Analysis Plant Layout Design for Effective Production

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***Abstract*—This research aims to improve the plant layout of pulley's factory to eliminate obstructions in material flow and thus obtain maximum productivity. The present plant layout and the operation process of each section (i.e. sand mold, core ware house, core making, disassembly surface finishing, furnace, and inspection sections) have been investigated. The problem in term of material flow of each operation section was indentified. The result showed that disassembly surface finishing 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 rises production.**

***Keywords*—plant layout, material flow, production,**

I. Introduction

In industry sectors, it is important to manufacture the products which have good quality products and meet customers' demand. This action could be conducted under existing resources such as employees, machines and other facilities. However, plant layout improvement, could be one of the tools to response to increasing industrial productivities. Plant layout design has become a fundamental basis of today's industrial plants which can influence parts of work efficiency. It is needed to appropriately plan and position employees, materials, machines, equipments, and other manufacturing supports and facilities to create the most effective plant layout.

In the present, there are several methods for plant layout design such as systematic layout planning (SLP) [1,2], algorithms [3,4], and arena simulation [5] can apply to design plant. Yujie *et al*. [1] studied SLP method to design the overall layout of log yards, the result showed the good workflow and was possible rearrangement pant layout under significance. Plant layout analysis and design for multi-products line production has been studied by Jaturachat *et al*. [5] .This work was carried out to investigate the suitable plant layout design for denture manufacturing. The suitable 4 plant layout models were designed and compared the efficiency of each plant by adjacency-based scoring. Moreover, line balancing was done to allocate human resource by using simulation programming (Arena 10) to find the increasing productivity of the new improvement layout. These thus reflect the importance of the plant layout design to bring about an increase in productivities. Yet, plat layout design is complicated due to many related factors such as employees, workflow, machine positions, and the relationship between machines and work. These factors result in plant layout improvement planning. Moreover, investment is required for machine positioning. Hence, the primary step for plant layout improvement should be started with indentifying the problems of the current plant layout in order to maximize the productivities at the minimized investment. This research therefore aims to find out the causes of discontinuous work flow in pulley plant resulting from the plant layout. The researchers of this research have studied on the problems occurred to improve the plant layout and minimized the budget for the improvement.

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II. Plant layout planning

A. Procedure for Plant Layout Designs

The sequences of procedure following three steps were described.

1. The fundamental of plant layout was studied.
2. Machines are collected
3. The process for product production has been used in analysis.
4. The present plant layout was analyzed to identify the problem under flow material and operation.
5. The suggestions were collected to write the report and were proposed to authorize to make decision for rearrangement the plant layout.

B. Analysis of original plant layout

This case is based on a Pulley factory, where located in Thailand. Pulleys, size 2 rong 5 inch, were produced 320 pieces of day. Pulley systems are used in the real world to lift large masses onto tall heights**.** Pulley is made from a wheel and a rope. This factory has been design the plant layout based on process layout was shown in Fig. 1. The initially pulley production, metals from scrap yard were moved to furnace for melting, along with core making then their materials moved to sand mold and disassembly and surface finishing section respectively. The pulleys are investigated by inspectors at inspection section, following kept at warehouse. The details of each section were

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described as follow. In additional the size and number of equipments was relational to area as shown in Table 1.

1. **Sand plant** is the section with approximately 212 m^2 working area. It is the starting point of the manufacturing process.
2. **Core making** is the section which produces cores starting with moving the sand in to make the cores. Then the cores will be stored in core store.
3. **Core store** is the section which stores the cores to use in the manufacturing.
4. **Sand mold section** is the section continues from the sand plant and core making sections where the workers put the sand into the mold and compress it with jolt squeeze machine. The core is then inserted in each sand mold and all sand molds are moved to wait for pouring molten metal.
5. **Furnace section** is the section which the plant uses cupola furnace for a metal casting. When the work is added with the molten metal and left for 1 night, it is then moved to disassembly and surface finish sections.
6. **Disassembly and surface finish section** is the section which disassembles the mold and finishes the work's surface before sending it for quality inspection.
7. **Inspection** is the section which inspect whether the work has defect such as crack or fin. The work with defect identified will be sorted out while the work with no defect will be sent to warehouse to wait for the delivery to customers.

TABLE I. RELATIONSHIP BETWEEN EQUIPMENT SIZE AND AREA

Department	Total working area (m^2)	Number of equipments and machines	Material handling
Sand plant	212.4	2	2
Sand mold by machine	386.56	16	-
Core store	25.92	-	-
Core making	29.4	10	-
Inspection	98.15	1	-
Disassembly surface finish	19.47	2	1
Melting casting	106.2	2	6
Inventory	2.25	-	1
Sand mold by hand	53.1	-	-
Raw material	48.01	-	-
Scrap yard	33	1	-
Sand ware house	35	-	1

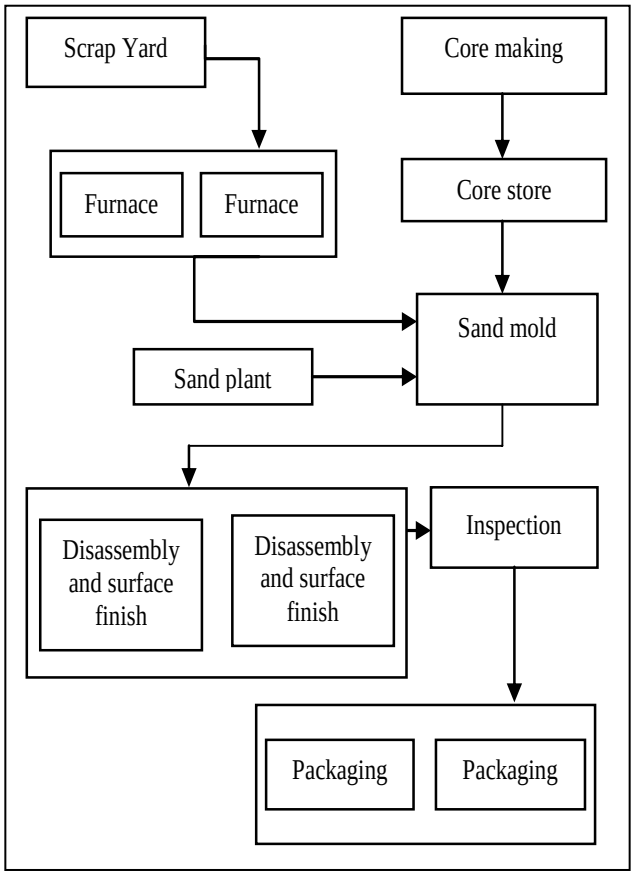

Figure 1. Process layout of Pulley production

III. ANALYSIS PLANT LAYOUT

According to the study of the manufacturing process, the details for flow of material, the sand mold, core ware house, core making, disassembly and surface finishing, inspection sections, and material handling equipment were described as follows.

A. Sand mold

This section makes a mold with a jolt squeeze machine and locates at the east area of the plants. The area consists of zones for making molds and placing finished molds to wait for pouring molten metal. All zones are clearly separated and work on different types of works. The problem found is that the wall separating sand mold and furnace causes an indirect path between these two zones which increase the time consumption for molten metal transferring.

B. Core warehouse

It is located almost at the building's end near the furnace. The section is a rectangle room surrounded by metal fence and one door for entrance and exit. Inside the room, cores are all placed on the floor which causes inconvenience in getting them for usage. Thus, there should be shelves to orderly place the cores.

C. Core making

This section is located at the building's end with brick furnace set up orderly. However, there is untidy placement

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of some works such as cores around the furnace which may cause an accident. Therefore, the core making and core warehouse sections should be moved to be adjacent in order to reduce the time consumed in core transferring. Besides, the 5 S training should be emphasized to employees for work habit improvement.

D. Disassembly and surface finishing

The distance from sand mold section to disassembly and surface finishing section is far with indirect path, causing longer time in transferring works. The problem should be solved by relocating disassembly and surface finishing section to be in between sand mold section and inspection section with shorter direct path. This could reduce the distance and time in transferring works

Inspection section

This section inspects work as the last step of the process before moving the works to warehouse or delivering to customers. The problem occurred is that the all types of works are placed together without separation causing all products to mix up.

After studying on the mentioned information, the new plant layout design is created by setting the disassembly and surface finishing section to be in between sand plant section and inspection section (Fig.2). In addition, the inspection section is improved to prevent an error of mixed-up product types.

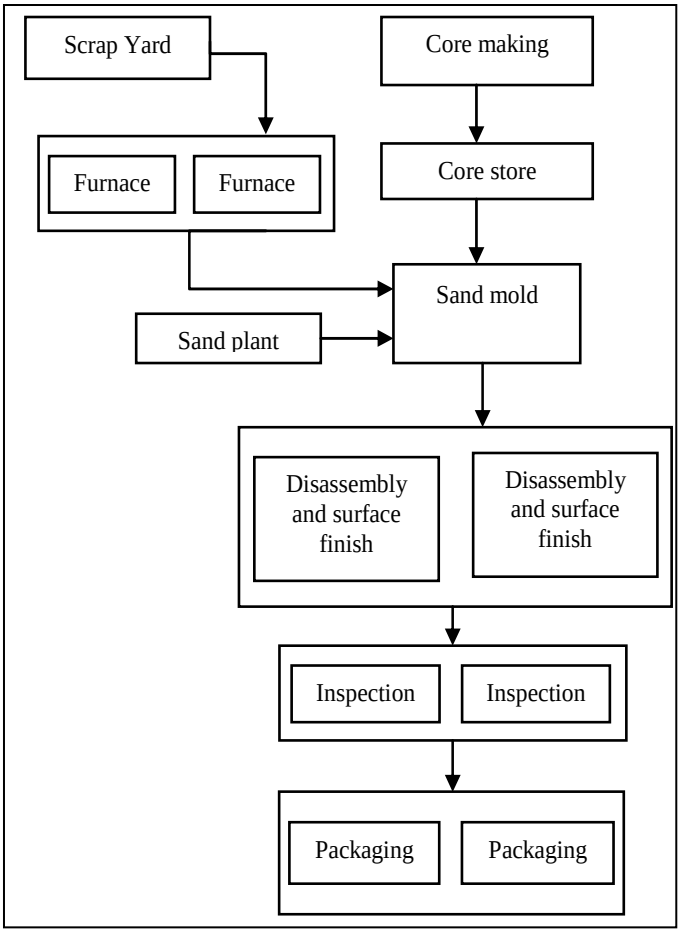

Figure 2. Process layout of Pulley production

IV. Conclusion

According to the analysis of the workflow for the pulleys with the size of 2 rong 3 inch, it was found that sand mold, disassembly and surface finishing, core ware house, core making, furnace, and inspection sections should be modified for the layout for convenient workflow. The distance of workflow from the modified plant layout of their sections can be reduced. Not only improving workflow but also 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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