

## 2.2. CRITICAL WORKS and CRITICAL PATHS.

Let us slightly complicate the example from the previous lecture. We consider a construction of a house. Now we will study 4 activities: A is a construction of a foundation, B is a construction of a room 1, C is a construction of a room 2, D is roofing.

The table of followers has the following form:

Activities	Duration (days)	Activities-followers
A	5	B, C
B	8	D
C	6	D
D	4	–

The table of predecessors has the following form.

Activities	Predecessors
A	–
B	A
C	A
D	B, C

The work D has two direct predecessors. It is not possible to start this task before both tasks B and C are completed. The corresponding Gantt diagram is given below.

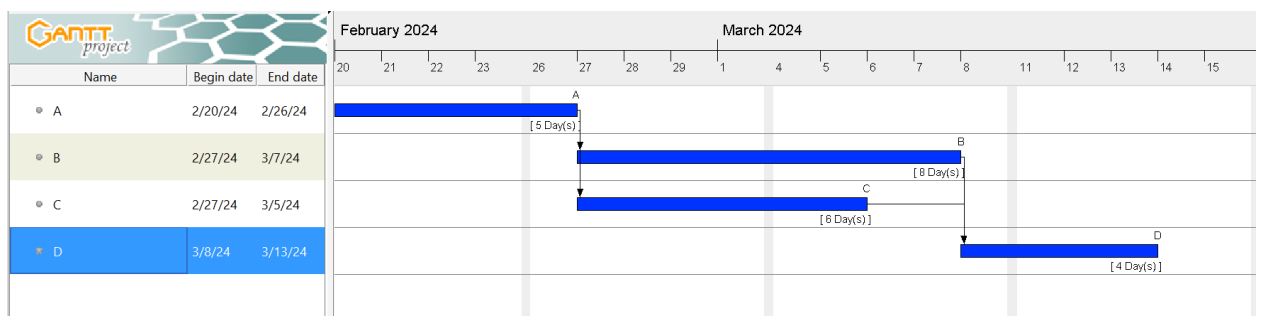


Fig. 2.8. Gantt chart for the critical path example

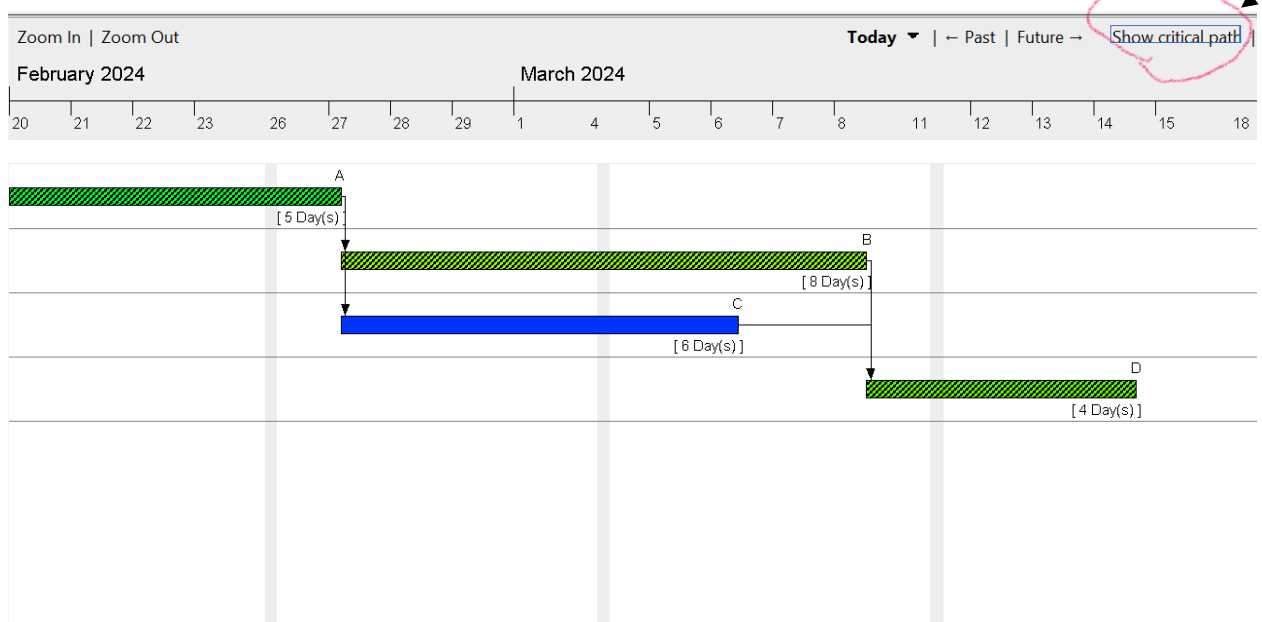
Often there is a question of reducing project deadlines. This is a classic time management problem. And here the definition of critical work is the most important.

**Definition 2.6.** A task (work, job, activity, stage) of a project is called a **critical task** if its completion cannot be extended in time or delayed without increasing the duration of the entire project.

Let's look at Figure 2.8. From the point of view of reducing the overall project duration, it is pointless to seek to reduce the durations of work C. At the same time, reducing the durations of the steps defined by activities A, B, D will lead to a reduction in the project duration.

**Definition 2.7.** The **critical path** of a network schedule is the complete path from the initial event to the final event (the end of the last task) that has the longest length (duration) of all complete paths. Its time length determines the completion time of all activities in the network schedule.

The "Show critical path" button in the upper right part of the GanttProject program allows you to highlight the critical path. In the diagram below, the relevant activities are highlighted in green. Together, these activities form a critical path.



*Fig. 2.9. Gantt chart with critical tasks*

Note that when trying to reduce the total duration of the project by reducing the duration of one or more network tasks, it is possible to change the critical path by changing the critical tasks included in it. For example, if the duration of activity B is reduced up to 5 days, then activity C will become critical and the critical path will change.

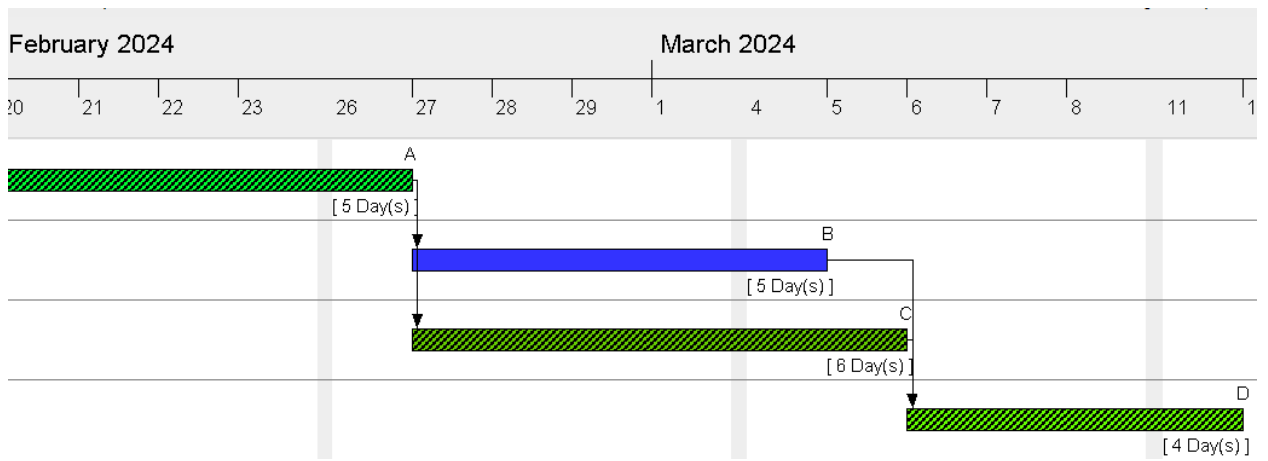


Fig. 2.10. New critical path

Note also that a critical path in a project may not be a single one. For example, if the duration of task B is also 6 days, we will have two critical paths, one of which includes task B and the other one includes task C.

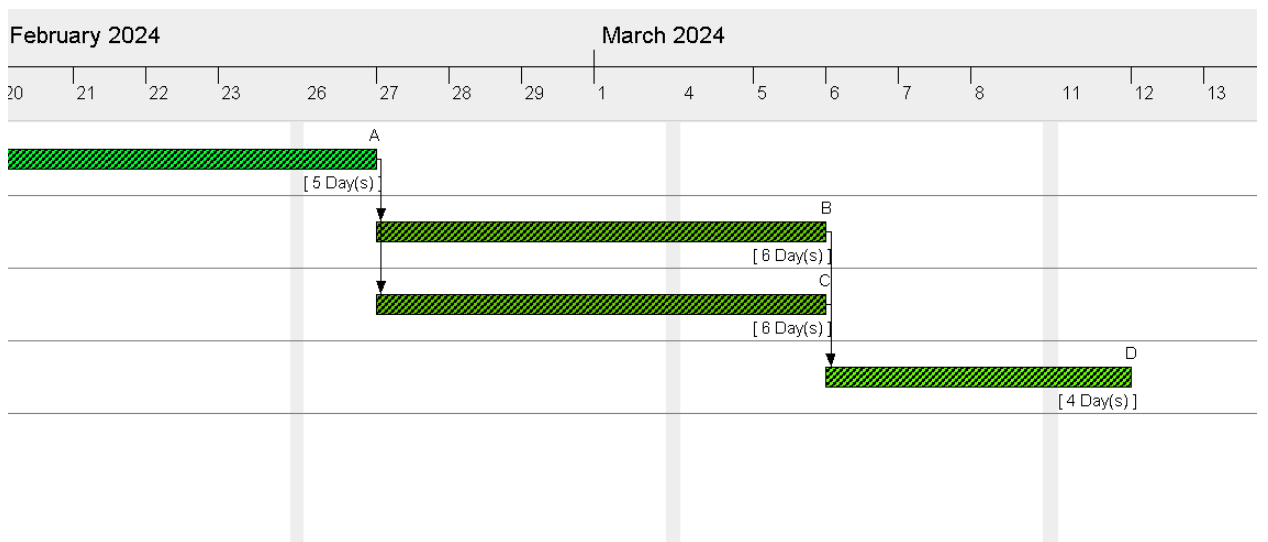


Fig. 2.11. Two critical paths

Most modern project management programmes (in particular, MS Project, GanttProject) automatically calculate critical paths when the corresponding input data is entered.

Let us *summarize* some of the results. Generally speaking, the planning and preliminary analysis of a project in terms of the work that makes up that project should answer the following questions.

1. What is the critical path, what is its duration, that is, the duration of the entire project?

2. What acceptable time intervals are available for the implementation of non-critical tasks (stage, works) of the project?
3. How will the postponement (delay) of each task affect the duration of the entire project? Closely related to this question is the project risk analysis.
4. How can the duration of project execution be shortened?