ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 2, Issue 3, May 2013

Computational Experiments on Assembly Line Balancing Problems Using Largest Candidate Rule

T. B.Kathoke[1], P.S.Ghawade[2], R.K.Waghchore[3], R.V.Paropate[4]

[1] Assistant Professor, Department of Mechanical Engineering, J.D.I.E.T, Yavatmal - 445001, India
[2] Assistant Professor, Department of Mechanical Engineering, J.D.I.E.T, Yavatmal - 445001, India
[3] Assistant Professor, Department of Mechanical Engineering, J.D.I.E.T, Yavatmal - 445001, India
[4] Assistant Professor, Department of Mechanical Engineering, J.D.I.E.T, Yavatmal - 445001, India

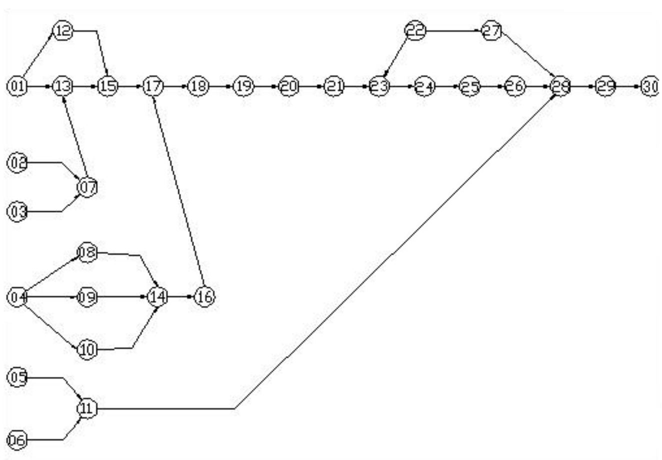
Abstract—This paper describes software development for assembly line balancing for doing experiments on shock absorber assembly line which is never to real life problem in the sense that resources on workstation are explicitly considered. The main objective of any assembly line balancing software is to assign task to workstation so that precedence constraints and cycle time constraints are not violated. This work adds resource constraints to the problem.

***Index Terms*— Case Study Computation Experiments, Line Balancing, Largest Candidate Rule, Zone & Resources.**

I. INTRODUCTION

Assembly line balancing is problem of assigning operation to workstations along assembly line in such a way that assignment is optimal in some sense. The assembly line balancing problem is how to group the assembly activities, which have to perform in an assembly task, then, put them into workstation, so that the total assembly time required at each workstation is approximately same[1,2]. The cycle time of the assembly line is determined by workstation with maximum total assembly time. The main objective of assembly line balancing software is to assign task to workstation so that precedence constraints and cycle time constraints are not violated [2]. This work adds resource constraints to the problem, which is not considered explicitly in any literature. This paper describes hypothetical case study of shock absorber which is computed by largest candidate rule.

II. CASE STUDY COMPUTATION EXPERIMENTS



The Precedence diagram of shock absorber is as shown above in fig.1 consists of about 30 tasks and the Table I shows Task times, Zones and Resources which are available for perform the operations [3, 7].

ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 2, Issue 3, May 2013

Table I

Task No	Task Code	Resources	Zone	Predecessor	Task Time
1	Task -01	Electrode gun	Left, Right	0	0.2
2	Task-02	Slot-02,Slot-04	Left	0	0.18
3	Task -03	Thinner00bv	Any	0	0.35
4	Task-04	Vernier caliper, Ring gauge ,Screw gauge	Left, Right	0	0.28
5	Task -05	Height gauge.	Left	0	0.12
6	Task-06	Height gauge	Left	0	0.12
7	Task-07	Thimble-07, Base-valve case holding fixture.	Front	2,3	0.15
8	Task-08	Thinner00pv	Left	4	0.40
9	Task-09	Bin-09	Left	4	0.21
10	Task-10	Bin-10	Left	4	0.21
11	Task-11	Trolley	Left	5,6	0.41
12	Task-12	Electrode gun	Right	1	0.28
13	Task-13	Inner Tube holding fixture, Pneumatic press tool	Left	1,7	0.18
14	Task-14	Assembly bin, Piston rod clamping fixture,	Left, Right, Front	8,9,10	0.35
15	Task-15	Sensor, Outer tube holding fixture	Left	12,13	0.28
16	Task-16	Piston rod clamping plate ,pneumatic hammer	Front	14	0.40
17	Task-17	Poka-yoka 17.	Left	15,16	0.15
18	Task-18	Damper clamping fixture.	Left	17	0.35
19	Task-19	Computer damper clamping plate, piston rod holding fixture	Left	18	0.22
20	Task-20	Sealing jaws,Bottam holding tool, damper clamping handle	Left	19	0.50
21	Task -21	Date code punch ,Sealing poka-yoka	Left	20	0.50
22	Task -22	Vernier caliper00sv	Left, Right	0	0.15
23	Task-23	Bottom holding fixture, thimble -23,Pressing tool	Right	22,21	0.40
24	Task-24	Vernier caliper 00n	Left	23	0.1
25	Task-25	Tube-25,Locktite	Right	24	0.1
26	Task-26	Pneumatic gun	Left	25	0.25
27	Task -27	Eyelet holding Fixture,Thimble-27,Pressing tool-27	Left	22	0.42
28	Task-28	Torque gun, Torque range, Clamping plate.	Left, Right	11,27,26	0.45
29	Task-29	Gauge -29	Left	28	0.30
30	Task-30	Box ,tube -30	Left, Right	29	0.20

Table II shows stations with their zones and resources.

ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 2, Issue 3, May 2013

Workstation No	Workstation Code	Resources	Zone
1	Station-01	Vernier caliper, Screw gauge, Ring guage,Bin-09,Bin-10,Assly bin, Piston rod clampingfixture,Thinner00pv,Piston rod clamping plate,Pnumatic hammer	Left, Right, Front
2	Station-02	Slott-02,Slott-04,Thimble-07,Base valve case holding fixture, Electrode gun, Inner tube holding fixture,Pnumatic press tool	Left,Front,Right
3	Station-03	Sensor, Outer tube holding fixture, Damper clampingfixture,Poka-yoka-17,Computer,damper clamping plate, piston rod holding fixture	Left,Front,Right
4	Station-04	Sealing jaws,Bottom holding tool, Damper clamping handle, date code punch, Sealing poka-yoka	Left, Right
5	Station-05	Vernier caliper00sr,Bottam holding fixture,Thimble-23,Pressing tool, Eyelet holding fixture,Thimble-27,Pressing tool-27	Left, Right
6	Station-06	Tube-26,Locktite, Gun-26,Vernier caliper00n	Left, Right
7	Station-07	Height gauge, Trolley, Torque gun (gun-28), Torque range, Clamping plate-27	Left, Right
8	Station-08	Gauge -29, Box, Tube-30	Left, Right

Table II

A. According To Zone and Resources

From the information of resource and zone requirement for different tasks & availability of workstations, it is decided which task is assignable to which workstation and problem is solved by largest candidate rule is described below.

B. According To Largest Candidate Rule

In this method, work elements are arranged in descending order according to their task time Assign elements to the worker at the first workstation by starting at the top of the list and selecting the first element that satisfy the precedence requirement & does not cause the total sum of task times at the station to exceed maximum allowable service time; when an element selected for assignment to the station, start back at the top of the list for subsequent 'assignment. When no more station element can be assigned without exceeding maximum allowable service time, then processed to the next station. Repeat steps above for the other stations in turn until all elements have been assigned [4, 5].The procedure of tasks assigns the works explained below with the help of flowchart as shown in Fig.2.

From the Precedence Diagram it is observed that Task-01, Task-02, Task-03, Task-05&Task-06 are free task i.e.no predecessor.

The zone & resources is required for Task-04 is available at Station-01 but the zone & resources required for Task-04 is available at Station-01 but the zone & resources of Task-01,Task-02,Task-03,Task-05& Task-06 are unavailable at Station-01 so ,Task-04 is assign at the top of the list on Station-01.The Task-08,Task-09 & Task-10 will start only when Task-04 is completed & Task-14at the end of Task-08,Task-09&Task-10 as well as Task-16 only after the completion of Task-14.Task-08 (0.40min) has more task time than Task-09&Task-10 as well as Task-09 &Task-10 has same task time Therefore,Task-08 assign after Task-04 & then Task-09,Task-10,Task-14 &Task-16 are assigned respectively one after one as shown in Table III.Repeat the procedure for all station.

ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 2, Issue 3, May 2013

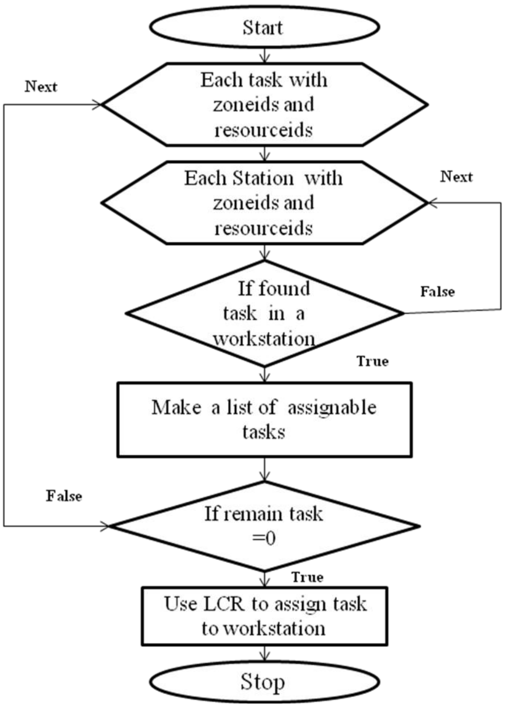


Fig 2. Flowchart

C. Cycle Time

An assignment of each task to a station such that the precedence constraints and further restrictions are fulfilled the set *Sk* of tasks assigned to a station k = *(1, m)* constitutes its station load, the cumulated task time is called station time. When a fixed common cycle time c is given a line balance is feasible only if the station time of neither station exceeds c. In case of *t (Sk)* < *c*, the station k has an idle time of *c – t (Sk)* time units in each cycle [4,6].For example, Station 1 has a cycle time 1.85 min, which is the sum of the all tasks on station 1.It is observed that After comparing all workstations cycle time, the maximum cycle time is on workstation 1 i.e. 1.85 min, which is considered to be fixed common cycle time and idle time, cumulative idle time, total idle time calculated for all stations as shown in Table III.

Table III

Workstation Code	Task Code	Predecessors	Task Time	Cycle Time	Idle Time	Cumulative Idle Time	Total Idle Time
Station-01	Task-04	0	0.28	1.85	0	0	
	Task-08	4	0.40				
	Task-09	4	0.21				
	Task-10	4	0.21				
	Task-14	8,9,10	0.35				
	Task-16	14	0.4				
Station-02	Task-03	0	0.35	1.34	0.51	0.51	
	Task-01	0	0.2				
	Task-12	1	0.28				
	Task-02	0	0.18				
	Task-07	2,3	0.15				
	Task-13	1,7	0.18				
Station-03	Task-15	12,13	0.28	1	0.85	1.36	
	Task-17	15,16	0.15				
	Task-18	17	0.35				

	Task-19	18	0.22				6.59
Station-04	Task-20	19	0.50	1	0.85	2.21	
	Task-21	20	0.5				
Station-05	Task-22	0	0.15	0.97	0.88	3.09	
	Task-27	22	0.42				
	Task-23	22,21	0.4				
Station-06	Task-24	23	0.1	0.45	1.4	4.49	
	Task-25	24	0.1				
	Task-26	25	0.25				
Station-07	Task-05	0	0.12	1.1	0.75	5.24	
	Task-06	0	0.12				
	Task-11	5,6	0.41				
	Task-28	11,27,26	0.45				
Station-08	Task-29	28	0.3	0.5	1.35	6.59	
	Task-30	29	0.2				

III. CONCLUSION

This software can be applicable to any type of assembly line problem only if all the information about task and workstation known and can be used any personnel computer with user friendly interactive presentation, provision to store case studies [8, 9] .The future scope is that help facilities can be used to make software more user friendly thus reducing skill level of user and future modification is developed software by considering operating cost factor and utility function also.

ACKNOWLEDGMENT

Words are often less to revels one's deep regards. With an understanding that works like this can never be the outcome of a single person, I take this opportunity to express my profound sense of gratitude and respect to all those who helped me throughout the duration Paper work.

REFERENCES

[1] Becker C. and Scholl A. 'A survey on problem and methods in generalized assembly line balancing' European journal of operation research, 2003.

[2] Emanuel Falkenauer "Line balancing in real world" proceedings of the International conference on Product lifecycle management PLM '05,360-370, 2005.

[3] Nils Boysen & Malte Fliedner & Armin Scholl, "A classification of assembly line balancing problems," JenaerSchriftenzurWirtschaftswissenschaft23/2006, Friedrich-Schiller-UniversitätJena, Wirtschaftswissenschaftliche Fakultät, 17 june2006.

[4] Mikel P.Groover 'Automation, Production system and computer integrated A manufacturing' Prentice-Hall India Limited, New Delhi, 1996.

[5] PatricR.Mcmullen, Gregoryv.frazier "A heuristic for solving mixed model line balancing problem with stochastic task durations and parallel station", Int J.production economics 51(1997) 177-190.

[6] E.S.Buffa'Modern production/operation management' Wiley Eastern Limited, 1991.

[7] Nikhil S. Gujarathi, Rohit M. Ogale, Tarun Gupta "Production capacity analysis of a shock absorber assembly line using simulation" Proceedings of simulation conference R.G.Ingalls,M.D.Rossetti,J.S.Smith & B.A.Peters,eds. Winter 2004.

[8] Mastering visual basic 6.0.

[9] David I.Schreider "Computer Programming Concepts and Visual Basic", University of Phoenix (College of Information Systems and Technology).

AUTHOR BIOGRAPHY

T.B.Kathoke: He is post –graduated in M-tech (CAD/CAM). He is working as a assistant Professor in J.D.I.E.T, Yavatmal. He has presented one research paper in international conference and published one research paper in international Journal.

ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 2, Issue 3, May 2013

P.S.Ghawade: He is post –graduated n Production technology & management .Currently, He is working as a assistant Professor in J.D.I.E.T, Yavatmal. He has presented three research papers in International Conference & one in international journal.

.**R.K.Waghchore:** He has completed M-Tech in CAD/CAM.. He is working as assistant Professor in J.D.I.E.T; Yavatmal .he has presented one research paper in international conference and published one research paper in international Journal.

R.V.Paropate: He has post graduated in M-tech (Production). He is presently working as assistant Professor in J.D.I.E.T; Yavatmal .He has presented two research papers in international conference & two research paper international journal.