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Design of plant Layout Using concurrent engineering Techniques

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Abstract: *This research aims to improve the plant layout of manufacturing industry to make optimum space utilization, eliminate obstructions in material flow and thus obtain maximum productivity. Various optimization approaches for small problems and heuristic approaches for the larger problems have been proposed to elucidate the problem. The operation process of each section(i.e. material storage, cutting, welding, grinding, drilling, machining shop I,II,III CNC shop and inspection section and finish product storage) have been investigated. The problem in the space utilization and material flow pattern was identified. Various techniques were applied after finding the solution through traditional methods to get much improved optimum solutions. The suitable of new plant layout can decrease the distance of material flow, which rise production.*

Introduction:

A common industrial problem of allocating facilities is to either maximize adjacency requirement or minimize the cost of transporting materials between them. [1-3] The maximizing adjacency objective uses a relationship chart that qualitatively specifies a closeness rating for each facility pair. This is then used to determine an overall adjacency measure for a given layout.[5] The "minimizing of transportation cost" objective uses a value that is calculated by multiplying together the flow, distance and unit transportation cost per distance for each facility pair.[6]

Plant layout design has become a fundamental basis of today's industrial plants which can influence parts of work efficiency and productivity.[3,4] 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[7].

Literature Survey:

Anucha watanapa, Phichit Kajondecha, Patcharee Duangpitakwong[1] "Analysis Plant Layout Design for Effective Production" obstruction in material flow and thus obtain maximum productivity. The present plant layout and the operation process of each section sand mould, core ware house, core making, and disassembly surface finishing, furnace and inspection section have been investigated. The problem in term of material flow of each operation section was identified. Then using some techniques, 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.

V jayabalan and P Arikaran [2] "Analysis of unequal areas facility layout problem" the facility layout design to improve plant productivity, manufacturing problem. Optimization approaches for small problem and heuristic genetic algorithm (GA), simulation annealing(SA), Ant colony algorithm(ACO), Particle Swarm optimization(PSO). Using the hybrid approaches, combination of above techniques is used to get the better solution and improve the facility layout design.

Haned Samarghandi [4] "Application of TOPSIS and Fuzzy TOPSIS Methods for plant layout design" Multi Attribute decision making(MADM) is a common task in human activities. It consists of finding the most preferred alternative from a given set of alternative. We propose two multiple-attribute decision making (MADM) methods in solving a plant layout design problem. They are: technique for order preference by similarity to ideal solution (TOPSIS) and fuzzy TOPSIS. The layout design problem is a strategic issue and has a significant impact on efficiency of a manufacturing system. The present study explores the use of MADM approaches in solving a layout design problem. The success of the present study has no guarantee for its applicability to other applications. Judicious use of a design method is advised in solving a specific application.

S Narayaana Reddy and V Varaprasad "Optimization of in multi objective facility layout using non-traditional optimization technique" done by taking qualitative and quantitative approaches in to consider. PSO has been implemented for the problem and the optimal layout is considered.

Gyan Tshering Lepcha, D C Roy [5] "Job Shop Layout Design Using Group Technology" The original motivation for redesigning the entire shop floor was the need to realize improvements in material flow and output level. Since the machines were scattered this made it very difficult to study the cost involving the flow of materials through these machines. So for the purpose of analyzing total material handling cost, 34 elements (jobs) were taken which are mainly processed through 6 machines, out of which 32 elements were divided in to 4 part families using Direct Clustering Method(DCM) with group technology concept method and similar machines were arranged together to analyze the cost using computerized relative allocation of facilities technique(CRAFT) with aide of computer graphic. Finally, a new job shop layout was designed, which yield minimum material handling cost.

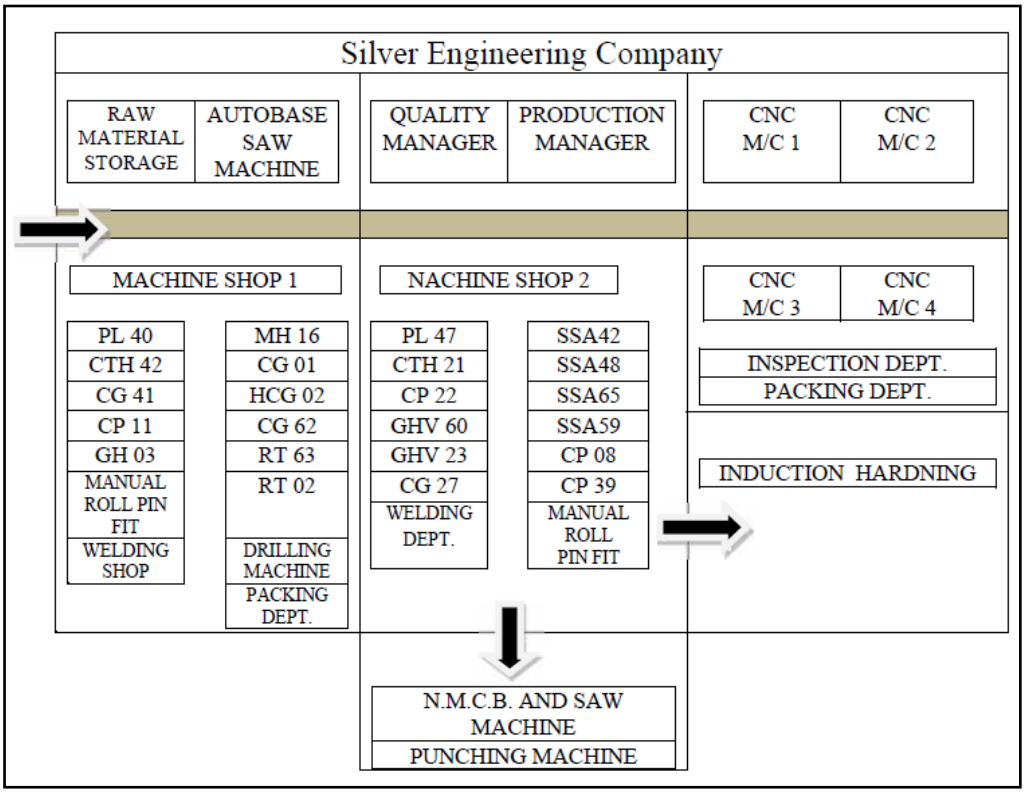
PLANT LAYOUT PLANNING:

Procedure for Plant Layout Design

The sequences of procedure following steps were described:

Table 1: Relationship between Departments (Machine Size) and Area.

Departments	**Area SQMT**
Raw Material	500
Machine shop- I	1700
Machine shop- II	1800
CNC shop	1100
Drilling shop	640
Welding shop	1000
Inspection shop	400
Packaging shop	200



PLANT LAYOUT

Figure 1: Existing Layout

1. The area and machines of plant layout was studied.
2. Machines are collected
3. The process and flow pattern for product production has been used in analysis.
4. The Existing 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.

Company Details Name: Silver Engineering Company
Location: Rajkot-Gondal Highway, Nr. Kishan Petrol Pump, B/h Magotteaux Industries Pvt. Ltd., Kangasiyali Ta. Lodhika Rajkot, Gujarat - 360 004 (India)
Product:

a) Top Link Spindle.
b) Parallel male stud coupling.
c) D.C.Crank shaft assy
d) Position control sleeve

Area statement:
Plot area =10000 SQMT,
Cover area 70% =7340 SQMT,
Factory shed area =2660 SQMT,
Build up area: Ground floor.

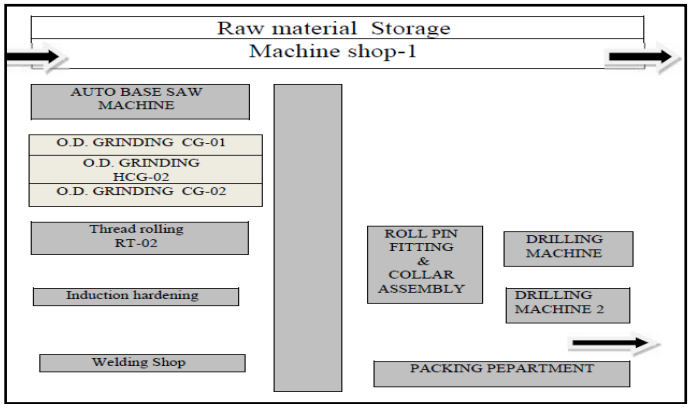


Figure 2A: Change Layout Machine Shop-1

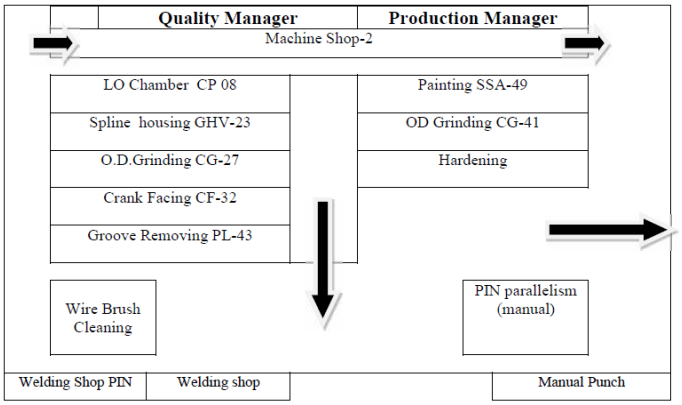


Figure 2B: Change Layout Machine Shop-2

Component Name:- Top Link Spindle
Material: - 20MnCr5

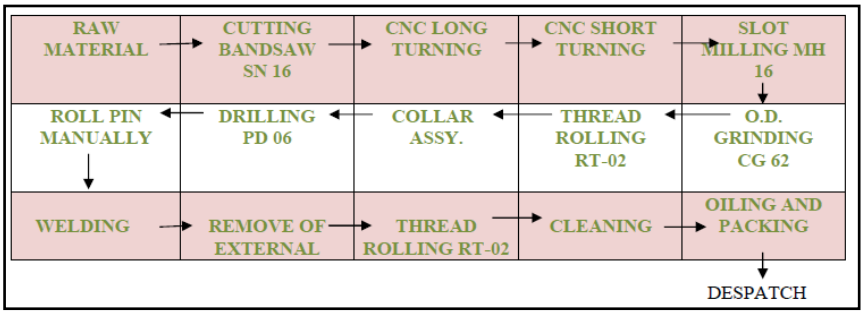


Figure 3A: Flow Chart of Top Link SPindle

Analysis of Existing Layout

Analysis of Existing Layout, this case is based on the travelling roller manufacturing industry. The original layout of company is shown in figure 1. The details of each section were described as follows. In additional the size and number of equipments was relational to area as shown in table 1.

Analysis Plant Layout

Analysis of the production process, products detail for flow of material, raw material storage, CNC shop, welding shop, drilling shop, machining shop, surface finishing, inspection section and material handling equipment were described as follows:

Flow of material from raw material storage department to cutting machine is in proper shape and size. This raw material travels a long distance for surface finishing in CNC department. Completing CNC operation material travel to machine shop I then grinding, drilling and welding operation perform but travelling distance was more and material handle was not properly so less production.

Raw material storage shop

The section approximated within 500 M² area.

Machining shop I

Section approximated within 1700 M² area. Top Link Spindle is manufactured in this section.

Machine shop II

Section approximated within 1800 M²area. D.C. crank shaft is manufactured in this section.

CNC shop

Approximated with 1100 M² area

Welding shop

Approximated with 1000 M² area. This section consists of arc welding, torch cutting and plug cutting machine.

Drilling shop

Approximated with640 M² area. Two types of machine counter drilling and plain drilling.

Inspection and packing shop

Section is approximated with 600 M² area.

Finish product storage

Section is approximated with 160 M² area.

After studying on the mentioned information, the new plant layout design is created by shifting raw material storage area and machine shop (figure 2). In addition, the assembly and inspection section is improved for optimum space utilization.

Fabrication Product			Product Name: Top Link Spindle				
Operation	Dist. meter	Machining Time minute	○	⇨	D	□	▽
Lying raw material from storage		0.20					
Cutting section	12.20						
CNC shop	23.00	0.50					
Induction hardning	33.00	1.30					
Slot milling	20.60	1.00					
Grinding	20.90	3.00					
Thread Rolling	4.50	0.30					
Spindle & coller Assy	11.00	0.30					
Drilling	1.50	1.30					
Roll pin fitting	0.60	1.25					
Ext. Welding remove	9.00	1.30					
Thread rolling	9.00	1.00					
Oiling and packing inspection	17.65	1.00					
Pre -dispatch	9.25	2.00					
Dispatch	1.20						

Figure 3B: Operation Process Chart of Top Link SPindle

Fabrication Product				Product Name:-D.C.Crank shaft assy				
Operation	DIST. Meter	Travelling time in Min.	Machining time in Min.	○	⇨	D	□	▽
Lying raw material from storage	-	-	0.20					
Cutting section	12.20	1.00	-					
CNC shop	23.00	1.20	0.50					
OD grinding	33.00	1.25	1.30					
Spline hobbing	20.60	0.20	1.00					
Spring seat welding	20.90	0.30	3.00					
Crank sleeve welding	4.50	0.35	0.30					
Crank facing	11.00	0.20	0.30					
Crank pin welding	1.50	0.20	1.30					
Crank shaft welding	0.60	0.10	1.25					
Timing punch	9.00	0.25	1.30					
Thread Rolling	9.00	0.50	1.00					
Oiling and packing inspection	17.65	1.00	1.00					
Pre -dispatch	9.25	0.45	2.00					
Dispatch	1.20							

Figure 4: Operation Process Chart of D.C.Crank Shaft

METHODOLOGY

In this research, proposed layout was designed on the basis of operation process chart (Figure 3 and 4) and flow chart (Figure 3A) of products. Load distance score method is quantitative technique for layout analysis use for optimum space utilization and reduced the travelling distance. In this method, first load/ frequency matrix made based on department/ machines. Secondly, distance matrix is made based on proposed layout.

Finally, total distance matrix is formed, for analysis of layout. Load distance score method applied for both.

Operation process chart for top link spindle, D.C.crank shaft assembly and position control sleeve is investigated. In existing layout, in order path is observed from material storage area to welding section. Total distance traveled from raw material to finish product storage for all products is 340 meter, 341 meter and 286 meter.

CONCLUSION

According to the analysis of the operation chart, flow chart and material handling chart for the all product, it was found that raw material storage, drilling section, machine shop and proper sequence machine should be modified for the layout for convenient workflow. The distance of flow chart material handling from the modified plant layout of their shop can be reduced by convenient flow. 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.

REFERANCES AND NOTES

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