SE 2011
Project Management - Scheduling

Ron van der Meyden

**(University of New South Wales
Sydney, Australia)**

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What is a Schedule

A plan for how the project resources will be applied to do the job over time:

- **When** will tasks be undertaken
- **What** resources will be applied to the tasks:
  - Which *staff* will perform the tasks,
  - What *equipment* will be used,
  - What *materials/other inputs* will be used.

Why bother?

- Determine feasibility: can the project outcome be delivered within the time/resource constraints?
- Optimize use of resources (particularly when shared with other projects/activities)
- Enable progress/performance tracking.
- Manage stakeholder expectations.
- Enable re-planning analysis in response to unexpected events.

Inputs to Scheduling

- Work breakdown structure
- effort estimates
- task relationships
- resources (people, equipment, materials)
- risk analysis (e.g. measures of uncertainty in effort estimates)

Scheduling for Optimization

One of the aims of scheduling is to optimize the use of resources:

- time
- staff
- equipment
- money

Sometimes (e.g., this course!) all but one resource is fixed and you just need to manage the remaining one (time).
In general, there may be conflicts, e.g. a schedule that optimizes time (early project completion) may require more money.

Example

Project: build a city house and vacation home
Available builders (each capable of only one job at a time):

- Alice's Constructions quotes:
  city: 5 months, $400K, vacation: 3 months $400K
- Bob the Builder quotes:
  city: 4 months, $450K, vacation: 4 months $450K

City	Vacation	Time	Cost
A	A	8 months	$800K
A	B	5 months	$850K
B	A	4 months	$850K
B	B	8 months	$900K

Estimating Effort

To develop a schedule, we need an idea of how long each activity/task will take.
Best done:

- bottom up: from lowest levels of WBS,
- by the person who will do the work,
- based on historical data, if it exists,
- based on measures of outcome complexity (e.g. function points, lines of code/text),
- taking into account uncertainties.

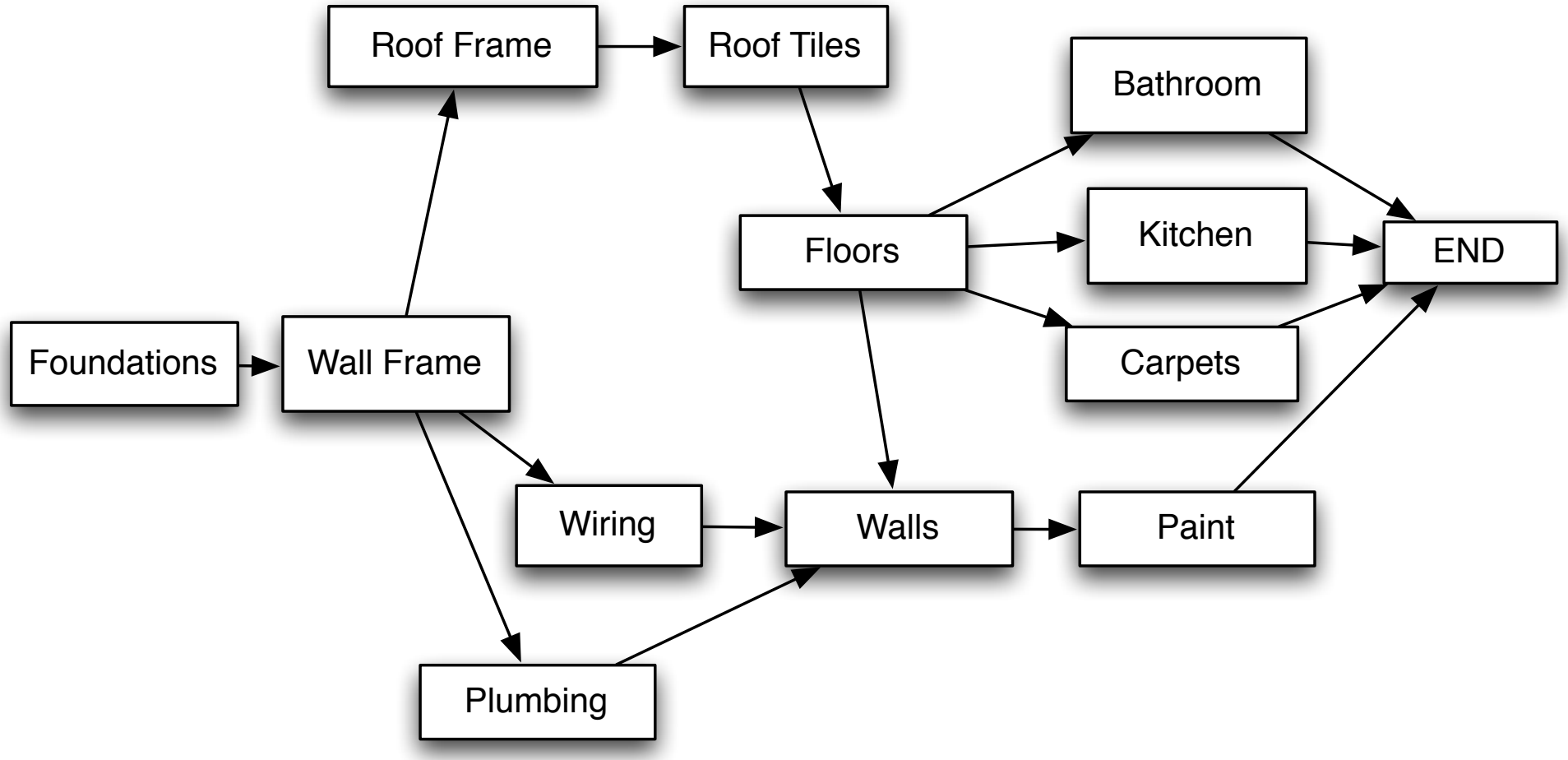
Estimating Effort: uncertainty

Ways to accommodate uncertainty about estimate:

- best guess + safety factor (e.g. 20%)
- beta distribution:

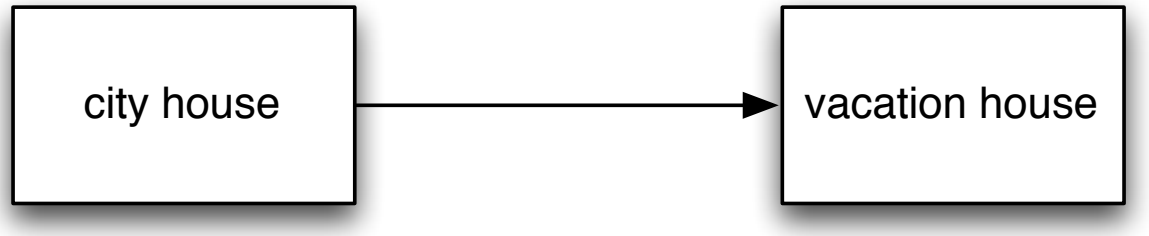
$$(optimistic + 4 \times expected + pessimistic)/6$$

Precedence Constraints



Resource Constraints may add Precedence Constraints

If using just one builder:



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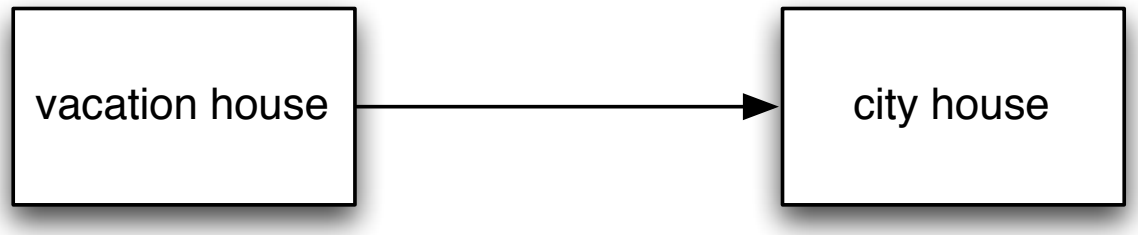
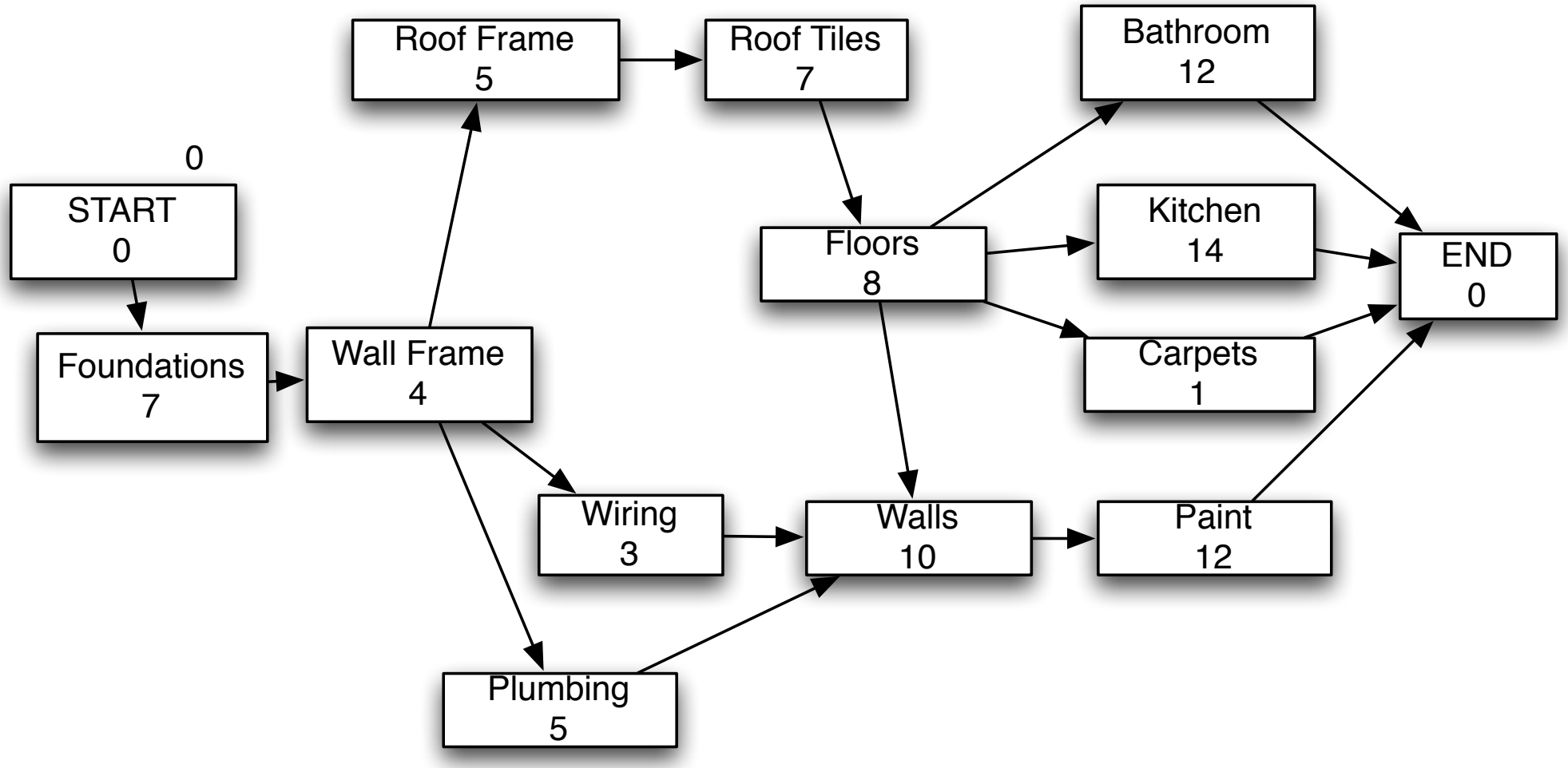


Computing Minimal Completion Time



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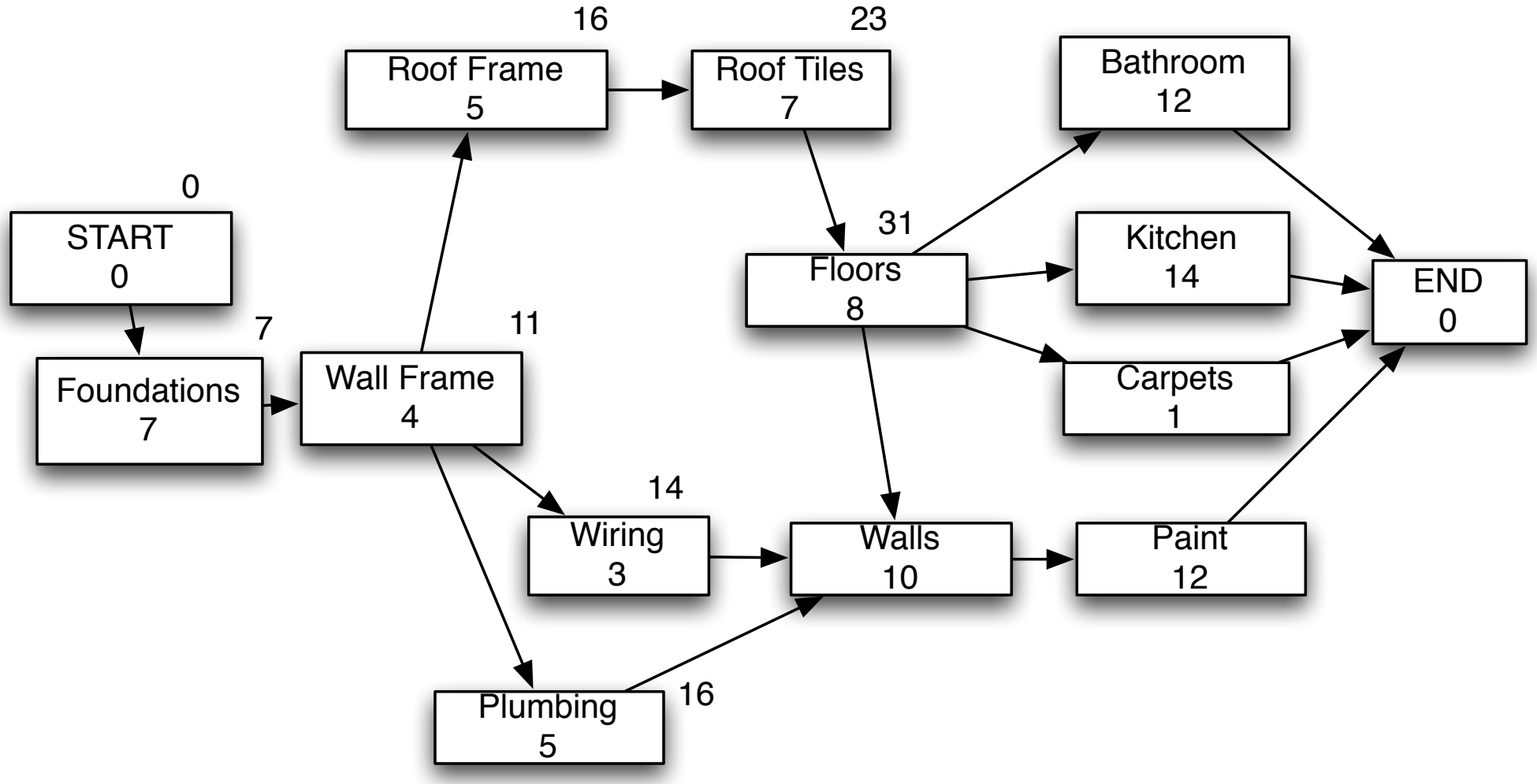

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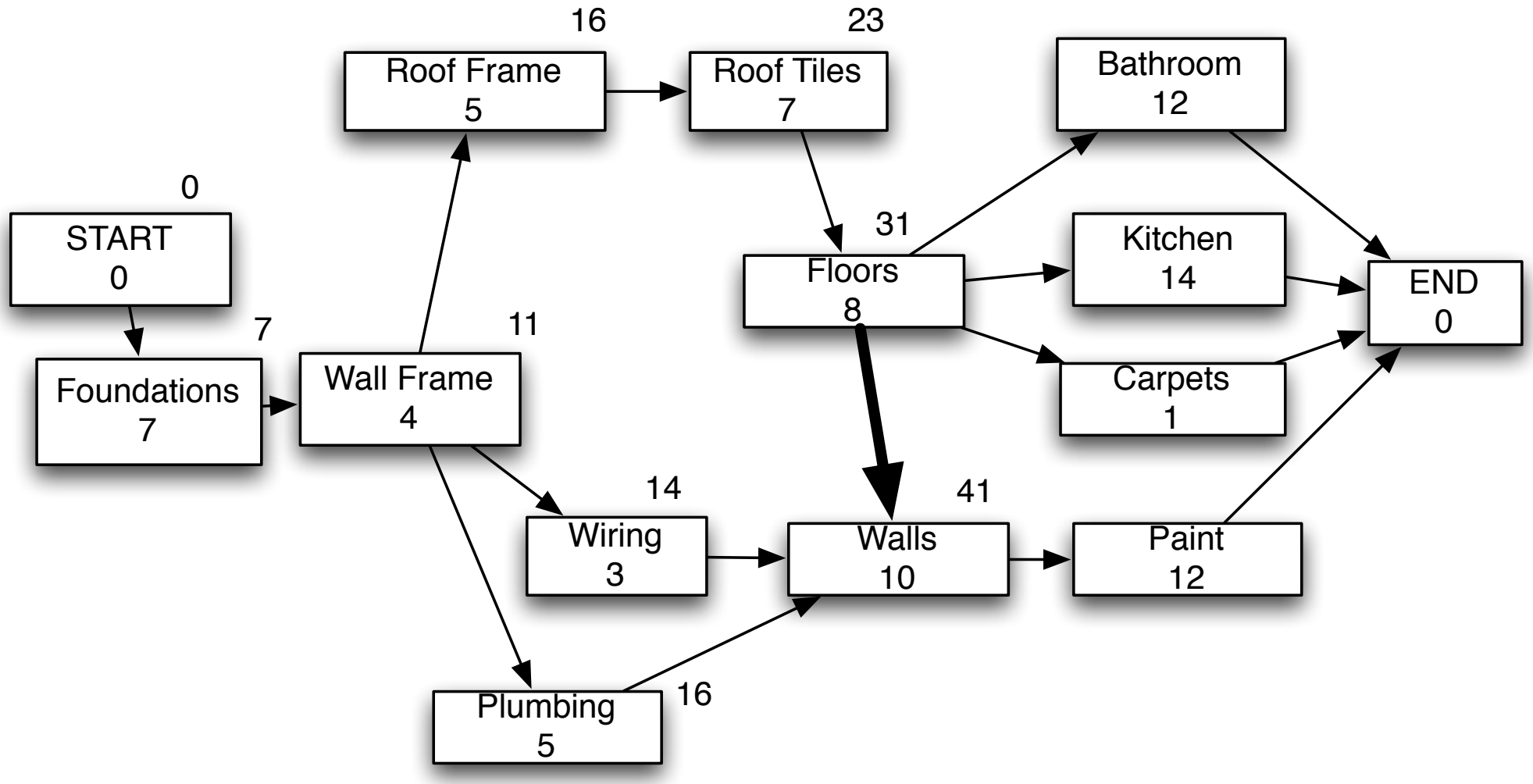

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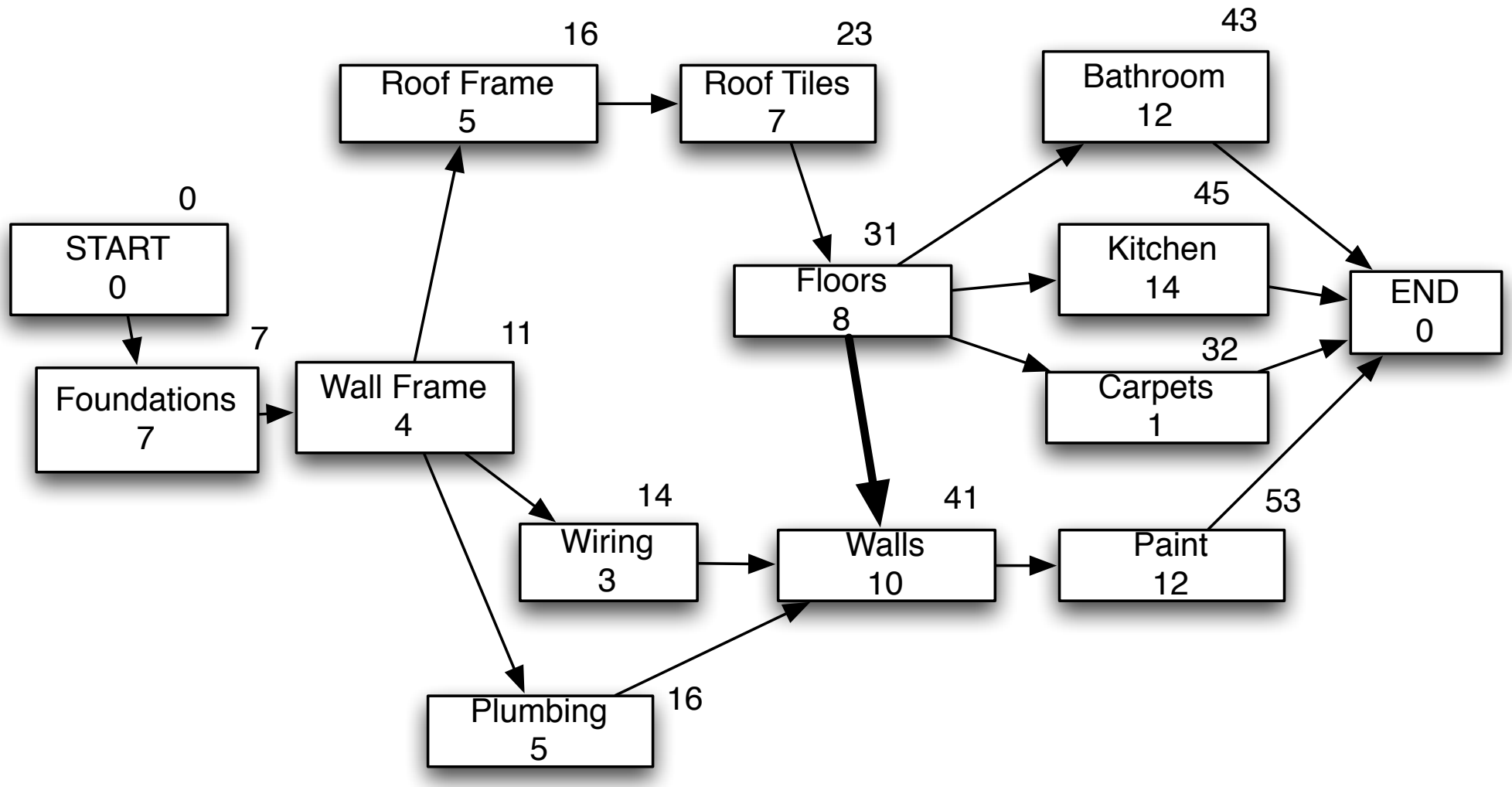
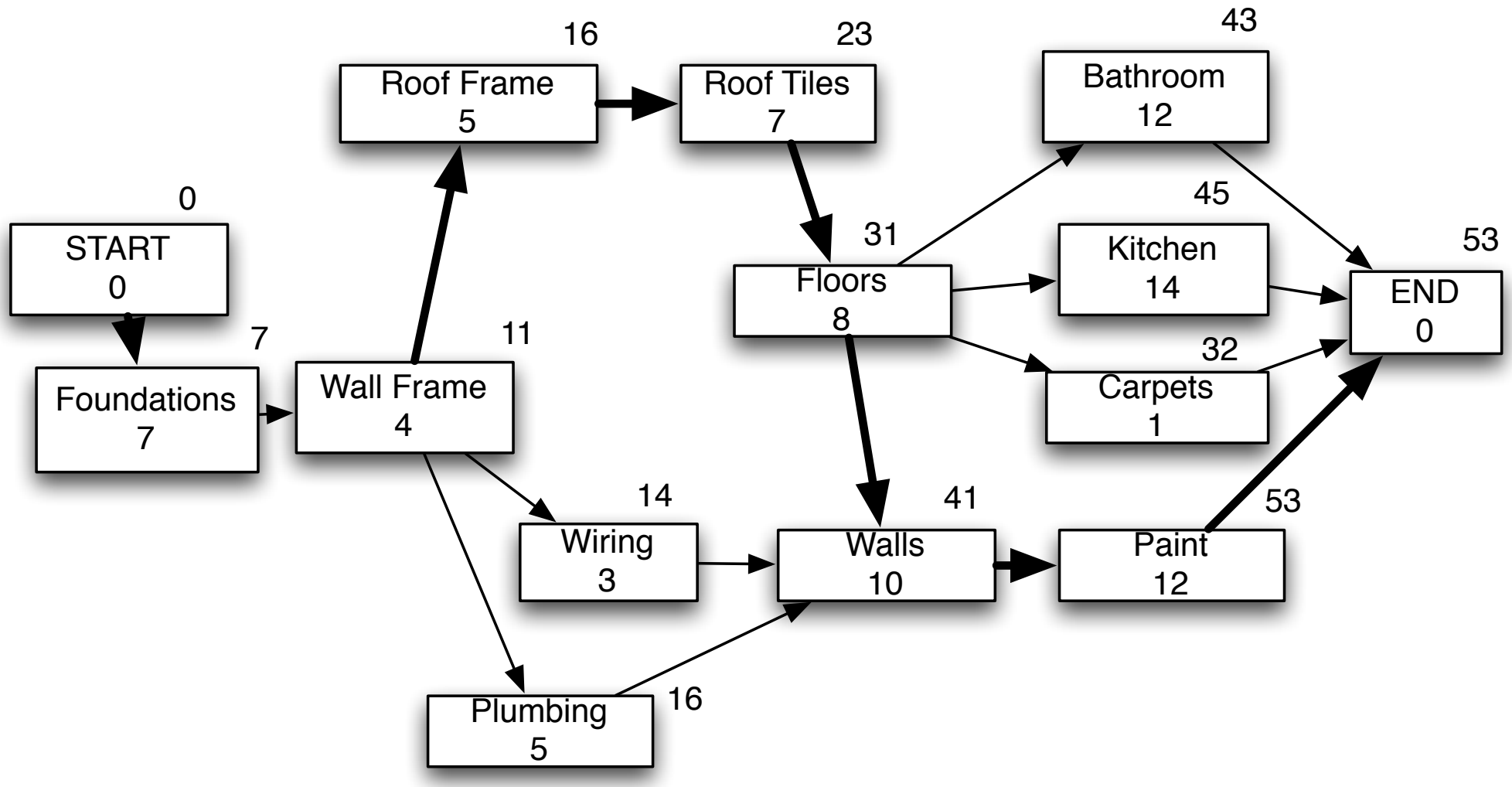


Critical Path



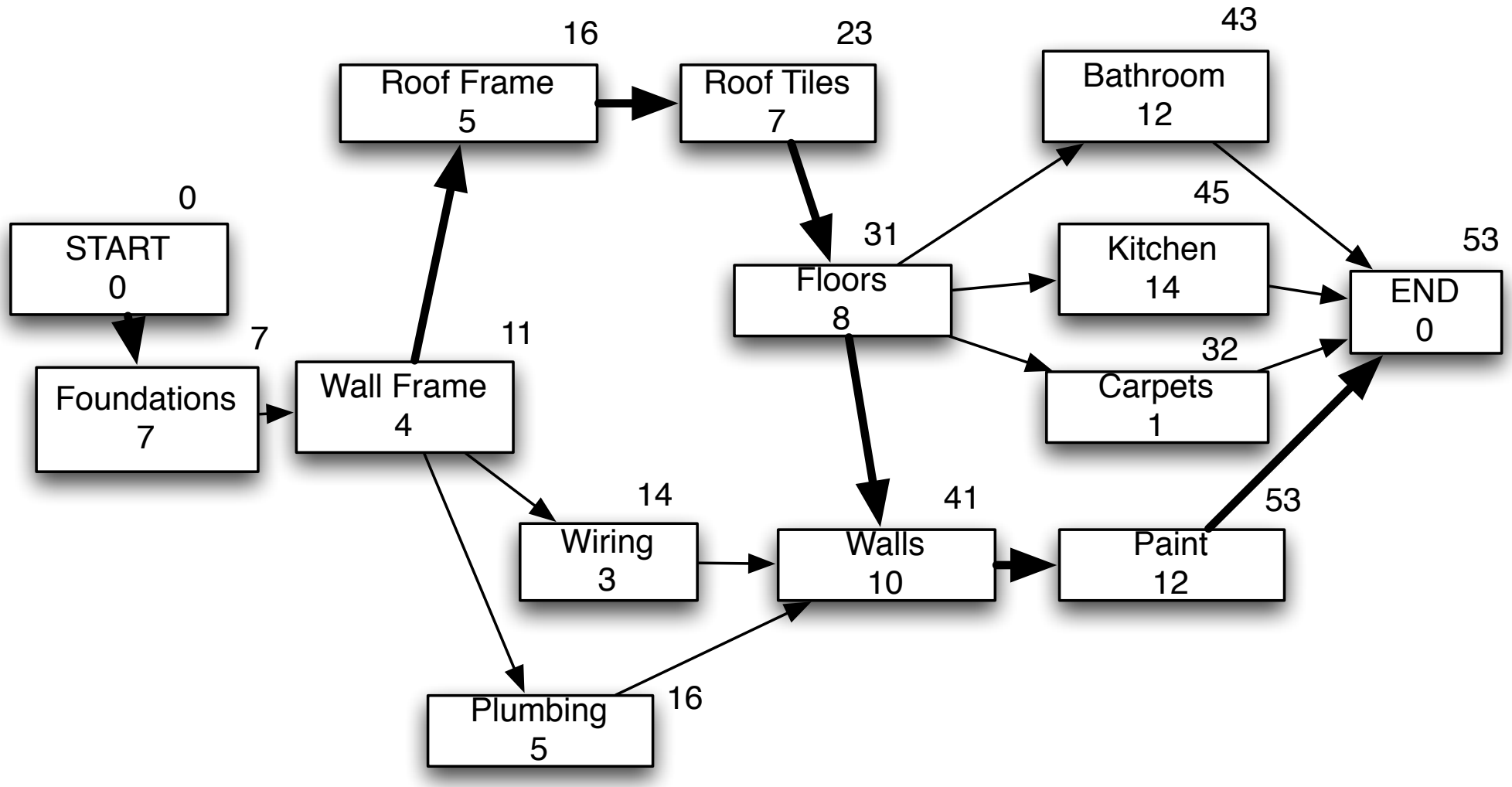
Critical Path

A path from START to END is *critical* if the sum of its activity durations are equal to the minimal completion time.

- Any delay on an activity on the critical path increases minimal completion time.
- Delays between end of an activity on the critical path and start of the next increase minimal completion time.
- Attempts to decrease minimal completion time should focus first on activities on the critical path (e.g. add resources to such an activity, delete/modify an activity)

Optimizing an Activity on the Critical Path

Suppose we hire 3 painters rather than 1.



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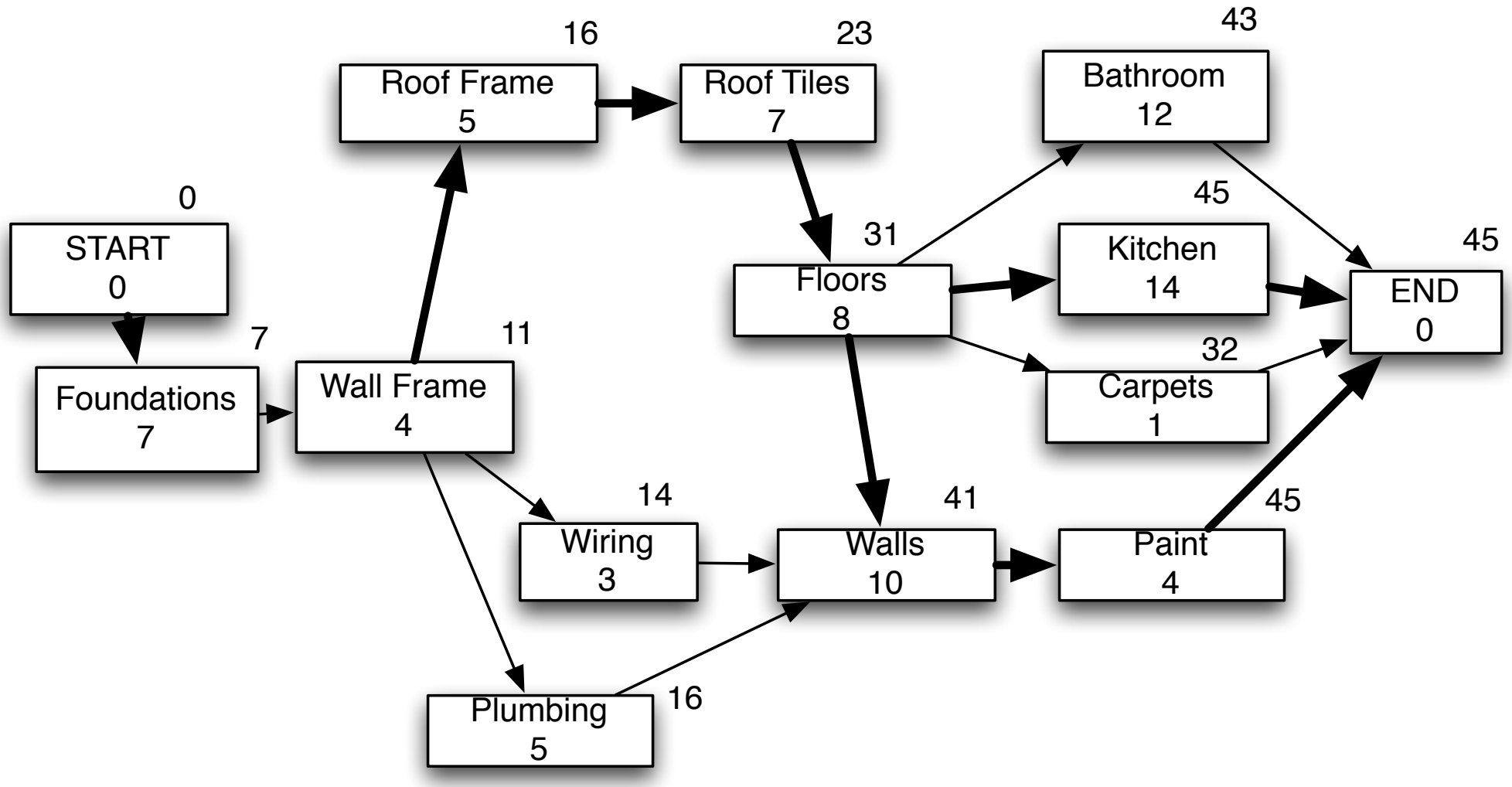

Schedules

A *schedule* is a mapping *start* from Activities/Tasks to times

$$end(t) = start(t) + duration(t)$$

Condition: If task t_1 must precede t_2 then $end(t_1) \leq start(t_2)$

Project Management Software

Implements critical path computation, schedule construction, and much more ..

- Microsoft Project
- Project Libre (free software)
  `http://sourceforge.net/projects/projectlibre/`