CPM Precedence Method
(Contract Dates; Milestones; Schedule Updating)
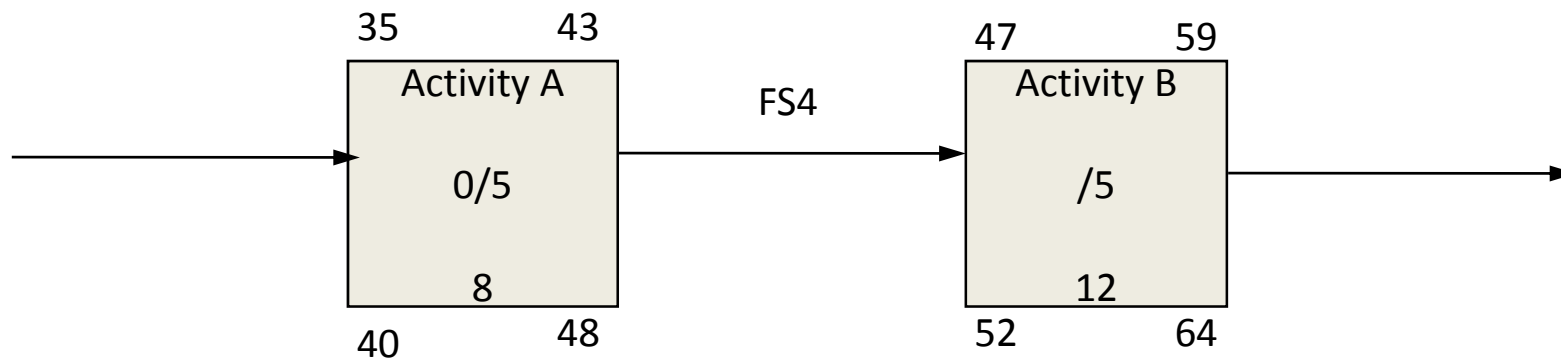
Construction Project Management

2013. 4.2.
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Interfering Float (IF)

- The amount of time that allow an activity to be delayed without affecting the completion date of the project but will affect its immediate successors.

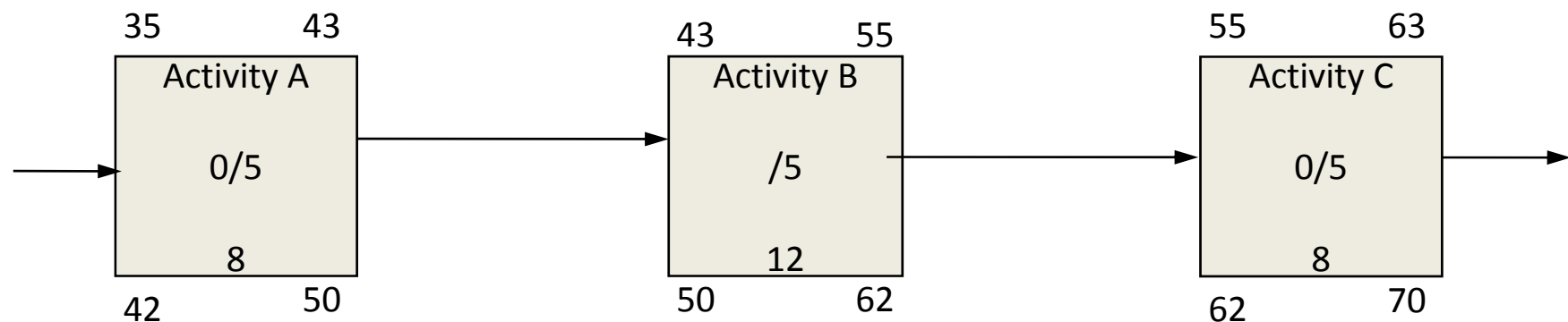 Interfering Float = Total Float – Free Float

35	Activity A	43
	0/5	
	8	
40		48

FS4

47	Activity B	59
	/5	
	12	
52		64

- $TF_A = 5$
- $FF_A = 0$
- $IF_A = TF_A - FF_A = 5$

Independent Float (INDF)

- The amount of time delay that can occur to an activity without affecting subsequent activities or restricting the preceding activities

(Finish to Start Relationship)

INDF (Y) = ES (Z) − LF (X) − Duration (Y)

35		43
	Activity A	
	0/5	
	8	
42		50

43		55
	Activity B	
	/5	
	12	
50		62

55		63
	Activity C	
	0/5	
	8	
62		70

- INDF $_B$ = ES $_C$ - LF $_A$ − Duration $_B$

   = 55 − 50 − 12 = -7 -> 0

Milestone

- Milestone is an event of major significance representing an important intermediate goal
- An event is a single point in time that can be represented by an activity with zero duration
- Milestone is used
  - to signify the end of a certain phase or group of activities
  - to inform that the project is now ready to move to the next phase
 - as a contractual requirement
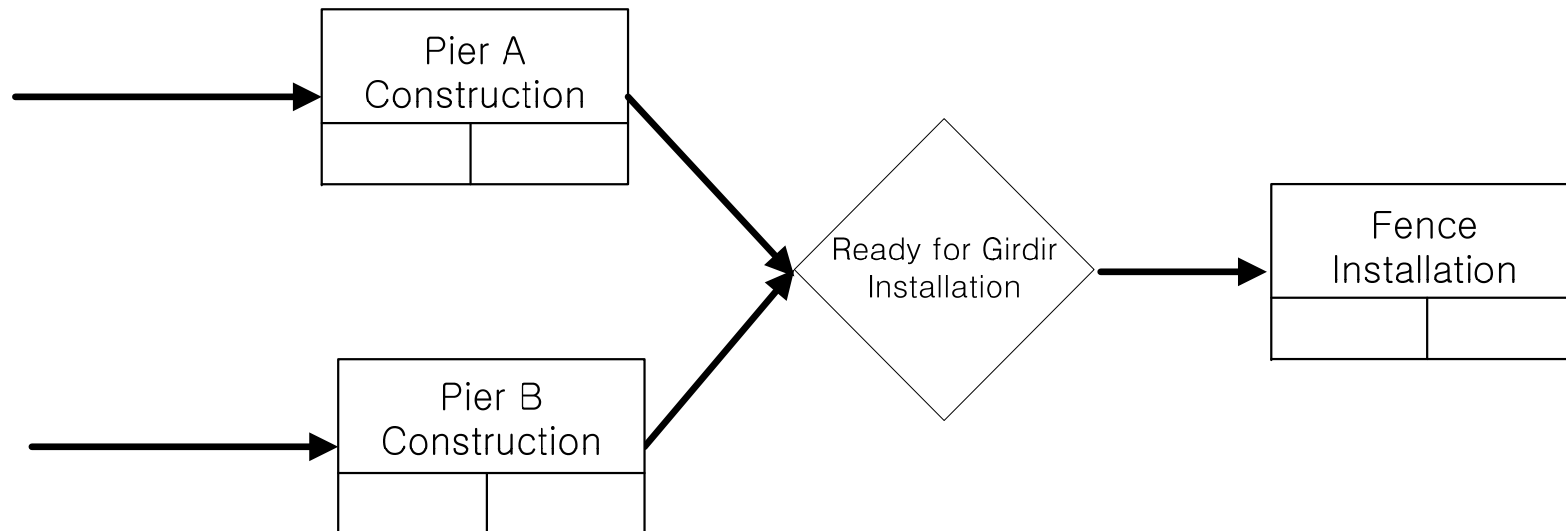
Contract Dates (Scheduled Dates, Plug Dates, Imposed Dates, and Artificial Constraints to Dates)

- Dates specified in the contract, to control start or finish dates of activities
- Contract dates can affect the computation of early and finish times of activities in the CPM network
- Contract dates can be used to ensure that important activities can be executed as planned
- Contract dates imposed on a project can disrupt the natural logic of CPM network
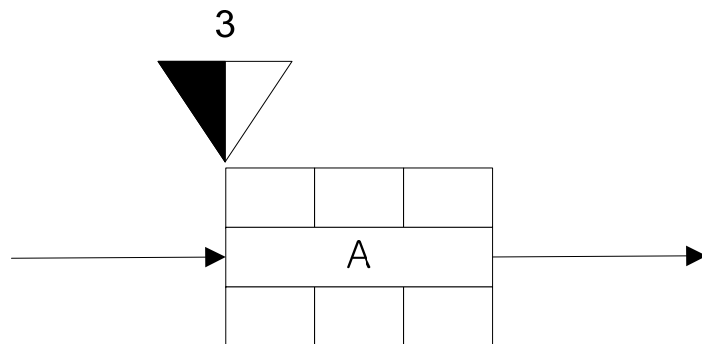- Contract dates can be placed on activities or events

Early Constraints of Contract Dates

- "Not Earlier Than" Date
  - The activity (or the event) can occur on the specified date or later
  - A notation example:

    Apr. 2, 2013
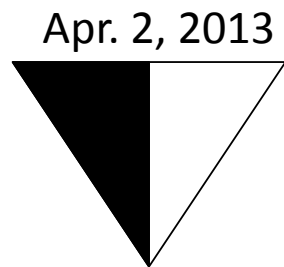
    Apr. 2, 3, 4 … are Yes, otherwise No

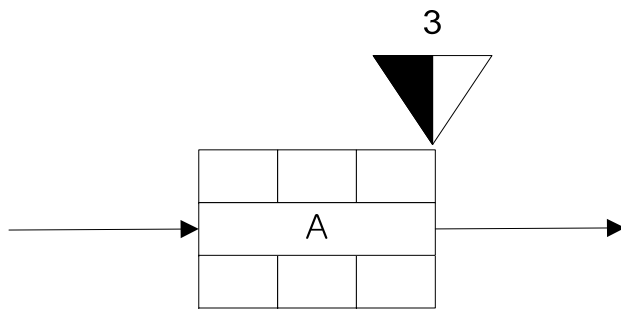 - Early Start Constraint for an activity in Primavera: "Not Earlier Than" date imposed on the activity start

    3

    Activity A can start on day 3, 4, 5 …

    but not on day … 1, 2

Early Constraints of Contract Dates (cont'd)

- "Not Earlier Than" Date (cont'd)
  - Early Finish Constraint for an activity in Primavera: "Not Earlier Than" date imposed on the activity finish

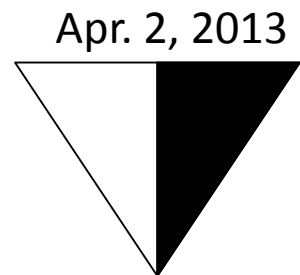Activity A can finish on day 3, 4, 5 …

but not on day … 1, 2

  - Early Start Constraint is also called Start Not Earlier Than Constraint
  - Early Finish Constraint is also called Finish Not Earlier Than Constraint

Late Constraints of Contract Dates
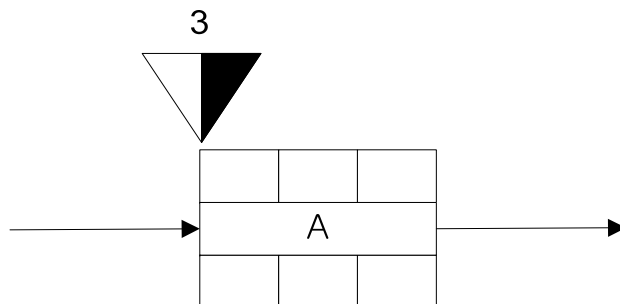
- "Not Later Than" Date
  - The activity (or the event) can occur on the specified date or earlier
  - A notation example:

Apr. 2, 2013

... Mar. 31, Apr. 1, 2 are Yes, otherwise No

  - Late Start Constraint for an activity in Primavera: "Not Later Than" date imposed on the activity start
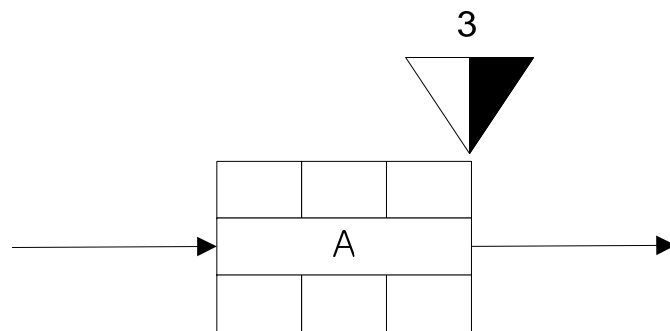
3

Activity A can start on day ... 1, 2, 3

but not on day 4, 5, 6 ...

Late Constraints of Contract Dates (cont'd)

- "Not Later Than" Date (cont'd)
  - Late Finish Constraint for an activity in Primavera: "Not Later Than" date imposed on the activity finish

Activity A can finish on day ... 1, 2, 3

but not on day 4, 5, 6 ...

  - Late Start Constraint is also called Start Not Later Than Constraint
 - Late Finish Constraint is also called Finish Not Later Than Constraint

Mandatory Constraints of Contract Dates

- "Not Later and Not Earlier Than" Date
  - Aka "Absolutely Required Date;" the activity (or the event) can occur only on the specified date
  - A notation example:

    Apr. 2, 2013

   Apr. 2 is Yes,

    otherwise No

  - Mandatory Start Constraint for an activity in Primavera: "Not Later and Not Earlier Than" date imposed on the activity start

    3

	A	
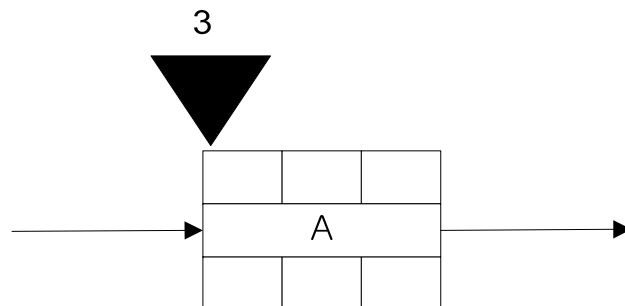
    Activity A can start only on day 3 but not on other days

# Mandatory Constraints of Contract Dates (cont'd)

- "Not Later and Not Earlier Than" Date (cont'd)
  - Mandatory Finish Constraint for an activity in Primavera: "Not Later and Not Earlier Than" date imposed on the activity finish
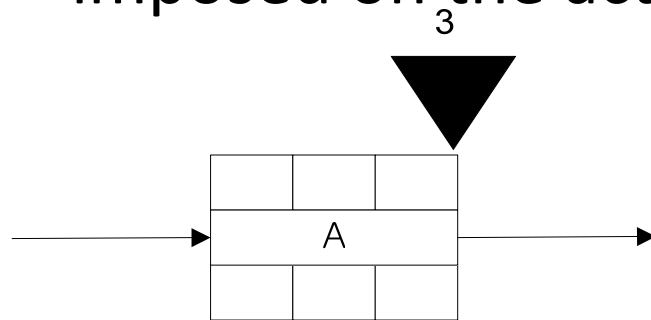
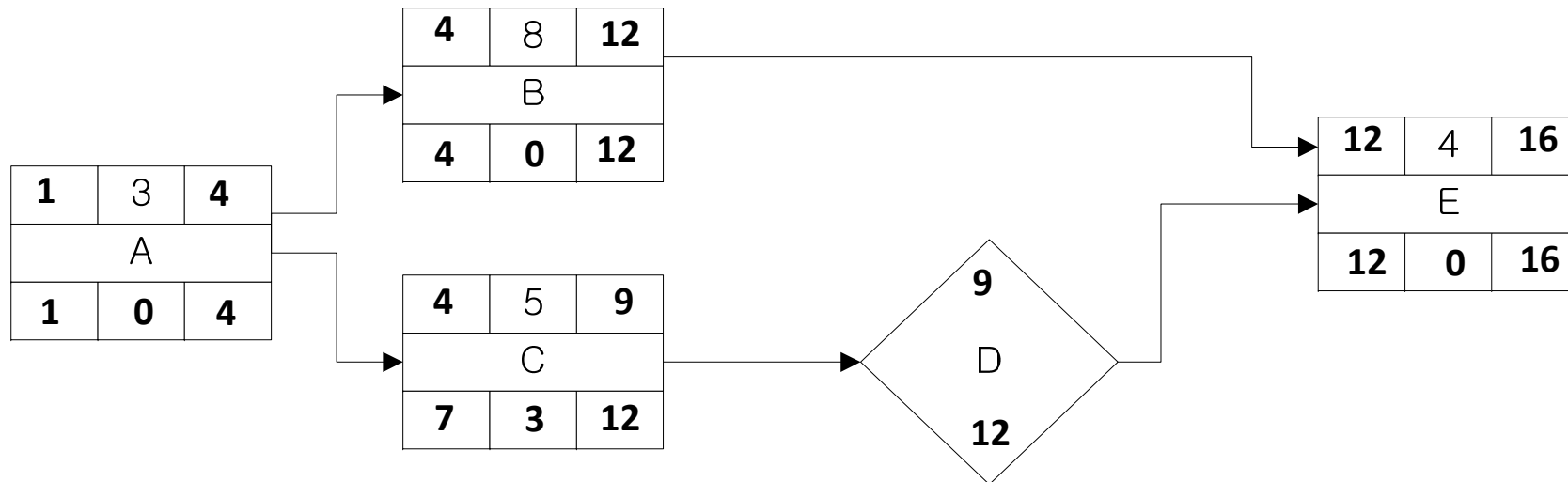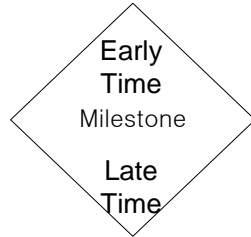Activity A can finish only on day 3 but not on other days

Contract Dates on Milestones

- "Not Earlier Than" Date
  - Milestone A can occur on day 9, 10, 11 …
  - But not on day …. 6, 7, 8

- "Not Later Than" Date
  - Milestone A can occur on day … 7, 8, 9
  - But not on day 10, 11, 12 …

- "Not Later and Not Earlier Than" Date
  - Milestone A can occur only on day 9
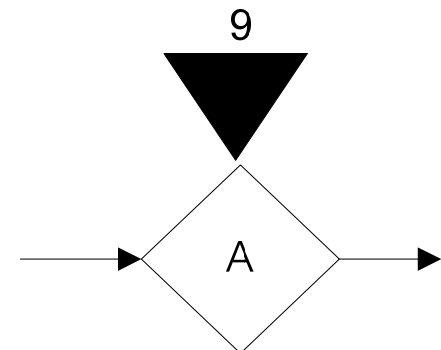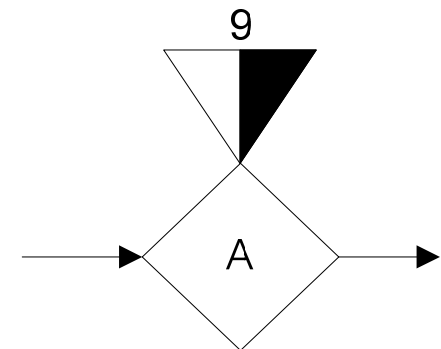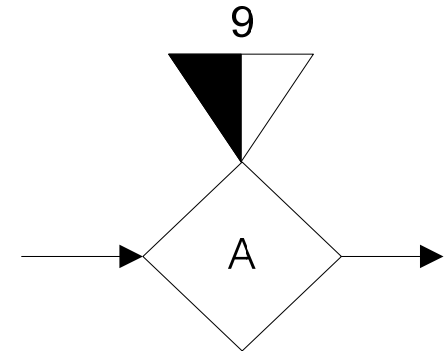
CPM Example without Contract Dates

Early Start	Duration	Early Finish
Task Name		
Late Start	Total Float	Late Finish

Early Time

Milestone

Late Time

4	8	12
B		
4	0	12

1	3	4
A		
1	0	4

4	5	9
C		
7	3	12

9

D

12

12	4	16
E		
12	0	16

"Not Earlier Than" Date Impact

Early Start	Duration	Early Finish
Task Name		
Late Start	Total Float	Late Finish

Early Time — Milestone — Late Time

4	8	12
B		
7	3	15

1	3	4
A		
4	3	7

4	5	9
C		
10	6	15

15

D
15
15

15	4	19
E		
15	0	19

"Not Later Than" Date Impact

Early Start	Duration	Early Finish
Task Name		
Late Start	Total Float	Late Finish

Early Time
Milestone
Late Time

4	8	12
B		
4	0	12

1	3	4
A		
1	0	4

4	5	9
C		
5	1	10

10

D

9

10

12	4	16
E		
12	0	16
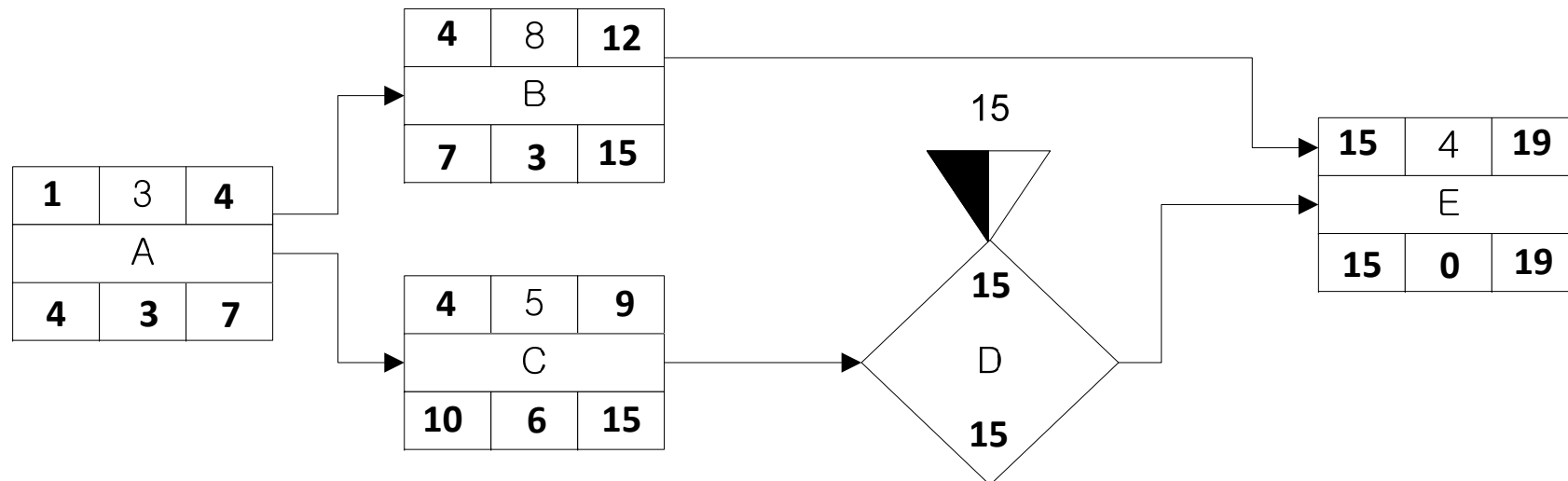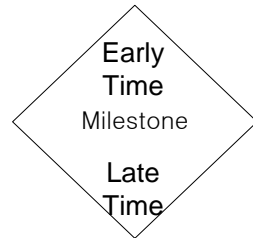
"Not Later and Not Earlier Than" Date (Absolutely Required Date) Impact

Early Start	Duration	Early Finish
	Task Name	
Late Start	Total Float	Late Finish

Early Time / Milestone / Late Time

4	8	12
	B	
4	0	12

1	3	4
	A	
1	0	4

4	5	9
	C	
4	0	9

9

D

9

9

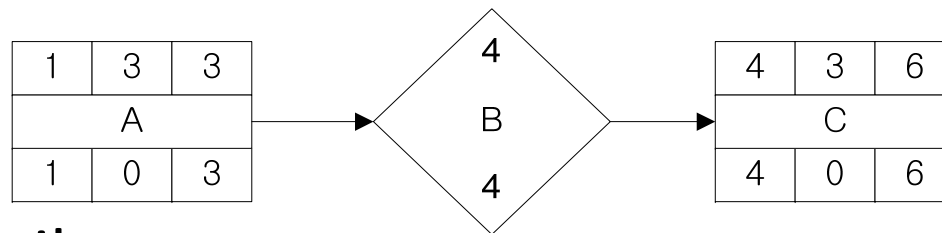| 12	4	16
	E	
12	0	16
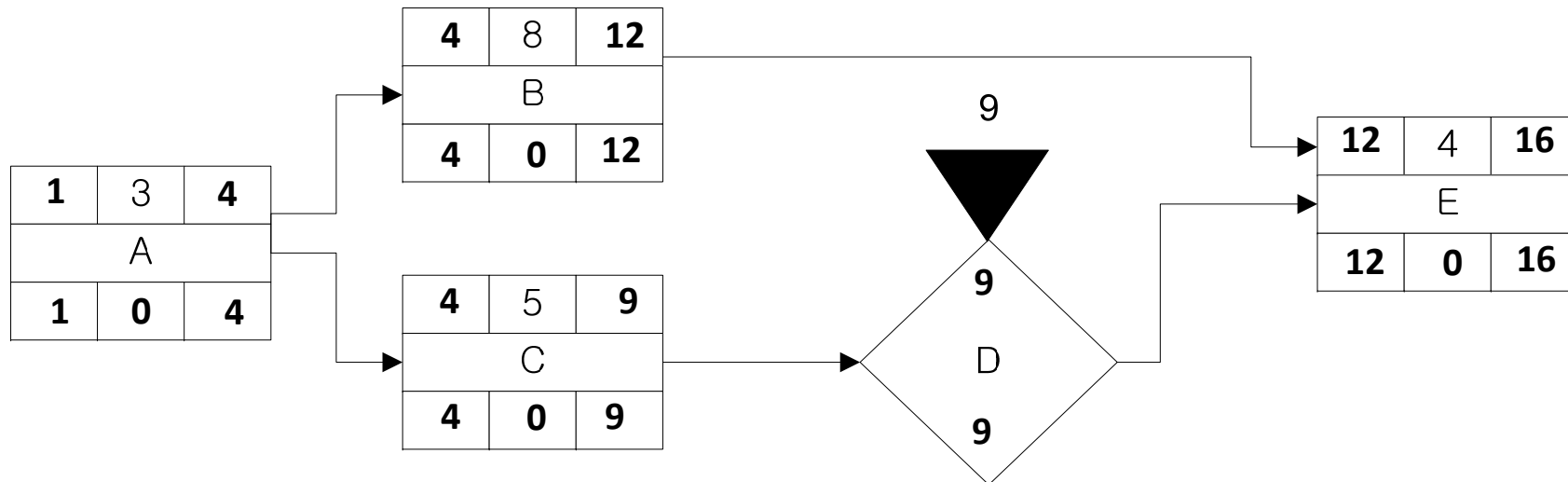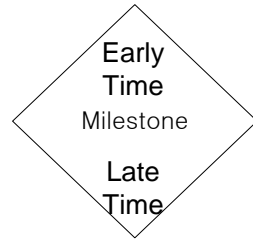
Milestones in Scheduling Software
(under the Assumption of 8 Working Hours Per Day)

- ## There are two types of milestones in Primavera
  - ### Start milestone
    - Only start constraints (early start constraint or late start constraint) can be applied
    - The times of the milestone is associated with the successor

1	3	3
	A	
1	0	3

B: 4 / 4

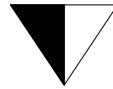| 4	3	6
	C	
4	0	6

  - ### Finish milestone:
    - Only finish constraints (early finish constraint or late finish constraint) can be applied
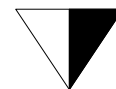   - The times of the milestone is associated with the predecessor

1	3	3
	A	
1	0	3

B: 3 / 3

4	3	6
	C	
4	0	6
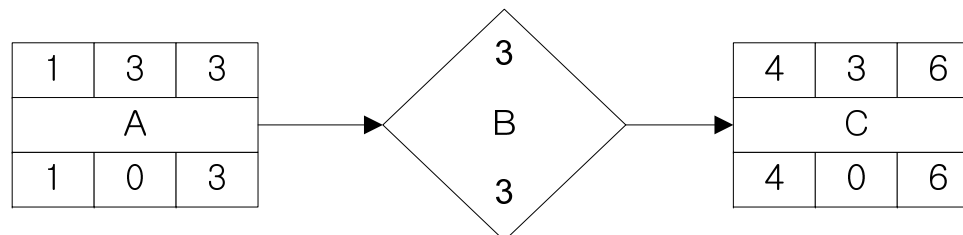
CPM Computation with Contract Dates

Schedule Update

- What would you do if the CPM network turns out to be unrealistic?
  1. Throw it to the garbage basket
  2. Put it in a frame and hang it on the wall
  3. Update it and keep using it
- During construction, new and more accurate project information becomes available
  - Accurate or actual amount of times required for activities
  - Accurate or actual amount of resources required for activities
  - Accurate or actual amount of money required for resources
  - Accurate or actual logical relationships among activities
  - New or deleted activities
  - In-progress activities with remaining duration
  - finished activities
  - …

Schedule Update (cont'd)

- The new and more accurate project information should be reflected on the original plan
- The revised plan can inform the users of the best way to use the resources; the project manager can make better informed decisions
- The CPM network is updated based on the most up-to-date information
  - On a regular basis, the new information is collected from the site mostly or from other sources
  - The date at which the CPM network is updated is called Data Date
  - Date Date is the new start date for the remaining part of the project
- The project should be carefully monitored using the schedule updating process to ensure the timely completion of the project

CPM Computation Example for Schedule Update