act.) made a start.
4- Ask yourself the following questions;

- What must be completed immediately befor this activity can start?
- What activity can follow once its activity is complete?

5- Put these new activities on the diagram .
6- Report step 4x5 until you have a reseasnobly comperhensive diagram o. the project.
7- Re examine the plans, specifications to ensure that all parts of the project are covered .
8- Check and duble check the logic and contents(dummies in arrow network can be a source of eiror) be sure each activity has an intentionally defined start and finish point.
9- Befor drafting the final version of the network recheck it with those parties consulted for the input in step_1 - to be sure it represent thinking . This step is particularly important, it is useless to impore an unworkable schedule an the people responsible for the execution of the project.

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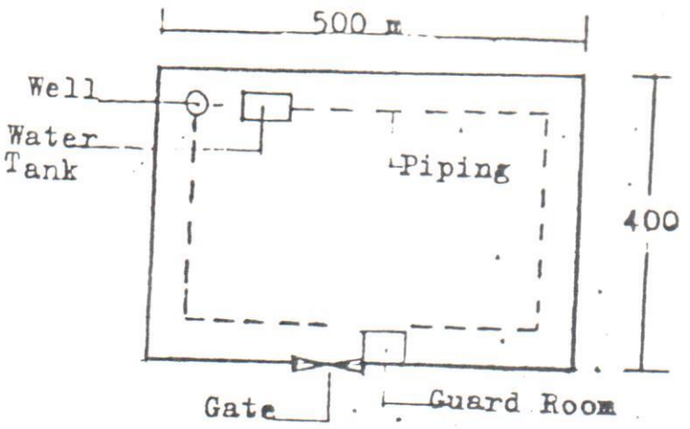
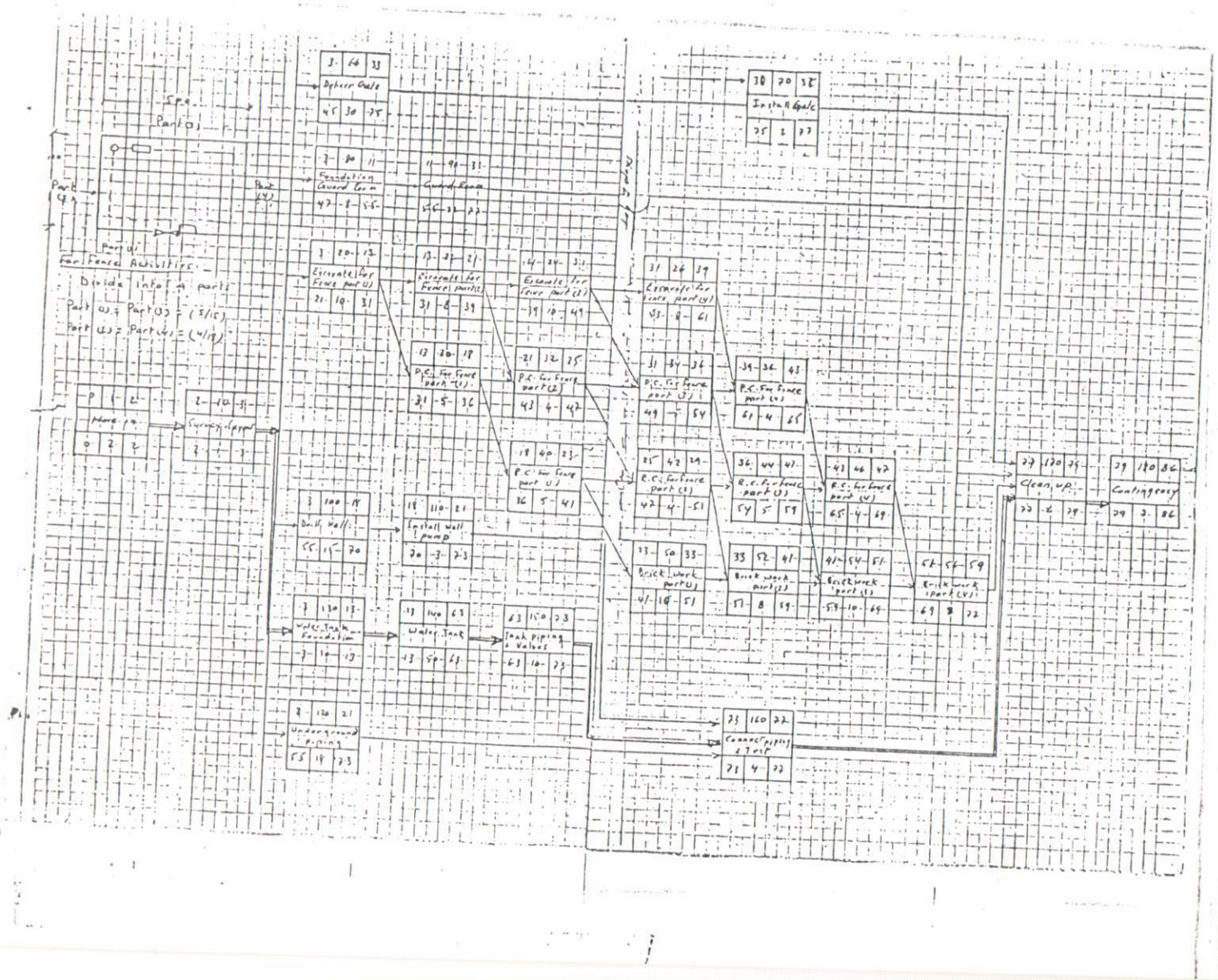
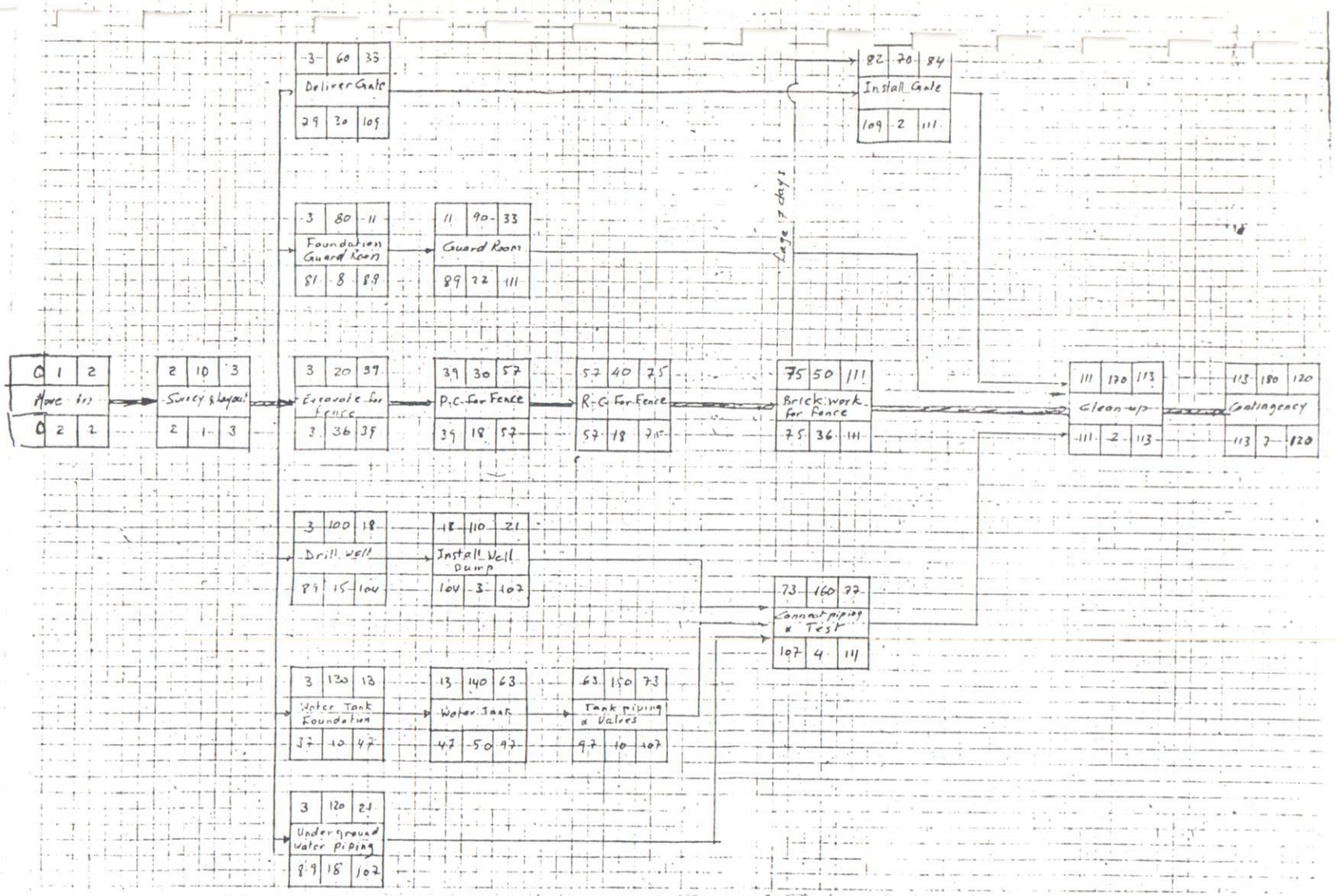


Fig. I

Table I : Main Activities

Activity	No.	Duration (days)
Move in	1	2
Survey & layout	10	1
Excavate for fence	20	36
P.C. for fence	30	18
R.C. for fence - semelles	40	18
Brick work for fence	50	36
Deliver Gate	60	30
Install Gate	70	2
Foundation for Guard Room	80	8
Guard Room	90	22
Drill Well	100	15
Install well pump	110	3
Underground water piping	120	18
Water tank foundation	130	10
Water Tank	140	50
Tank piping & valves	150	10
Connect piping & test	160	4
Clean up	170	2
Contingency	180	7


Part (1)
Part (2)
Part (3)
Part (4)
Part (5)
For Fence Activities
Divide into 4 parts
Part (1) = Part (3) = 1/4 (3/12)
Part (2) = Part (4) = (4/12)
Move to
Excavate for Fence part (1)
Excavate for Fence part (2)
Excavate for Fence part (3)
Excavate for Fence part (4)
P.C. for Fence part (1)
P.C. for Fence part (2)
P.C. for Fence part (3)
P.C. for Fence part (4)
R.C. for Fence part (1)
R.C. for Fence part (2)
R.C. for Fence part (3)
R.C. for Fence part (4)
Brick work part (1)
Brick work part (2)
Brick work part (3)
Brick work part (4)
Dig Foundation
Foundation Concrete
Build Wall
Install Wall pump
Water Tank Foundation
Water Tank
Tank Piping & Valves
Underground piping
Connect piping & Test
Clean up
Contingency


Mobe in
Survey & layout
Excavate for fence
P.C. for Fence
R.C. for Fence
Brick work for Fence
Clean up
Contingency
Deliver Gate
Install Gate
Foundation Guard Room
Guard Room
Drill well
Install Well Pump
Water Tank Foundation
Water Tank
Tank piping & Valves
Underground water piping
Connect piping & Test
Lags 7 days

ACTIVITY SCHEDULE REPORT

PICKING CRITERIA: NONE
TIME WINDOW: FINISH TO FINISH

SORTING CRITERION: ES

EVENT PREC	EVENT SUCC	DESCRIPTION	DURATION DAYS	MILE	EARLIEST START	EARLIEST FINISH	LATEST START	LATEST FINISH	TF	FREE	IF
5	10	MOVE-IN	2.0	0	24JAN82+ 0.0	25JAN82+ 8.0	24JAN82+ 0.0	25JAN82+ 8.0	0	0.00	0
10	20	SURVEY,LAYOUT	1.0	0	26JAN82+ 0.0	26JAN82+ 8.0	26JAN82+ 0.0	26JAN82+ 8.0	0	0.00	0
20	30	EXCAVATE-FOR-FENCE	36.0	0	27JAN82+ 0.0	9MAR82+ 8.0	27JAN82+ 0.0	9MAR82+ 8.0	0	0.00	0
20	140	WATER-TANK-FOUNDATIO	10.0	0	27JAN82+ 0.0	7FEB82+ 8.0	13MAR82+ 0.0	23MAR82+ 8.0	0	0.00	0
20	80	DELIVER-GATE	30.0	0	27JAN82+ 0.0	2MAR82+ 8.0	17MAR82+ 0.0	20APR82+ 8.0	0	0.00	0
20	90	FOUND-FOR-GUARD-ROOM	8.0	0	27JAN82+ 0.0	4FEB82+ 8.0	28APR82+ 0.0	6MAY82+ 8.0	0	0.00	0
20	130	UNDERGR-WATER-PIPING	18.0	0	27JAN82+ 0.0	16FEB82+ 8.0	8MAY82+ 0.0	27MAY82+ 8.0	0	0.00	0
20	110	DRILL-WELL	15.0	0	27JAN82+ 0.0	13FEB82+ 8.0	12MAY82+ 0.0	29MAY82+ 8.0	0	0.00	0
90	100	GUARD-ROOM	22.0	0	6FEB82+ 0.0	2MAR82+ 8.0	8MAY82+ 0.0	1JUN82+ 8.0	0	0.00	0
140	150	WATER-TANK	30.0	0	8FEB82+ 0.0	6APR82+ 8.0	24MAR82+ 0.0	20MAY82+ 8.0	0	0.00	0
110	120	INSTALL-WELL-PUMP	3.0	0	14FEB82+ 0.0	16FEB82+ 8.0	30MAY82+ 0.0	1JUN82+ 8.0	0	0.00	0
120	170	DUMMY	0.0	0	16FEB82+ 8.0	16FEB82+ 8.0	1JUN82+ 8.0	1JUN82+ 8.0	0	0.00	0
130	170	CONNECT-PIPING,TEST	4.0	0	17FEB82+ 0.0	21FEB82+ 8.0	29MAY82+ 0.0	1JUN82+ 8.0	5	90.00	5
80	50	DUMMY	0.0	0	2MAR82+ 8.0	2MAR82+ 8.0	20APR82+ 8.0	20APR82+ 8.0	4	86.00	4
100	170	DUMMY	0.0	0	2MAR82+ 8.0	2MAR82+ 8.0	1JUN82+ 8.0	1JUN82+ 8.0	4	42.00	4
30	40	P.C-FOR-FENCE	18.0	0	10MAR82+ 0.0	30MAR82+ 8.0	10MAR82+ 0.0	30MAR82+ 8.0	3	78.00	3
40	50	R.C-FOR-FENCE	18.0	0	31MAR82+ 0.0	20APR82+ 8.0	31MAR82+ 0.0	20APR82+ 8.0	0	0.00	0
150	160	TANK-PIPING,VALVES	10.0	0	7APR82+ 0.0	18APR82+ 8.0	22MAY82+ 0.0	1JUN82+ 8.0	0	0.00	0
160	170	DUMMY	0.0	0	18APR82+ 8.0	18APR82+ 8.0	1JUN82+ 8.0	1JUN82+ 8.0	0	0.00	0
50	70	INSTALL-GATE	9.0	0	21APR82+ 0.0	1MAY82+ 8.0	23MAY82+ 0.0	1JUN82+ 8.0	3	38.00	3
50	60	BRICK-WORK-FOR-FENCE	36.0	0	21APR82+ 0.0	1JUN82+ 8.0	21APR82+ 0.0	1JUN82+ 8.0	0	0.00	0
70	170	DUMMY	0.0	0	1MAY82+ 8.0	1MAY82+ 8.0	1JUN82+ 8.0	1JUN82+ 8.0	0	0.00	0
60	170	DUMMY	0.0	0	1JUN82+ 8.0	1JUN82+ 8.0	1JUN82+ 8.0	1JUN82+ 8.0	3	27.00	3
170	180	CLEAN-UP	2.0	0	2JUN82+ 0.0	3JUN82+ 8.0	2JUN82+ 0.0	3JUN82+ 8.0	0	0.00	0
180	190	CONTINGENCY	7.0	0	5JUN82+ 0.0	12JUN82+ 8.0	5JUN82+ 0.0	12JUN82+ 8.0	0	0.00	0

TOTAL NUMBER OF ACTIVITIES IN THIS REPORT IS 25

TOTAL TIME TO FINISH IS 120.0 DAYS
OCCURRING ON 12JUN82+ 8.0

BAR CHART

PICKING CRITERIA: MOVE
TIME WINDOW: FINISH TO FINISH

SORTING CRITERION: ES

ROW SHEET

		ACTIVITY
5	10	MOVE-IN
10	20	SURVEY,LAYOUT
20	30	EXCAVATE-FOR-FENCE
20	140	WATER-TANK-FOUNDATIO
20	80	DELIVER-GATE
20	90	FOUND-FOR-GUARD-ROOM
20	130	UNDERGR-WATER-PIPING
20	110	DRILL-WELL
90	100	GUARD-ROOM
140	150	WATER-TANK
110	120	INSTALL-WELL-PUMP
130	170	CONNECT-PIPING,TEST
30	40	F C-FOR-FENCE
40	50	A C-FOR-FENCE
150	160	TANK-PIPING,VALVES
50	70	INSTALL-GATE
50	60	BRICK-WORK-FOR-FENCE
170	180	CLEAN-UP
180	190	CONTINGENCY

TIME IN DAYS

 CONTENTS OF CPM INPUT FILE HOSNY

CURRENT MASTER FILE IS: HOSNY

CONTAINING THE FOLLOWING SPECIFICATIONS--

TITLE: EXAMPLE 1
NETWORK NOTATION: IJ
TIME UNITS: DAYS

OPTIONS SPECIFIED FOR RUN:
CALENDAR DATING: YES
START DATE 24JAN82 WORKING 8.0 HRS/DAY ON MON TUE WED THU SAT SUN
PROJECT FINISH TARGET: NO

DATA ANALYSED YET: YES

 CONTENTS OF CPM INPUT FILE HOSNY

NMBR		NAME				DEPT		DUR	MILE	COS1	COS2	COS3	COS4	TARS	TARF	COMP	%
		RES1	RES2	RES3	RES4	RES5	RES6	RES7	RES8	RES9	RES10						
5	10	MOVE-IN						2.0		0.0	0.0	0.0	0.0	RES	RES	RES	0.00
		0	0	0	0	0	0	0	0	0	0						
10	20	SURVEY/LAYOUT						1.0		0.0	0.0	0.0	0.0	RES	RES	RES	0.00
		0	0	0	0	0	0	0	0	0	0						
20	30	EXCAVATE-FOR-FENCE						36.0		0.0	0.0	0.0	0.0	RES	RES	RES	0.00
		0	0	0	0	0	0	0	0	0	0						
20	60	DELIVER-GATE						30.0		0.0	0.0	0.0	0.0	RES	RES	RES	0.00
		0	0	0	0	0	0	0	0	0	0						
20	90	POUND-FOR-GUARD-ROOM						8.0		0 0	0.0	0.0	0.0	RES	RES	RES	0.00
		0	0	0	0	0	0	0	0	0	0						
20	110	DRILL-WELL						15.0		0 0	0.0	0.0	0.0	RES	RES	RES	0.00
		0	0	0	0	0	0	0	0	0	0						
20	140	WATER-TANK-FOUNDATIO						10.0		0.0	0.0	0.0	0.0	RES	RES	RES	0.00
		0	0	0	0	0	0	0	0	0	0						
20	130	UNDERGR-WATER-PIPING						18.0		0 0	0.0	0.0	0.0	RES	RES	RES	0.00
		0	0	0	0	0	0	0	0	0	0						
30	40	P.C-FOR-FENCE						18.0		0.0	0.0	0.0	0.0	RES	RES	RES	0.00
		0	0	0	0	0	0	0	0	0	0						
40	50	P.C-FOR-FENCE						18.0		0.0	0.0	0.0	0.0	RES	RES	RES	0.00
		0	0	0	0	0	0	0	0	0	0						
50	80	BRICK-WORK-FOR-FENCE						36.0		0 0	0.0	0.0	0.0	RES	RES	RES	0.00
		0	0	0	0	0	0	0	0	0	0						
50	70	INSTALL-GATE						9.0		0 0	0.0	0.0	0.0	RES	RES	RES	0.00
		0	0	0	0	0	0	0	0	0	0						