Basics of time scheduling

What is a time schedule?

- Why?
  - There are lots of processes during a construction project
  - Some hundreds of people are involved
  - These have to be harmonised in space and in time

- Types of processes
  - Design processes
  - Realisation processes (purchase/preparation of materials)
  - Authority procedures
  - Handover-takeover procedure, permission of use...
What is a time schedule?

- Affecting factors:
  - Law, regulation;
  - Financing;
  - Technology;
  - Resources...

- Time and...
  - Money: Financial schedule, cash-flow
  - Quality: Quality control plan
  - Resources: human, machine, material, money...

What is a time schedule?

- Purposes and aims
  - To give the duration of a project/construction
  - To expose likely difficulties of the future, and help to solve them
  - To minimize the unproductive time of men and machines
  - To use as a control tool

Plan → Organise → Manage → Control

The time plan has to be detailed (and accurate) enough for the actual use – project manager, construction manager, general foreman, skilled workers, etc.
What is a time schedule?

- Types of schedules – according to elaboration (during a building project)
  - The later it is made, the more accurate and detailed it can be
  - Time scale >
  - Number of activities <

„Time planning“
Information needed

- What to do?
  - Operations, activities;
  - Events;
  - Quality and quantity.

- How to do it?
  - Technology;
  - Type of labour (trades);
  - Type of machine, equipment;
  - Subcontractors.

- Costs?

Information incorporated:

- Duration of activities or time span available
- Contents on technology (how?)
- Time-Space correspondence
- Sequence based on technologies
- Milestones: starting and finishing dates → whole duration
- Partial payments, cash-flow
Standards: tools for estimating time required for the processes

- Performance standard [time/unit] (h/m³, h/m²...)
- Standard output [unit/time] (m³/h, pcs/h)
- The standards are determined by statistical/technical analysis, by measuring and comparing former performance.
- The standards have to be adjusted to the actual circumstances (location, resources, ...)

Example: partition making (ceramic blocks) 27m²

\[
\text{Volume [unit]} \times \text{Performance standard [time/unit]} = \text{Work [time]}
\]

\[
27 \text{m}^2 \times 0.56 \text{h/m}^2 = 15.12 \text{ h}
\]

\[
\text{Work [time]} \div \text{Allocated resource [unit]} = \text{Duration [time]}
\]

\[
15.12 \text{ h} \div 3 \text{ workers} = 5.04 \text{ h} \Rightarrow 1 \text{ day (8h/day)}
\]
Example: partition making (ceramic blocks) $27m^2$

\[
\text{Work [time]} = \frac{\text{Volume [unit]}}{\text{Standard output [unit/time]}}
\]

$27m^2 \times \frac{0.56h/m^2}{\text{Work [time]}} = 15.12\ h$

Duration [time] = \frac{\text{Work [time]}}{\text{Allocated resource [unit]}}

Result information:
- Operation (task), Quantity
- Labour / equipment, quantity
- Duration

From these results
- the time-plan,
- the labour schedule,
- the equipment (plant) schedule,
- the material schedule,
- and the payment schedule can be made.

Connections between operations:
- Consecutive
- Parallel
- Overlapping
Timetable (tabular or alpha-numerical schedule)

- Data given with numbers - dates
- Exact, but difficult to see the current status

Example: a retaining wall

<table>
<thead>
<tr>
<th>ID</th>
<th>Activity</th>
<th>Time</th>
<th>Start</th>
<th>Finish</th>
<th>Labour</th>
<th>Machine</th>
<th>Cost</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Demolish top soil</td>
<td>2 d</td>
<td>02-04-10</td>
<td>03-04-10</td>
<td>1</td>
<td>build.</td>
<td>€...</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Excavating trench</td>
<td>2 d</td>
<td>04-04-10</td>
<td>05-04-10</td>
<td>3</td>
<td>backhoe.</td>
<td>€...</td>
<td>15% labr.</td>
</tr>
<tr>
<td>3</td>
<td>Blinding</td>
<td>3 d</td>
<td>06-04-10</td>
<td>08-04-10</td>
<td>5</td>
<td>labr.</td>
<td>€...</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Formwork (foundation slab)</td>
<td>3 d</td>
<td>08-04-10</td>
<td>10-04-10</td>
<td>2</td>
<td>carp.</td>
<td>€...</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Reinforcement (foundation slab)</td>
<td>5 d</td>
<td>08-04-10</td>
<td>12-04-10</td>
<td>4</td>
<td>steel.</td>
<td>€...</td>
<td>35% prefabr.</td>
</tr>
</tbody>
</table>
**Time schedule representation**

Bar chart – Gantt chart
- Most widely used technique
- A list of project elements (+other information) – duration visualised
- Easy to see the current status – „today”

<table>
<thead>
<tr>
<th>ID</th>
<th>Activity</th>
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<th>Labour</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
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<td>1</td>
<td>Demolish top soil</td>
<td>2 d</td>
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<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>2</td>
<td>Excavating trench</td>
<td>2 d</td>
<td>3 labr.</td>
<td></td>
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<tr>
<td>4</td>
<td>Formwork (foundation slab)</td>
<td>3 d</td>
<td>2 carp.</td>
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</tbody>
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**Time schedule representation**

Bar chart – Gantt chart
- Resource management: workers, equipment

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<th>1</th>
<th>2</th>
<th>3</th>
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<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Demolish top soil</td>
<td>2 d</td>
<td>1 labr.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2</td>
<td>Excavating trench</td>
<td>2 d</td>
<td>3 labr.</td>
<td></td>
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<td>Blinding</td>
<td>3 d</td>
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<td>4</td>
<td>Formwork (foundation slab)</td>
<td>3 d</td>
<td>2 carp.</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Reinforcement (foundation slab)</td>
<td>5 d</td>
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</tr>
<tr>
<td></td>
<td>Bulldozer</td>
<td>2 d</td>
<td></td>
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<tr>
<td></td>
<td>Backhoe</td>
<td>2 d</td>
<td></td>
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<tr>
<td></td>
<td>Labour</td>
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<td>1 1 3 3 5 5 11 6 6 4 4</td>
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</tbody>
</table>
Linear schedule – Cyclogram
- It shows progress: space and time
- It consists of two scales – one for time (e.g. days, weeks,…) and one for space (+tabular info)

<table>
<thead>
<tr>
<th>ID</th>
<th>Activity</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Formwork - slab</td>
<td>8 d</td>
</tr>
<tr>
<td>2</td>
<td>Reinforcement - s</td>
<td>12 d</td>
</tr>
<tr>
<td>3</td>
<td>Concrete - s</td>
<td>12 d</td>
</tr>
<tr>
<td>4</td>
<td>Remove formwork - s</td>
<td>4 d</td>
</tr>
<tr>
<td>5</td>
<td>Formwork - wall</td>
<td>8 d</td>
</tr>
<tr>
<td>6</td>
<td>Reinforcement - w</td>
<td>12 d</td>
</tr>
<tr>
<td>7</td>
<td>Concrete - w</td>
<td>12 d</td>
</tr>
<tr>
<td>8</td>
<td>Remove formwork - w</td>
<td>4 d</td>
</tr>
</tbody>
</table>

Network diagram
- It contains information about relations of activities
- Easy to see the activities that affect the finishing time of the whole project (critical path), and activities that can have lag (delay).
- Two types of network diagrams:
  - activity on arrow (AOA) CPM
  - activity on node (AON) – these are generally easier to create and interpret. (MPM)
**Time schedule representation**

**Network diagram – MPM network**

- Information about activities:
  - Starting date(s)
  - Finishing date(s)
  - Float (slack)

- Information about relations of activities:
  - Finish-Start
  - Start-Start
  - Finish-Finish...

**Time schedule representation**

**Network diagram**

- Activity on node (AON) network

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Network diagram with activities and their durations, relationships, and float calculations.