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Analysis of Plant Layout for Reducing Production Cost

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ABSTRACT

This research aims to improve the plant layout of steel flat manufacturing factory to eliminate obstructions in material flow and thus obtain maximum productivity in relatively less cost. The present plant layout and the operation process of each section (i.e. preheating furnace, rough rolling, intermediate rolling, finish rolling, cutting and inspection) have been investigated. The problem in term of processing time, stack time, distance moved, material handling cost and processing cost of each operation section was identified. The result showed that the machine center rough rolling, intermediate rolling, cutting machine and inspection sections should be allocated to make the good material flow. The suitable of new plant layout can decrease the distance of material flow, which minimize production cost.

KEYWORDS: Plant layout, Rolling, Material flow, Manufacturing

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1. INTRODUCTION

A good placement of facilities contributes to the overall efficiency of operations and can reduce until 50% the total operating expenses (Tompkins et al., 1996). Simulation studies are frequently used to measure the benefits and performance of given layouts (Aleisa & Lin, 2005). regrettably, layout problems are known to be complex and are commonly Non-Polynomial-Hard (Garey & Johnson, 1979). As a consequence, a remarkable amount of research has been carried out in this area during the last 10-15 years. A few surveys have been published to review the different trends and research directions in this area.

- **Definition of layout problems**

A facility layout is an arrangement of everything needed for production of items or provide services. A facility is an entity that facilitates the performance of any job.

2. ANALYSIS OF ORIGINAL PLANT LAYOUT

This case is based on a steel flat manufacturing factory, where located in India. Flat size is 70X7 10 to 15 feet long. Flats are used in the automobile vehicles as leaf spring. Steel flats are made from steel ingots. This factory has been design the plant layout based on process layout was shown in Fig. 1. The initially flat production starts from preheating furnace where steel ingots get preheated, along with rough milling then their materials moved to intermediate millings, finishing millings, and cutting machine respectively. The steel flats are investigated by inspectors at inspection section, following kept at warehouse. The details of each section were described as follow.

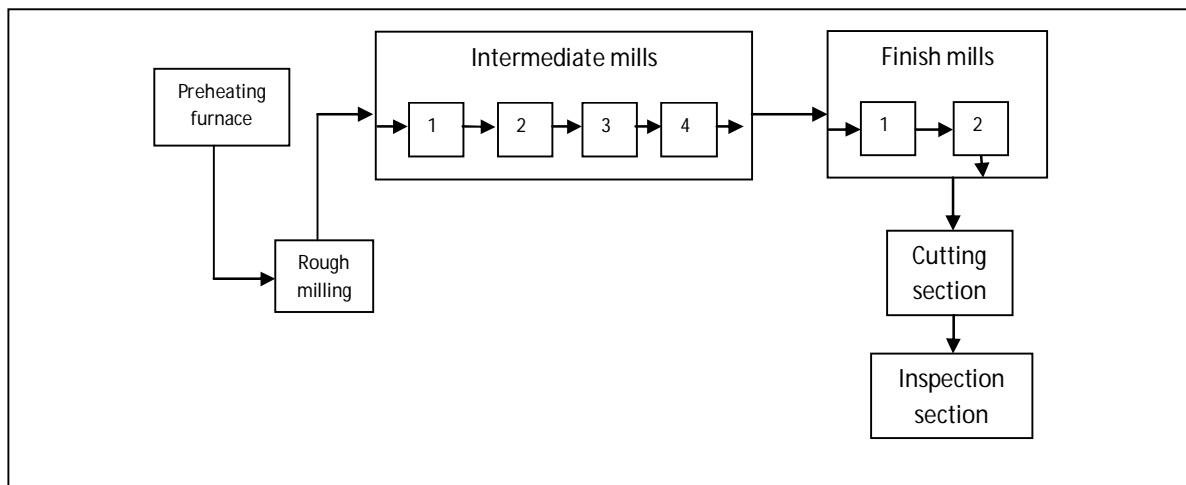


Fig: 1 Base case (current shop layout: It is multi row Layout)

(a)Preheating furnace: It is the section where steel ingots get preheated is about to 1140°C the preheating is done 2 hour in furnace at the time of heating the size of ingot remain unchanged.

(b)Rough milling: After coming out from furnace it goes to roughing mill where ingot of 4” thickness may be reduced upto 1 1/2” and this milling is not a precision milling.

(c)Intermediate millings: After coming from rough mill the ingot goes to intermediate mills 1, 2, 3, and 4 accordingly thickness of flat changes from 1 1/2” to 12 mm.

(d)Inspection section: It is the place where inspection done by the trained quality inspector.

3. EXPERIMENTAL ANALYSIS OF PROPOSED PLANT LAYOUT

According to the study of the manufacturing process, the details for plant design layout and flow of material from machine center like Preheating furnace, Rough milling, Intermediate millings, Finish millings, Cutting section and Inspection section are described in table 1.

S. No	Machine	Preheating furnace	Rough mill	Intermediate milling				Finish milling		Cutting	Inspection	Total
				1	2	3	4	1	2			
1	Processing Time	300	13	9	7	12	8	8	11	7	9	384 Sec.
2	Slack time	10	9	12	9	7	12	13	12	370	7	461 sec.
3	Distance moved	6.06	3.5	5	1.21	1.06	1.06	1.27	1.27	9	9	38.43 Mtr.
4	Material handling cost	26	41.77	30.69	4.69	4.69	4.69	4.69	4.69	54.66	62.42	238.99 Rs

After studying on the mentioned information, the new plant layout design is created by setting the Rough milling; intermediate millings, Finish millings and Cutting section are described in table 2. In addition, the inspection section is improved to prevent an error of mixed-up product types.

S. No	Machine s	Preheating furnace	Rough mill	Intermediate milling				Finish milling		Cutting	Inspection	Total
				1	2	3	4	1	2			
1	Processing Time	300	14	11	9	10	7	7	12	7	9	386 sec.
2	Slack time	10	7	10	8	6	11	12	12	366	5	447 sec.
3	Distance moved	6.06	3.3	4.20	1.26	1.3	1.26	1.4	1.48	5.0	3.5	28.76mtr
4	Material handling cost	26	41.51	29.52	4.69	4.69	4.69	4.69	4.69	15.91	61.25	197.64Rs

The difference between old and new layout design is shown by table 3.

S. No	Machines	Preheating furnace	Rough mill	Intermediate milling				Finish milling		Cutting	Inspection	Total
				1	2	3	4	1	2			
1	Processing Time	0	1	2	2	-2	-1	-1	1	0	0	2 Sec.
2	Slack time	0	-2	-2	-1	-1	-1	-1	0	-4	-2	-14 Sec.

3	Distance moved	0	-0.2	-0.8	0.05	0.24	0.2	0.13	0.21	-4	-5.5	-9.67 Mtr.
4	Material handling cost	0	-0.26	1.17	0	0	0	0	0	38.75	-1.17	-41.35 Rs.

By rearranging the plant layout the following changes are made in slack time, distance moved and material handling cost.

(a)Distance moved: It is the distance traveled by the product for processing from one machine to another machine which can be reduced by rearranging the plant layout. So the distance move is reduces in new layout 20 cm between preheating furnace and rough milling, 80 cm between rough milling and intermediate milling 1, 4 meter between finish milling 2 and cutting section and 5.5 meter between cutting section and inspection section.

(b)Slack time: It is the time taken by the product to move from one machine to next machine.

(c)Material handling cost: It is the cost of man and machine which is required to convey the material from one machine to another. The material handling cost is reduced because of reduction in distance travel. The cost is lesser than the old layout 26 paisa for rough milling, 1.17 Rs for intermediate milling 1, 38.75 Rs for cutting section and 1.17 Rs for inspection section per ton.

4. CONCLUSION

According to the analysis of the workflow for the steel flat, it was found that rough milling, intermediate millings, finish millings, cutting section and inspection section should be modified for the layout for convenient workflow. The distance of workflow from the modified plant layout of their sections can be minimized. It also improving workflow and the accidents from objects which were not in order during material transportation can be decreased. Finally, rearranging layout decreased distance and time consumption in flow of material and accidents, resulting in an increase in productivity.

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