Network technique (the CPM/PERT method)

To illustrate this method is shown a practical example.

The system is divided in 2 phases:

1. Logical planning
2. Time calculation

### Logical planning

The logical planning embrace a planning of the flow of work so you get a clearly picture of the specific process dependence of each other, that is you make a graphical construction of the flow of the building process.

Example: Excavation- and concrete work

Activities: B1 Leveling and removal of mould

B2 Performance of shuttering

A2 Excavation

C2 Sewerage

C3 Drain laying

A3 Placing of shuttering

A4 Casting

A5 Striking

B6 Casting of ground deck

Out of these activities it is now possible to set up a logical working plan:



Now you had made an order for the working processes where it is possible to see which activity that had to be finished before the next one can start.

### Time calculation

The next thing to take notice of is the duration of the activities. Here among other things must following topics be included in the calculations:

1. Equipments (which have one's disposal)
2. Materials (including time of delivery)
3. Personnel (can among other things be calculated from the calculated prices)
4. Season (weather – the winter period has more loss of days than the summer period)

Of cause the decision of time must depend on an estimate and also on experiences from other similar building activities (dg = days).



From these durations the earliest time of finishing can be calculated by the aid of following the different traces from start and calculate forwards.



The time of finishing is now determined and a backwards calculation can be done, that is you begin with the end of time and calculate backwards from this. By calculating it would always be the lowest value of time that should be returned.



By looking at the different activities one can see that some of them had a freedom of action to say that there could occur delays which means nothing for the finalization of the building activities.

This freedom of action is named *total slack*, and on the path without *total slack* we have the **critical path**.

None of the activities on the critical path may be delayed, otherwise the total process would be delayed.

### Slack

One had to distinguish between three forms for the slack of the activity, namely:

1. Total slack
2. Free slack
3. Independent slack

Ad 1) *Total slack*

All *predecessors* started as *early as possible*.

All *successors* started as *late as possible*.

Ad 2) *Free slack*

All *predecessors* started as *early as possible*.

All *successors* started as *early as possible*.

Ad 3) *Independent slack*

All *predecessors* started as *late as possible*.

All *successors* started as *early as possible*.

To obtain uniform symbols within the Network planning the following are used:

A, B: Activity

d: Duration of activity (Ad, Bd...)

Ets: Earliest time of start (ts)

Etf: Earliest time of final (tf)

Lts: Latest time of start (ts)

Ltf: Latest time of final (tf)

Ts: Total slack

Fs: Free slack

Is: Independent slack

BEts BEtf

B

Bd

BLts BLtf

AEts AEtf

A

Ad

ALts ALtf

etc..…….

Ts Fs Is Ts Fs Is

It is **very important** that the designations is placed the indicated places in the box of the activity.

### Calculation of slaks

Total slack: ATs = ALtf – AEtf

Free slack: AFs = BEts – AEtf

Independent slack: BIs = CEts – Bd – ALtf

The finished diagram look like this (bold arrow = critical path):



The calculated results can be entered into a scheme:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Act. no. | Activity | Duration | Earliest | | Latest | | Slack | | |
|  | | | Start | End | Start | End | Total | Free | Independent |
| B1 | Levelling and removal of mould | 2 | 0 | 2 | 0 | 2 | 0 | 0 | 0 |
| B2 | Performance of shuttering | 2 | 2 | 4 | 3 | 5 | 1 | 1 | 1 |
| A2 | Excavation | 3 | 2 | 5 | 2 | 5 | 0 | 0 | 0 |
| C2 | Sewerage | 4 | 2 | 6 | 4 | 8 | 2 | 0 | 0 |
| C3 | Drain laying | 1 | 6 | 7 | 8 | 9 | 2 | 0 | 2 |
| A3 | Placing of shuttering | 2 | 5 | 7 | 5 | 7 | 0 | 0 | 0 |
| A4 | Casting | 1 | 7 | 8 | 7 | 8 | 0 | 0 | 0 |
| A5 | Striking | 1 | 8 | 9 | 8 | 9 | 0 | 0 | 0 |
| B6 | Casting of ground deck | 3 | 9 | 12 | 9 | 12 | 0 | 0 | 0 |