# Sequencing Problems

Processing of n jobs through m machine

m = 1, 2, 3, 4

processing of two jobs through m machine

m = 1, 2, 3, 4, 5

## Assumptions

(i) only n machines are involved
(2, 3, or 4)

(ii) Each job is processed in the order

(iii) Set up time is note considered
i loading and unloading time

(iv) In-process storage space is available

(v) order of completion of jobs has
no significant

(vi) The actual or expected time is
known

(P)

## 'n' Jobs Two machines

A mle operator has to perform two operations, turning, and threading on a no. of different jobs. The time required to perform these operations (in minutes) for each job is known. Determine the order in which the jobs should be processed in order to minimize the total time required to turn out all the jobs.

| Job | Time for turning in minutes | Time for threading (min) |
|---|---|---|
| ✓ 1 | 3 | 8 |
| 2 | 12 | 10 |
| ✓ 3 | 5 | 9 |
| ✓ 4 | 2 | 6 |
| ✓ 5 | 9 | 3 |
| ✓ 6 | 11 | 1 ✓ |

Also find the total processing time and idle times for turning and threading opn

Soln → Turning

← Threading

| 4 | 1 | 3 | 2 | 5 | 6 |
|---|---|---|---|---|---|

| Job | Turning opn | | Threading opn | | |
|---|---|---|---|---|---|
| | in | out | in | out | Idle for threading |
| 4 | 0 | 2 | 2 | 8 | 2 |
| 1 | 2 | 5 | 8 | 16 | – |
| 3 | 5 | 10 | 16 | 25 | – |
| 2 | 10 | 22 | 25 | 35 | – |
| 5 | 22 | 31 | 35 | 38 | – |
| 6 | 31 | 42 | 42 | 43 | 4 |
| | | | | | 6 |

Thus the minimum elapsed time is 43 min. Idle time for turning opn is (43 - 42) = 1 min. Idle time for threading opn is 2 + 4 = 6 min

(P) There are seven jobs, each of which has to go through the machines A and B in the order AB. Processing times in hours are given as

| Job : | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| m/c A : | 3 | 12 | 15 | 6 | 10 | 11 | 9 |
| m/c B : | 8 | 10 | 10 | 6 | 12 | 1 | 3 |

Determine a sequence of these jobs that will minimize the total elapsed time T. Also find T and idle time for machine A and B.

Soln

| 1 | 4 | 5 | 3 | 2 | 7 | 6 |
|---|---|---|---|---|---|---|

| 1 | 5 | 2 | 3 | 4 | 7 | 6 |
|---|---|---|---|---|---|---|

| 1 | 5 | 3 | 2 | 4 | 7 | 6 |
|---|---|---|---|---|---|---|

| 1 | 5 | 2 | 3 | 4 | 7 | 6 |
|---|---|---|---|---|---|---|

TET : 67 hrs.

Idle time for A : 1 hr

Idle time for B : 3 + 2 + 3 + 2 + 7 : 17 hrs.

(8) A manufacturing company processes 6 different jobs in two machines A and B. Number of units of each job and its processing times on A and B are given in table. find the Optimal sequence, the total minimum elapsed time and idle time for either machine.

| Job no | no. of units | min on M/c A | min on M/c B |
|---|---|---|---|
| 1 | 3 | 5 | 8 |
| 2 | 4 | 16 | 7 |
| 3 | 2 | 6 | 11 |
| 4 | 5 | 3 | 5 |
| 5 | 2 | 9 | 7.5 |
| 6 | 3 | 6 | 14 |

Soln

| Job no. | Unit no. of job | A in | A out | B in | B out | Idle for B |
|---|---|---|---|---|---|---|
| 4 | I | 0 | 3 | 3 | 8 | 3 |
| | II | 3 | 6 | 8 | 13 | - |
| | III | 6 | 9 | 13 | 18 | - |
| | IV | 9 | 12 | 18 | 23 | - |
| | V | 12 | 15 | 23 | 28 | - |
| 1 | I | 15 | 20 | 28 | 36 | - |
| | II | 20 | 25 | 36 | 44 | - |
| | III | 25 | 30 | 44 | 52 | - |
| 3 | I | 30 | 36 | 52 | 63 | - |
| | II | 36 | 42 | 63 | 74 | - |
| 6 | I | 42 | 48 | 74 | 88 | - |
| | II | 48 | 54 | 88 | 102 | - |
| | III | 54 | 60 | 102 | 116 | - |
| 5 | I | 60 | 69 | 116 | 123.5 | - |
| | II | 69 | 78 | 123.5 | 131 | - |
| 2 | I | 78 | 94 | 131 | 138 | - |
| | II | 94 | 110 | 138 | 145 | - |
| | III | 110 | 126 | 145 | 152 | - |
| | IV | 126 | 142 | 152 | 159 | - |

| 4 | 1 | 3 | 6 | 5 | 2 |
|---|---|---|---|---|---|

Total Elapsed time = 159 min.

Idle time for A = 17 min.

Idle time for B = 3 min.

(P) n Jobs through 3 machines.

| Job | Time Arr (minutes) A | B | C |
|---|---|---|---|
| 1 | 3 | 8 | 13 |
| 2 | 12 | 6 | 14 |
| 3 | 5 | 4 | 9 |
| 4 | 2 | 6 | 12 |
| 5 | 9 | 3 | 8 |
| 6 | 11 | 1 | 13 |

Soln

$\min(A,C) \geq \max(B)$

$\min(2,8) \geq \max(8)$

∴ it obeys the condition $\min(C) \geq \max(B)$

it can be solved.

| Job | G (A+B) | H (B+C) |
|---|---|---|
| 1 | 11 | 21 |
| 2 | 18 | 20 |
| 3 | 9 | 13 |
| 4 | 8 | 18 |
| 5 | 12 | 11 |
| 6 | 12 | 14 |

TET = 77 min

Idle A = 35 min

B = 49 min

C = 8 min

| 4 | 3 | 1 | 6 | 2 | 5 |
|---|---|---|---|---|---|

| | A | | B | | C | |
|---|---|---|---|---|---|---|
| 4 | 0 | 2 | 2 | 8 | 8 | 20 |
| 3 | 2 | 7 | 8 | 12 | 20 | 29 |
| 1 | 7 | 10 | 12 | 20 | 29 | 42 |
| 6 | 10 | 21 | 21 | 22 | 42 | 55 |
| 2 | 21 | 33 | 33 | 39 | 55 | 69 |
| 5 | 33 | 42 | 42 | 45 | 69 | 77 |

(P)

| Job | A | B | C |
|---|---|---|---|
| 1 | 3 | 4 | 7 |
| 2 | 8 | 5 | 9 |
| 3 | 7 | 1 | 5 |
| 4 | 5 | 2 | 6 |
| 5 | 4 | 3 | 10 |

Soln

4 1 5 2 3

4 5 1 2 3

1 4 5 2 3

1 5 4 2 3

5 1 4 2 3

5 4 1 2 3

4
1
5
2
3

TET = 44

A = 17

B = 29

C = 7

(P) Find the sequence that minimizes the total elapsed time required to complete the following tasks. Each task is processed in any two of the machines A, B, and C in any order.

| m/c | Task 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| A | 12 | 6 | 5 | 3 | 5 | 7 | 6 |
| B | 7 | 8 | 9 | 8 | 7 | 8 | 3 |
| C | 3 | 4 | 11 | 5 | 2 | 8 | 4 |

Soln The possible ways are

AB, BA, BC, CB, AC, CA

The optimal Sequence & Elapsed time is

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| AB) | 4 | 5 | 3 | 2 | 6 | 1 | 7 | 53 |

BA 7 1 6 2 3 5 4 53

BC 7 6 3 4 2 1 5 52

CB 5 1 2 4 3 6 7 52

AC 4 3 6 7 2 1 5 46

CA 5 1 2 7 6 3 4 46

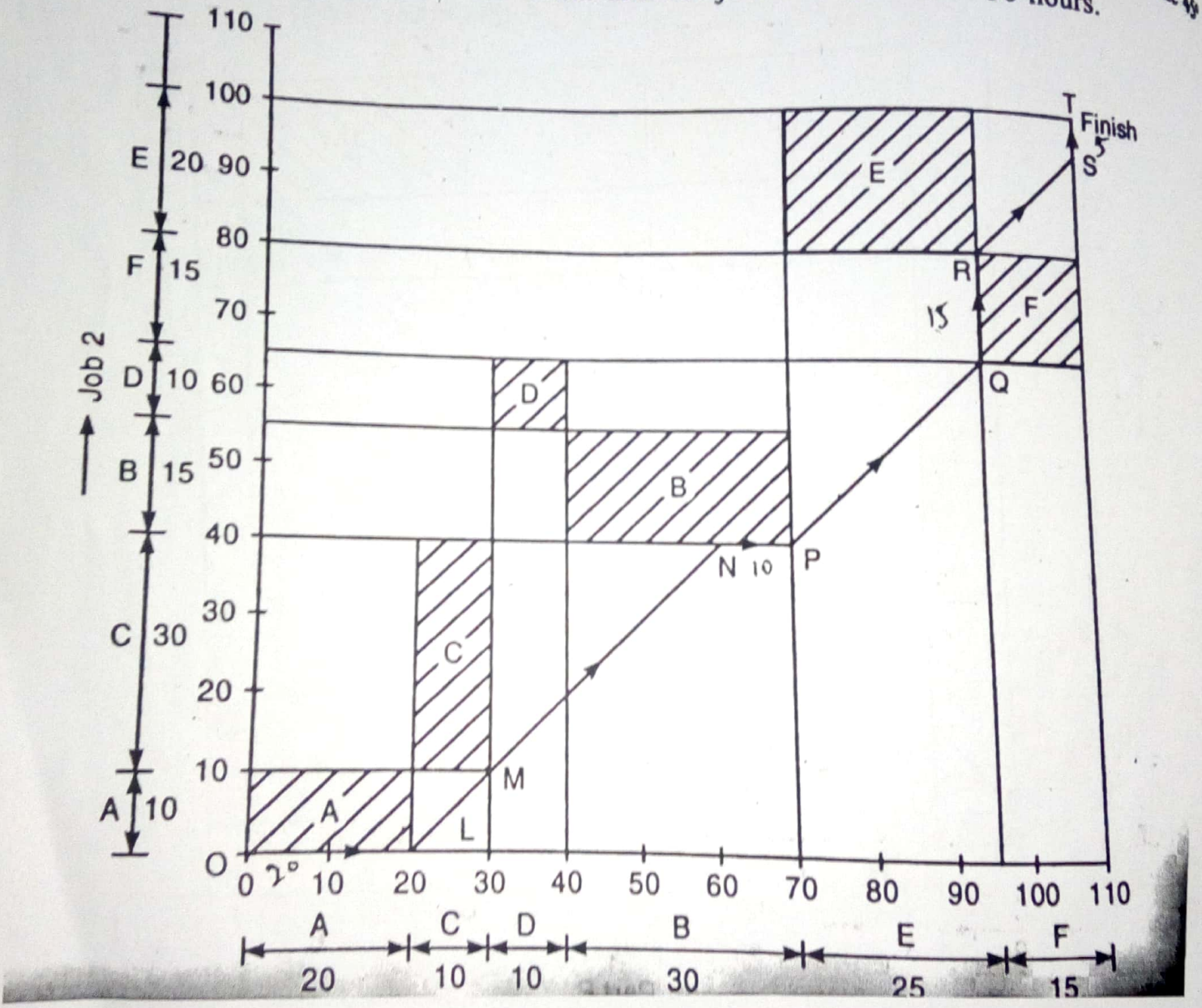
from the above all results AC and CA only obtained the minimum elapsed time 46.

∴ The sequence is 4 3 6 7 2 1 5

or 5 1 2 7 6 3 4.

n jobs through 4 m/c

rectangular blocks by pairing the same machines as shown in Fig. 5.7. Now a path from the origin O to the point of finish moving as much as possible along the 45° idle time for job 1 is 15 + 5 = 20 hours and for job 2 is 20 + 10 = 30 hours.



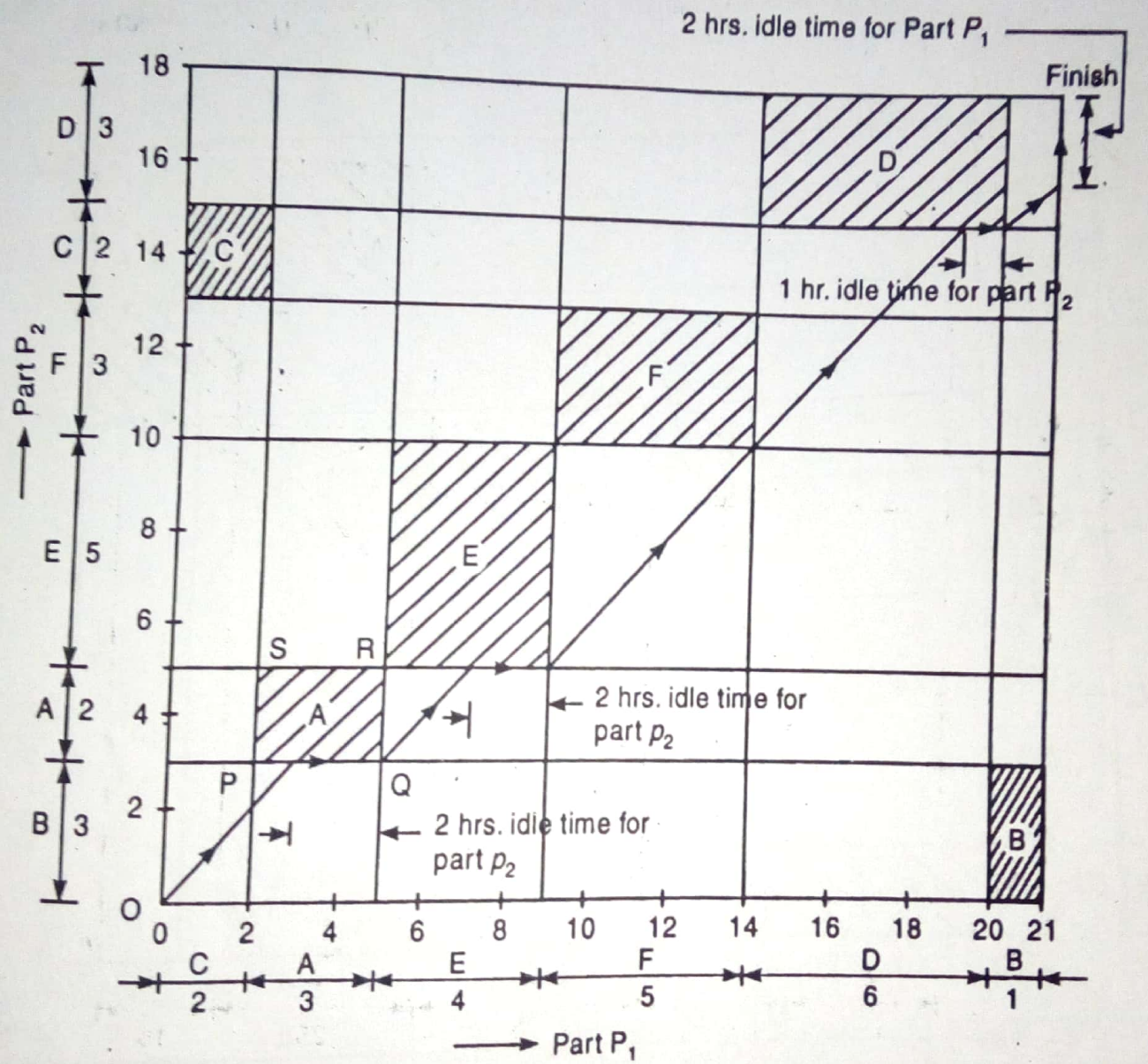
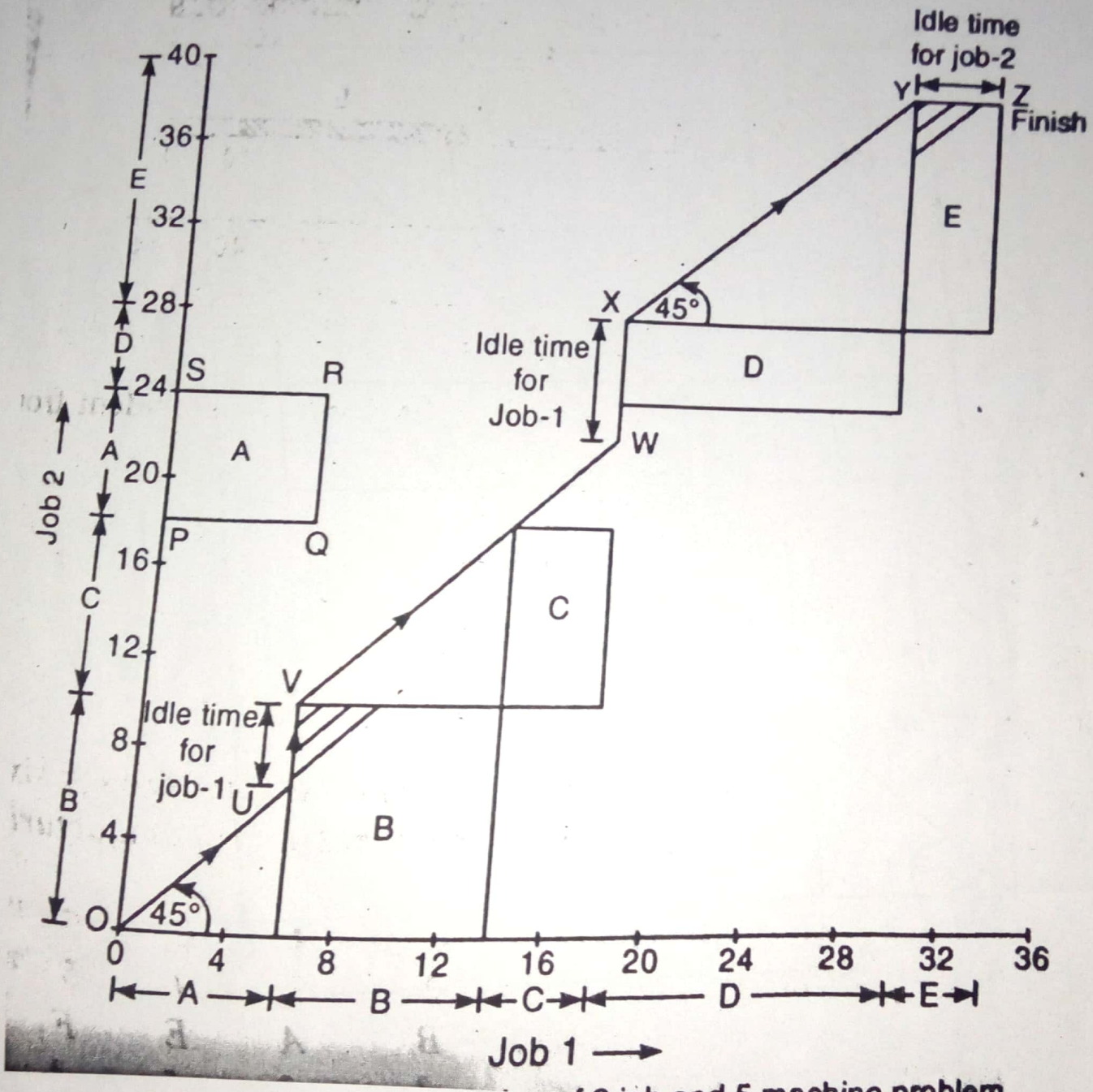



Fig. 5.6 Graphical solution of 2 part and 6 machine problem.

s shown in Fig. 5.4.




...f 2 job and 5 machine problem.

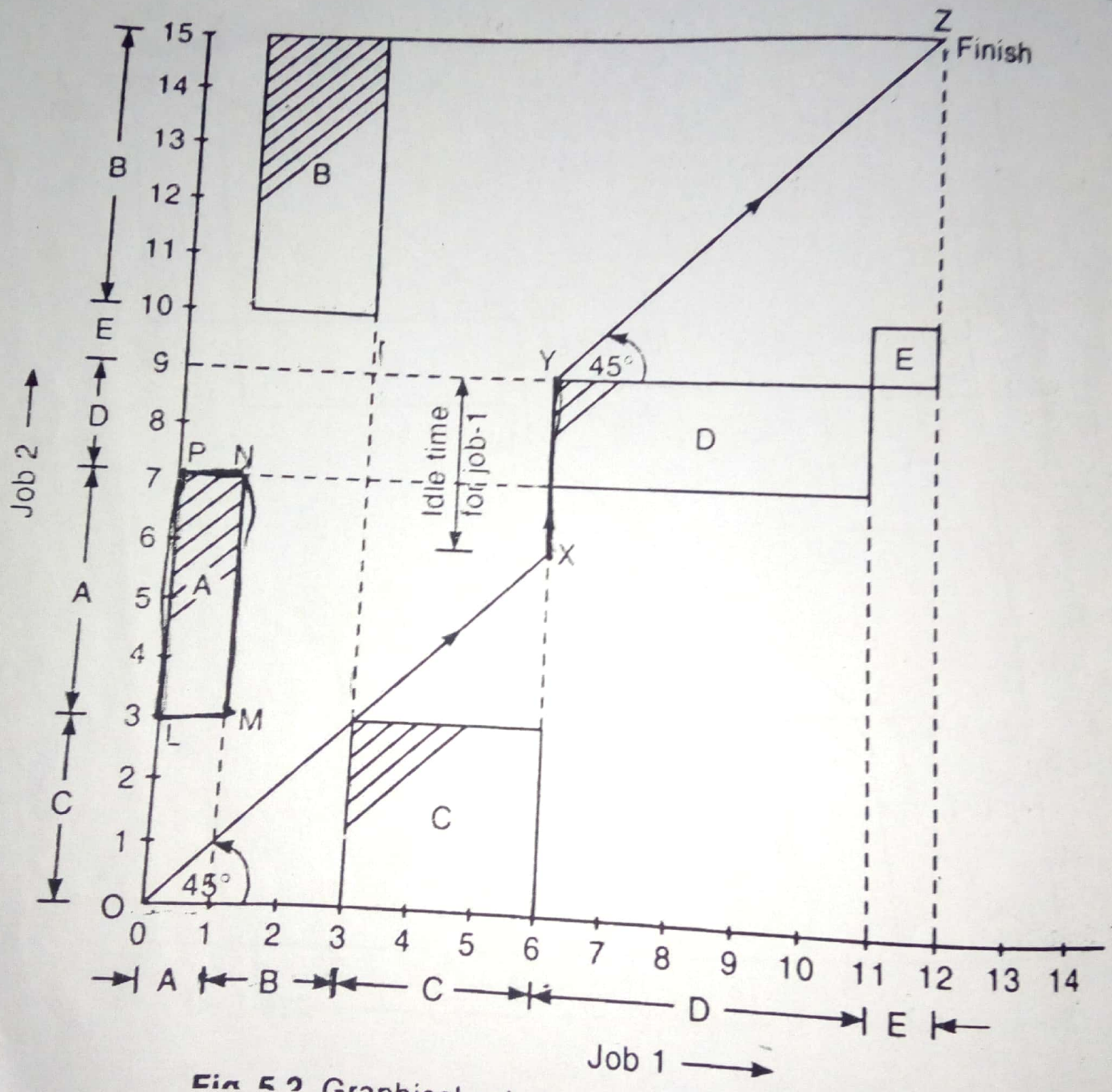



Fig 5.2 Graphical solution of 2 j