Increased Productivity and Planning By Improved Plant Layout Using Systematic Layout Planning at NCRM Division, Bhushan Steels Ltd. Khopoli, Mumbai

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Abstract-The objective of this research is to study plant layout of NCRM (Narrow cold rolling mill division) of Bhushan steels Ltd. Mumbai based on the systematic layout planning pattern theory (SLP) for increased productivity. In this case study, amount of equipments and tools in rolling coil production are studied. The detailed study of the plant layout such as operation process chart, flow of material and activity relationship chart has been investigated. The new plant layout has been designed and compared with the present plant layout. The SLP method showed that new plant layout significantly decrease the distance of material flow from pickling process until packing in packing department.

Keywords—Plant layout, NCRM, Systematic Layout Planning, Flow analysis, Activity relationship chart

I. INTRODUCTION

WITH rapid increasing of demand in production, industrial factories need to increase their potentials in production and effectiveness to compete against their market rivals. At the same time, the production process needs to be equipped with the ability to have lower cost with higher effectiveness. Therefore, the way to solve the problem about the production is very important. There are many ways i.e. quality control (QC), total quality management (TQM), standard time, plant layout to solve the problems concerning productivity. For example, a case studies from the lamp industry [1]. The found problem was that the staff did not work in orderly manner, resulting in confusion and no standard time nor facilitating tool. The staff spent too much time on work. The way to solve these problems was to improve the steps in working and the area where they worked through observation and fieldwork as well as proposing tools to facilitate the work to set balance and find the standardized time. In additional Yookkasemwong et al. [2] studied the production process for Cable box to form metal. The problem was that the work could not be finished within 8 hours. The problem was then studied from data collection, the actual time load, improper plant layout, and the duration of the process. The principle of ECRS was adapted to reduce the waste and arrange the repeated steps, resulting in changes in plant layout and staff workload. The impact of improper plant layout on the manufacturing process for valve and metal parts production has been studied. The plant layout was changed to comply with the international standards through SLP method [3]. Sucharitkul et al. studied the possibility of plant layout and installing aluminum foundry [4]. As for the layout of plant, it was done in accordance with the steps in systematic plant layout design. Yujie et al. studied the general plane of long yards using SLP which the best layout showed the good workflow and practical significance [5]. According to the researches mentioned above, plant layout is one way to reduce the cost of manufacturing and increase the productivity. Also increases good workflow in production route. This research describes original plant layout, material flow analysis, which includes area and distance between operation A and B, through such a rolling coil steel industry that was case study. From the

experience in rolling coil steel industry, it was found that there was wasted time or delay in manufacturing, that is to say, the movement of the material in long line and interrupted flow as well as useless area of the plant. According to these problems, the researchers would like to analyze the way to solve such problems and find the way to improve the plant layout. The basic industrial layout planning is applied to systematic layout planning (SLP) method in which showed step-by-step of plant design from input data and activities to evaluation of plant layout. This method provides the new plant layout that improves the process flow through the plant, and help to increase space in industries.

II. PROCEDURE FOR PLANT LAYOUT PLANTING

The data were collected and the number of tools/ equipment for manufacturing was counted in terms of the direction for raw materials and product. The operation process chart, flow of material and activity relationship chart have been used in analysis. The problem of the plant was determined and analyzed through SLP method to plan the relationship between the equipments and the area. The framework of SLP is shown in Fig. 1. Based on the data such as product, quantity, route, support, time and relationships between material flow from –to chart and activity relation chart are displayed. From the material flow and relationship activity in foundry production, the relation between each operation unit can be observed. Then the results were drawn through the comparison between the existing manufacturing process and the proposed way.

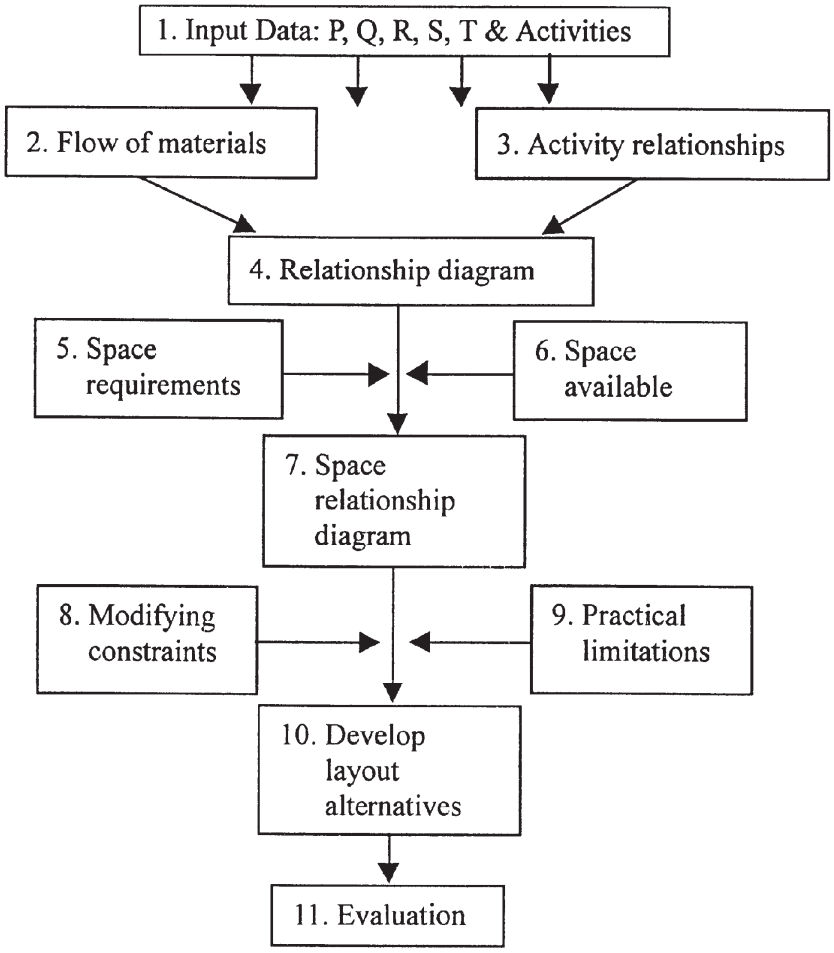


Fig. 1 Systematic layout planning method [3]

III. ANALYSIS OF NCRM PLANT LAYOUT

In this study, the rolling coil as production was mostly made to customer's order. The manufacturing process was shown in Fig. 2 along with the flow of the operation process. The size of the equipment was relational to the area as shown in Table 1 and 2. The industry would produce rolling coil with weight and width according to order. According to the original plant layout, the flow of the material, the utility of the area in the plant and material handling equipment could be discussed as follows:

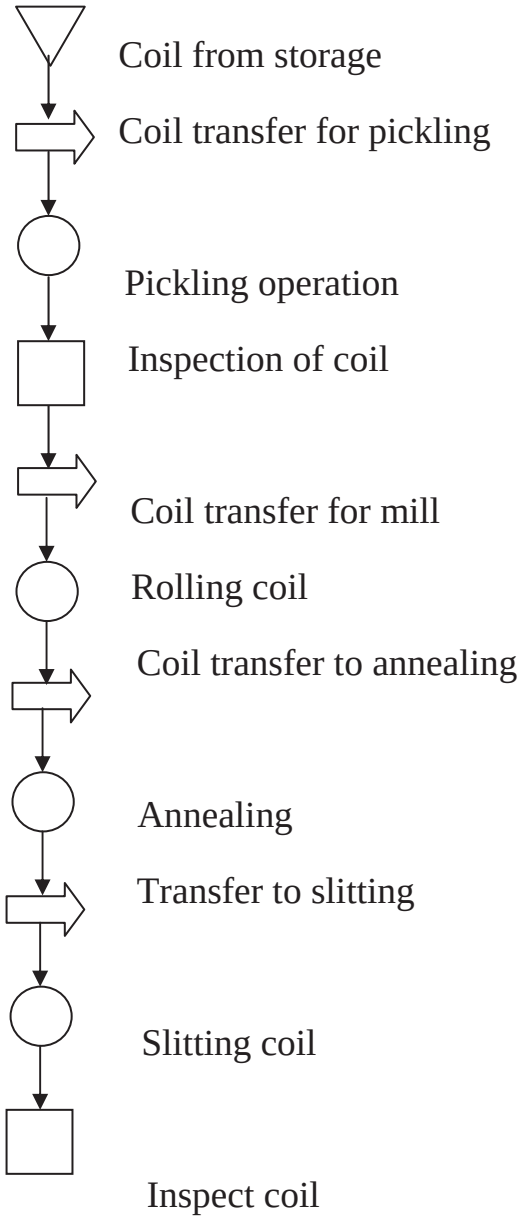


Fig. 2 Flow of operation for rolling coil [06]

TABLE- I

RELATIONSHIP BETWEEN EQUIPMENT SIZE AND AREA

Sr. No.	Department	Machine type	Number of machines	Machine area area/Working area (m2)	Total working area(m2
1.	Pickling	pickling	1	700	700
2.	Mill	Rolling mill	2	300	350
3.	Annealing	Bell Furnace	3	800	800
4.	Skin pass	Rolling mill	1	300	312
5.	CR Slitting	Slitting machine	3	300	500
6.	Packing	manually	-	-	500
7.	Ware house	Storage	-	-	1500

[07]

TABLE-II

DISTANCE COVERED BY ROLLING COIL IN NCRM (Original plant layout)

Sr. No.	Operation	Distance covered (In meter)
1.	Ware house	-
2.	Ware house to Pickling	40
3.	Pickling to rolling mill	20
4.	Pickling to slitting	30
5.	Rolling mill to annealing	20
6.	Slitting to HTSS	50
7.	Annealing to Skin pass	20
8.	Skin pass to slitting	20
	Total distance covered	**200**

[07]

A. The Flow of Materials

Raw materials were carried with long distance and that means a waste in time and energy, resulting in high cost as shown in Table 1, 2 such as moving the rolling coil from warehouse to Pickling for 30 meters, resulting wasted time and more energy.

B. Utility of the Area

The area was not used to the full potential because old machine and remaining materials were still there in the working area, resulting in useless area of the plant. The department of maintenance was still spacious and adjacent to the area where the raw materials were kept, resulting in limited area for storing raw materials. Thus, this affected the cost of energy.

C. Material handling equipment

The material handling equipment of the raw materials was not good enough, that is to say, Cranes and trolley was used to move the coils and the pathway was not flexible enough due to untidy arrangement of the things. This was the reason why the raw materials were to be carried for a long distance.

D. Storage area of Coils

Actually warehouse for Rolling coils or the raw materials was 1500 square meters. One Rolling coil took up 3 m2 so the plant could contain rolling coil for 5000 tons per month on ground and same amount of coil could arrange on these coils. The plant at the present time could contain only 8,000 tons per month. After the improvement, it had more space to contain billet or raw materials.

IV. ANALYSIS PLANT LAYOUT BASED ON SLP

According to the study of the manufacturing process, it was found that the long distance could be reduced for moving raw materials and the problem about useless area could be solved. The way to improve the plant was to apply SLP method to make the work flow continually by arranging the important sequence of the manufacturing. The details for each activity were described in Table 3, as follows:

1. A = Ware house

2. B = Pickling Process

3. C = Rolling Mill

4. D = Annealing Process

5. E = Skin pass

6. F = CR Slitting

7. G = High Tensile steel strip

8. H = Packing

The important sequence of each activity was rearranged from the most important one to the least important one as shown in Fig 3. The intensities of flow from each activity to another were developed in Fig 4.

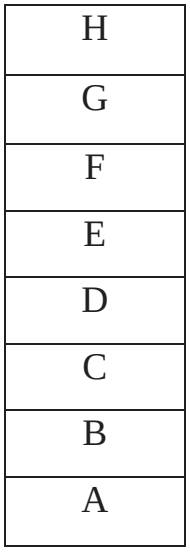


Fig. 3 The sequence of activities in the manufacturing process

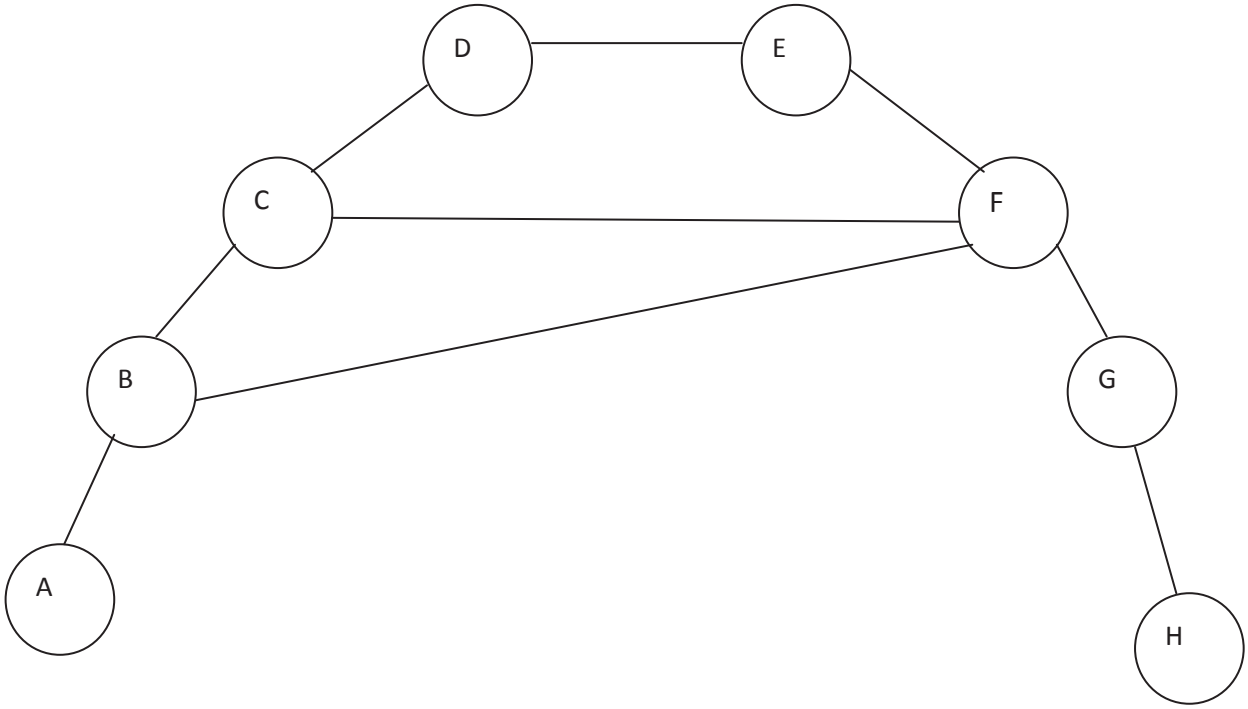
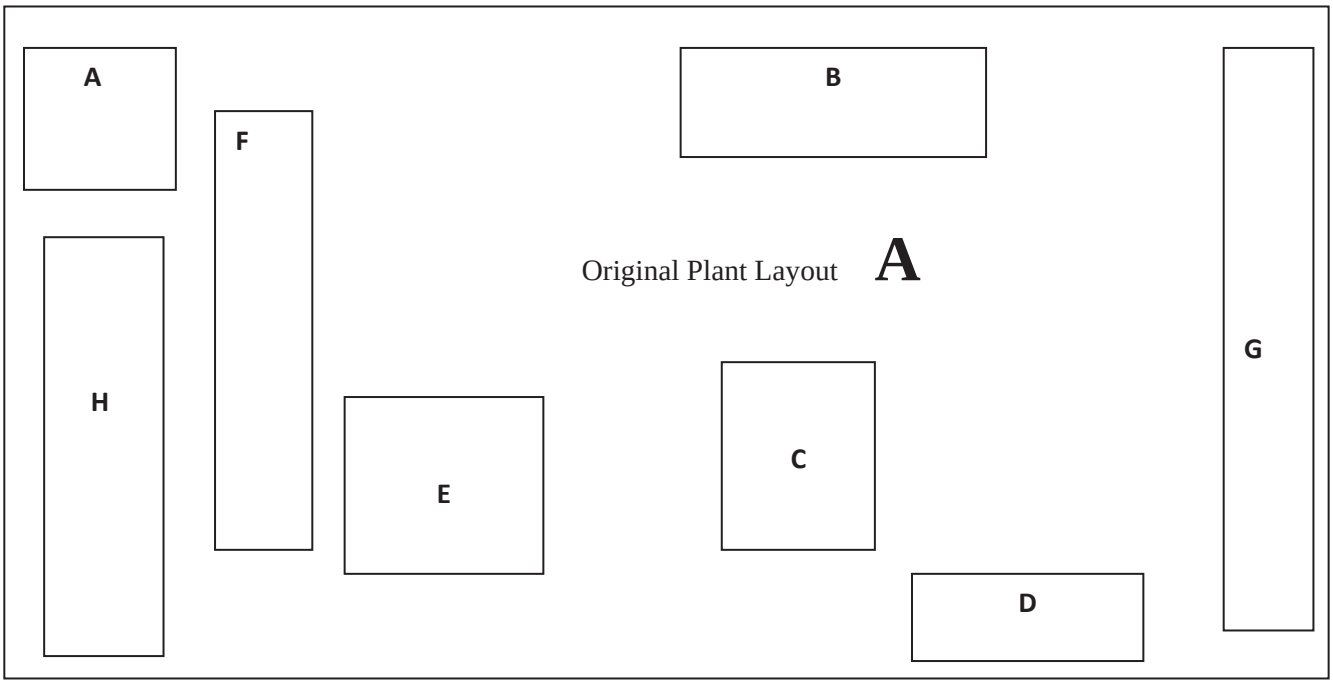


Fig.4 The intensities of flow in the manufacturing process

Based on modifying plant layout and practical limitations, a number of layouts were developed. There were improved the plant layout as shown in Fig 6. The original plant layout represents A, while modified plant layout represents B .



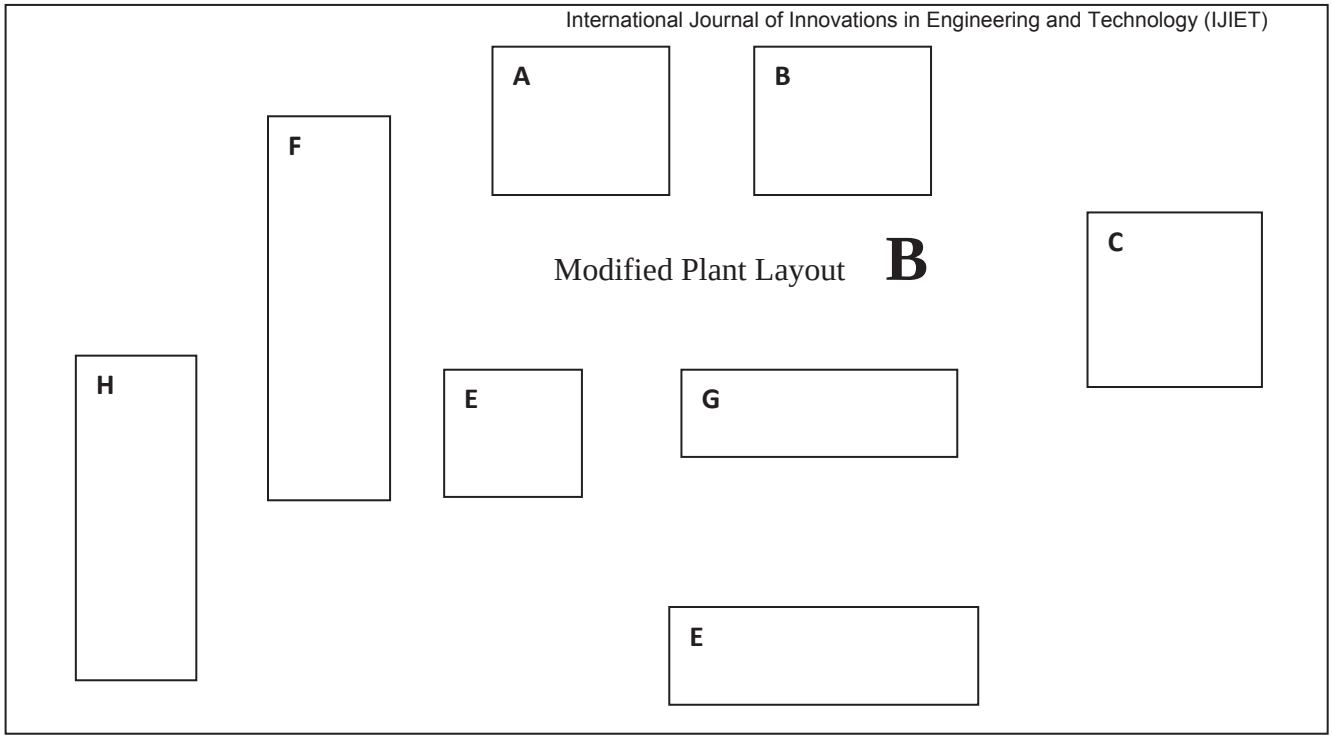


Fig. 5 Plant layout between origin and improvement

TABLE-IV

Sr. No.	Operation	Distance covered (In meter)
1.	Ware house	-
2.	Ware house to Pickling	20
3.	Pickling to rolling mill	20
4.	Pickling to slitting	30
5.	Rolling mill to annealing	20
6.	Slitting to HTSS	20
7.	Annealing to Skin pass	20
8.	Skin pass to slitting	20
	Total distance covered	**150**

According to the analysis of the workflow for the Rolling coil , it was found that the distance of ware house to the Pickling can reduced approx. 20 Meter. It is also found that the distance between slitting department and High Tensile steel strip department (HTSS) can also reduced approx. 30 Meter. According to Table –IV 50 Meter Distance can be reduced during the above given process. Finally, rearrange layout decreased flow of material, resulting in increased production.

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