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Improvement of Plant Layout for better Productivity by using Simulation

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ABSTRACT— This report aims to improve the plant layout of casting industry to eliminate obstructions in material flow and thus obtain maximum productivity of employee as well as plant. The efficiency of production depends on how well the various machines; production facilities and employee's amenities are located in a plant. Only the properly laid out plant can ensure the smooth and rapid movement of material, from the raw material to the end product. Plant layout encompasses new layout as well as improvement in the existing plant layout. Plant layout is an important decision as it represents long-term commitment. An ideal plant layout should provide the optimum relationship among output, floor area and manufacturing process. It facilitates the production process, minimizes material handling,
time and cost, and allows flexibility of operations, easy production flow, makes economic use of the building, promotes effective utilization of manpower, and provides for employee's convenience, safety, comfort at work, maximum exposure to natural light and ventilation. It is also important because it affects the flow of material and processes, labor efficiency, supervision and control, use of space and expansion possibilities etc. The report aims simulating the exsiting layout, identifying the problemsassociated with it and generating improved layout of the manufacturing facility.

Keywords— Simulation, Plant Layout, Productivity, Efficiency

I. INTRODUCTION

A Little adjustment in the area of machines and equipment in a plant can increase the flow of materials; this also affects the production cost and efficiency of the entire plant process. Plant layout is the systematic arrangement of a company's physical facilities to enhance the efficient use of all machines, material, equipment, and workers. It can also be defined as the plan of planning an ideal facility arrangement, which include machines, storage area, workers, inventory path, and other services that enhance the production, alongside the design of an efficient structure to accommodate the facilities. A good plant layout is designed to offer competitive advantage to manufacturers by enhancing the flow processes of inventory and information, thereby leading to reduction in manufacturing cost and improved productivity. Thinklink, observed that "The production efficiency of a manufacturing unit depends on how well various machines, flow paths, storage facilities, and employee are located in the plant." They observed that a systematically designed plant layout will guarantee a smooth and rapid movement of material from the raw material stage to the end product stage. A properly designed plant layout provides an ideal synergy among raw materials, manufacturing processes, available space, and the output. It ensures the efficient utilization of all available space and flexibility of arrangements and manufacturing operations, streamline the movement of inventory in the entire manufacturing plant without unnecessary delays, maintains adequate turnover of materials, reduces lead time and cost of material handling, and also ensure the workers safety, comfort and convenience. A plant layout can be defined as follows: "Plant layout refersto the arrangement of physical facilities such as machinery,equipment, furniture etc. within the factory building in such amanner so as to have quickest flow of material at the lowestcost and with the least amount of handling in processing theproduct from the receipt of material to the shipment of thefinished product." It may be defined as a technique of locatingmachines, processes and plant services within the factory so asto achieve the right quantity and quality of output at the lowestpossible cost of manufacturing. It involves a judiciousarrangement of production facilities so that

workflow is direct.As far as small business is concerned, it requires a smallerarea or space and can be located in any kind of building aslong as the space is available and it is convenient. Plant layoutfor Small Scale business is closely linked with the factorybuilding and built up area. From the point of view of plantlayout, we can classify small business or unit into threecategories as Manufacturing units, Traders and ServiceEstablishments. The overall objective of plant layout is todesign a physical arrangement to meets the required output –quantity and quality most economically or Plant layout ideallyinvolves allocation of space and arrangement of equipment insuch a manner that overall operating costs are minimized.

II. LITERATURE REVIEW

One of the main goals of now day's aggressive condition ideal plant layout configuration assumes a fundamental role in the cost decrease by improving the productivity. In the attempt to reach this goals, many researchers have been study the plant layout design and simulation of layout and lean manufacturing. It improving the productivity and decreases material handling cost and removing the unnecessary work.

Charles Chikwendu and Chukwumuanya et al. [1]This paper provided a detailed definition of plant layout; and listed efficient labour utilization, manufacturing and maintenance ease, enhanced productivity, manufacturing flexibility, effective utilization of staff, machines, materials, and equipment, as well as reduction of accidents, hazards, and inventory handling cost as some of the benefits of a well-designed plant layout.

Atharva Bhave et al. [4] in this paper they have improved productivity of plant by changing plants layout. First of all for improving productivity of plant various tools and techniques were studied like Continuous improvement process, lean management, layout improvement, cycle time etc. Then they examined present layout of plant by calculating cycle time of operations and number of parts produced. It is observed that it is getting stuck at fettling stage and thereby increasing cycle time of manufacturing. Then concepts of CIP were applied for plant layout improvement. They proposed new layout and also control the movements of worker and again calculated cycle time and number of parts produces per hour. Tremendous improvement in plants productivity has been observed.

Mr. Anurag A. Polshettiwar et al. [13] have studied the existing plant layout and simulating the existing layout, identifying the problems associated with it and generating optimum layout of the manufacturing facility.

Darina Duplakova et al. [14], have studied simulation programs are very widespread tool in designing of new systems, improving the existing systems, etc. The simulation software is possible to apply in various sectors, e.g. production, logistics or the field of various services. This article is focused on the application of Witness – simulation software in the manufacturing process. The introduction of this article is focused on short description of simulation issue in the manufacturing processes. The last part of the introduction is focused on description of Witness simulation software. The material and method section describes the manufacturing process from which the simulation model is created and subsequently optimized.

Enrico Briano et al. [15] Modeling and Simulation techniques are often powerful tools devoted to analyze the best layout for an industrial plant. In fact, these methodologies allow investigating the most suitable features or parameters regarding for instance buffer capacities or the number and type of machines and facilities, like for in-stance handling means.An easy way to comply with the conference paper formatting requirements is to use this document as a template and simply type your text into it.

III. PROBLEM STATEMENT

The plant layout redesign for increase in efficiency was considered necessary because of some reasons: improper martial flow through the shop floor. They have more rate of rejection in casting because of improper material handling.

IV. METHODOLOGY

The Plant was visited for collecting the data. The manufacturing of this component is done by batch manufacturing process.

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a. Process Description

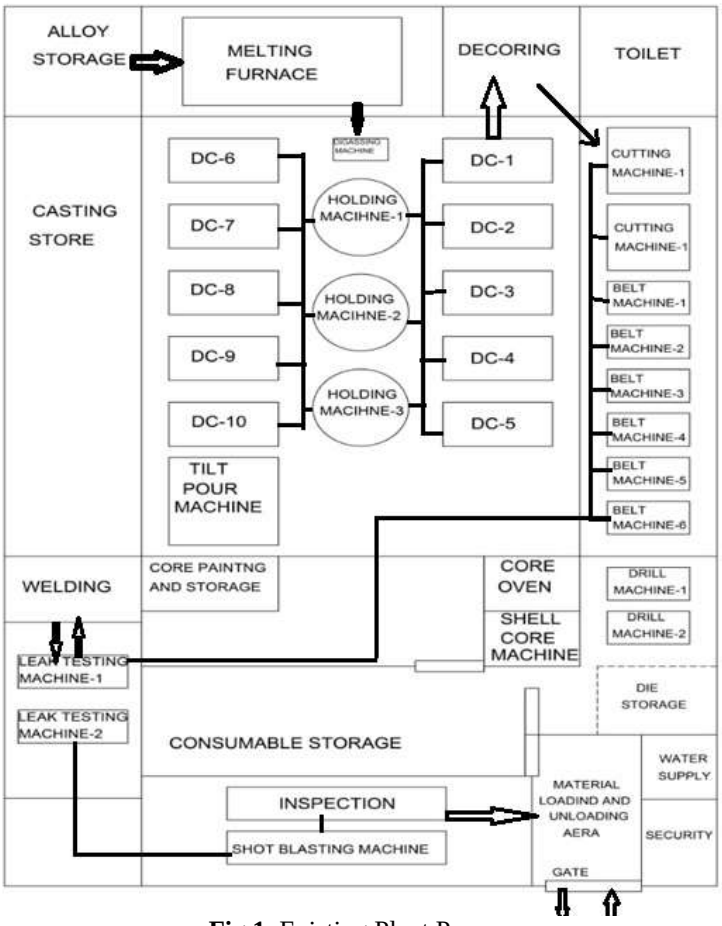

Fig 1. Existing Plant Process

Raw Martials enters thought the gate & raw material stored in storage room. After that it is send to melting furnace according to need of product lot. Then molten metal sent to holding furnace &afterword's sent to Degassing process. Side by side core making process is carried out & cores are paint & cores are baked in core oven of certain temp.

Well prepared molten metal & cores sent to GDC for casting of product. Casted product is sent to decoring machine for removal of cores. After decoring the runners & gating systems are cut by cutting machines. Decoring and cutting product are grinded by belt machines for remainingparting lines, corners & scratches etc. as per requirement casting product sent to drilling machine.

After all machining process casting is tested by leak testing machine. In that process defect in casting is observed then it will be sent to welding workshop for correction. Again it is checked by leak testing machine for leakage if leakage is found then process is repeated or good tested casting sent to shot blasting machine shop. After that it will be inspected by the quality supervisor & it is dispatched to another unit.

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B. Data Collected

Table 1 Observation Table

M/c	Avg. Cycle Time(sec)	Output/shift	Idle Time
GDC 1	141	20	38
GDC 2	87	30	24
GDC 3	116	21	36
GDC 4	120	20	35
GDC 5	119	19	33
GDC 6	148	15	60
GDC 8	178	12	85
GDC 9	121	22	34
GDC 10	118	20	35
Cutting M 1	19	1890	2
Cutting M 2	18	1925	2
Cutting M 3	18	1847	2
Grinding M 1	58	625	2
Grinding M 2	57	625	2
Grinding M 3	57	620	2
Grinding M 4	55	618	2
Grinding M 5	58	620	2
Grinding M 6	58	625	2
Grinding M 7	58	625	2
Drilling M 1	41	860	2
Drilling M 2	46	860	2
Leak testing 1	30	1072	2
Leak testing 2	24	1289	2
Leak testing 3	28	1141	2
Welding Machine	62	600	3
Shot Blasting	240	5400	3

C. Existing Plant Simulation

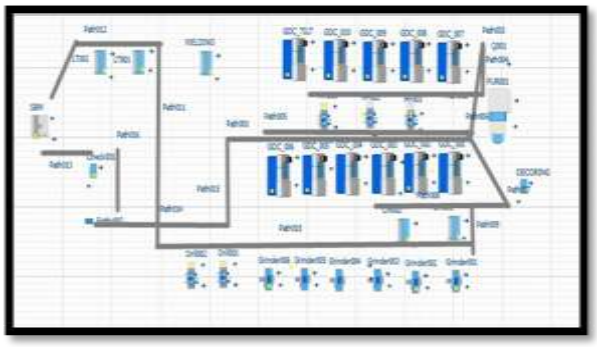

Fig 3. Existing Plant Simulation

Raw Martials enters thought the gate & raw material stored in storage room by path 001,002,015&014. After that it is send to melting furnace according to need of product lot. Then molten metal sent to holding furnace by path 004 & afterword's sent to Degassing process. Side by side core making process is carried out & cores are paint & cores are baked in core oven of certain temp.

Well prepared molten metal & cores sent to GDC001,002,003,004,005,006,007,008,009,010,011 for casting of product. Casted product is sent to decoring machine for removal of cores by path 005, 007. After decoring the runners & gating systems are cut by cutting machines001,002 by path 008. Decoring and cutting product are grinded by belt machines001,002,003,004,005,006 for remaining parting lines, corners & scratches etc. as per requirement casting product sent to drilling machine001,002 by path 009, 010.

After all machining process casting is tested by leak testing machine001,002,003 by path 011. In that process defect in casting is observed then it will

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be sent to welding workshop for correction. Again it is checked by leak testing machine for leakage if leakage is found then process is repeated or good tested casting sent to shot blasting machine shop by path 012. After that it will be inspected by the quality supervisor & it is dispatched to another unit.

Now above fig. shows the simulation of one product & flow of that product. In that only M Blade product simulation will be carried out. When the cycle time observed manually the casting cycle time is 116 sec and cutting cycle time is 19 sec and grinding cycle time is 58 sec, shot blasting cycle time 240sec, waiting time is 171sec. The total cycle time of M Blade Product is 604 sec & simulation cycle time is 614 sec. Actual Cycle time and Simulation Cycle time is approximately equal.

D. Proposed Plant Simulation

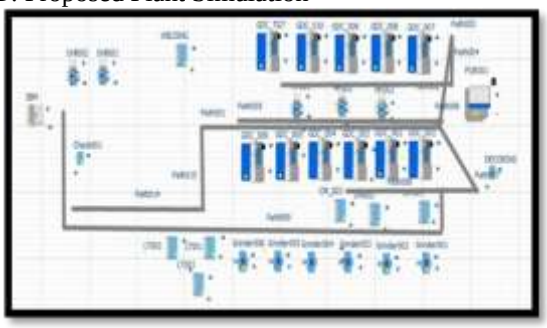

Fig. 4 Proposed Plant Simulation

Raw Martials enters thought the gate & raw material stored in storage room by path 001,002,015&014. After that it is send to melting furnace according to need of product lot. Then molten metal sent to holding furnace by path 004 & afterword's sent to Degassing process. Side by side core making process is carried out & cores are paint & cores are baked in core oven of certain temp.

Well prepared molten metal & cores sent to GDC001,002,003,004,005,006,007,008,009,010,011 for casting of product. Casted product is sent to decoring machine for removal of cores by path 005, 007. After decoring the runners & gating systems are cut by cutting machines001,002 by path 008. Decoring and cutting product are grinded by belt machines001,002,003,004,005,006 for remaining parting lines, corners & scratches etc. as per requirement casting product sent to drilling machine001,002 by path 009.

After all machining process casting is tested by leak testing machine001,002,003 by path 009. In that process defect in casting is observed then it will be sent to welding workshop for correction. Again it is checked by leak testing machine for leakage if leakage is found then process is repeated or good tested casting sent to shot blasting machine shop by path 009. After that it will be inspected by the quality supervisor & it is dispatched to another unit.

Proposed Plant Layout cycle time observed manually the casting cycle time is 116 sec and cutting cycle time is 19 sec and grinding cycle time is 58 sec, shot blasting cycle time 240sec, waiting time is 171sec. The total cycle time of M Blade Product is 604 sec & simulation cycle time is 547 sec.

V. CONCLUSION

A new layout has been designed by rearranging the layout, which is by moving the Leak testing machine closer to the Grinding Machine. By simulating the layout by using WITNESS simulation software, the efficiency of the machine is increased, productivity is also increased. Labour efficiency increased and this is done by reducing the distance between machines. In terms of productivity, the Existing layout produces simulating time which is 614 sec, while the improved layout produces 547 sec.In this way, the total increase in productivity due to implementation of proposed plant layout is found to be 10.92\%. The proposed plant layout can be used to improve the system of a factory to get better performances and increase productivity.

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