Implementation of Systematic Plant Layout (SPL) at Hitesh Mechanical Pvt. Ltd.

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Abstract: The purpose of this paper is to study the Plant layout of Hitesh Mechanical Pvt Ltd., New Mumbai using on SPL (Systematic Plant Layout) technique to improve the inventory management system for raw materials, scrap management and process planning for different operation on the work floor. Aim of this study is to improve the productivity by minimizing the idle time. Firstly, the problem in terms of storage, material flow is identified. In this paper the initial layout and the alternative layout is being designed based on the SPL methods, Activity relationship charts, From-to chart and algorithms like CRAFT, CORELAP. The SPL method help us to find the solution and increase the productivity and the storage capacity of the plant.

Index Terms - Systematic plant layout, algorithms, material flow, CRAFT, CORELAP, from-to chart, activity relationship chart, Hitesh Mechanical Pvt Ltd, fabrication, Pugh matrix.

I. INTRODUCTION:

With the evolution in the technology field, advance technologies and new methods and machines are being developed to increase the productivity. To meet the consumer demands and to survive in highly competitive market, it is necessary to have a proper system to maintain the market position. Any production industries should be ready to adopt and evolve so that they are commercially viable. Thus, the facility layout plays an important role as it is the base foundation of any industry, and continuing that this study is based on the methods and approach to design a small-scale industry to get the maximum benefits using available resources at their disposal.

1.Problem Statement:

Hitesh Mechanical Pvt. Ltd, New Mumbai a fabrication company located at MIDC RABALE. The products in this facility are manufactured by going through various processes like marking, cutting, fitting, welding, etc. The plant suffers from poor material handling and material storage systems. All the process is done at different locations in the facility which causes the improper work, unsafe working environment and increased in material traveling time.

2.Proposed System:

In response to the above problems the facility layout needs to be optimize to achieve the manufacturing goals of the company. This paper proposes to use systematic plant layout (SPL).

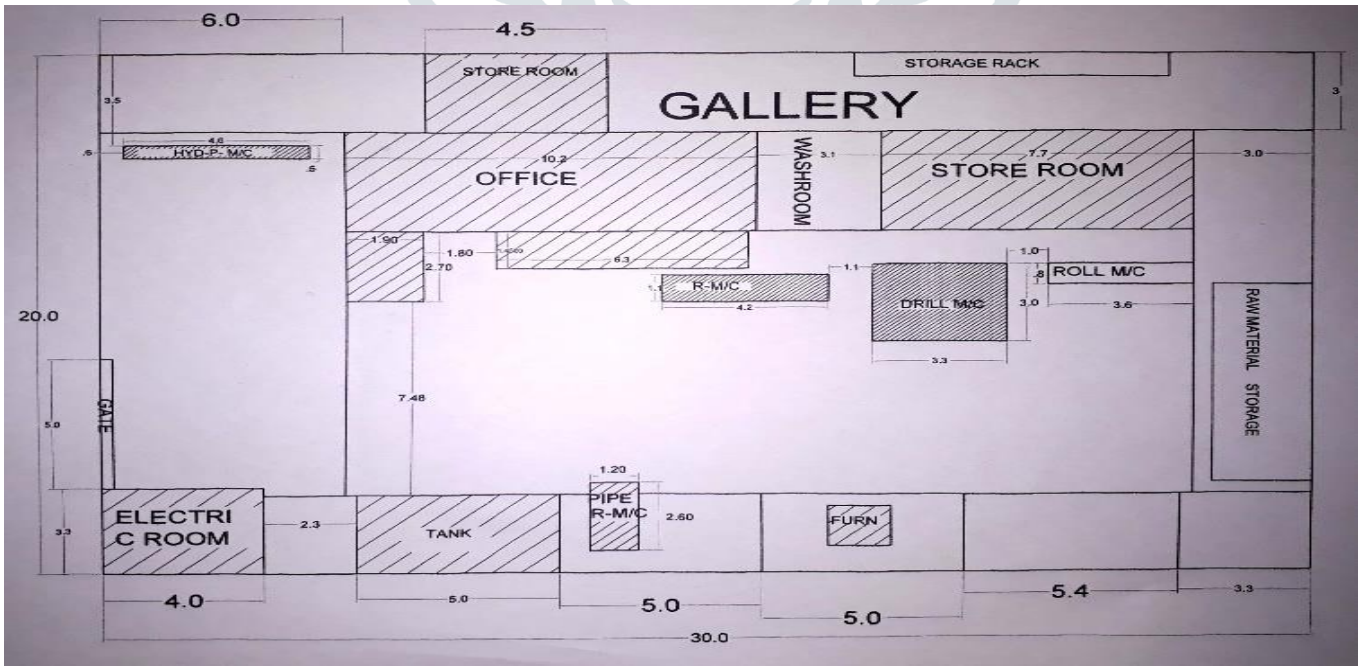


Fig 1 Initial Plant Layout

3.Initial layout:

Firstly, we have measured all the dimension of the layout and different machines used and available in the facility. Then, designed the initial layout of the facility with the help of the AUTOCAD software.

All dimensions are in meter (m). As from the layout we observe that the facility does not have fixed raw material storage area, and proper scrap management system and the processes are being performed at random positions and lot of time is wasted in travelling the material.

II. LITERATURE REVIEW:

[1] M.H Kulkarni, S.G. Bhatwedekar, H.M. Thakur [1] have explained the importance of facility planning and plant layout and it planning and also the different stages of the layout planning which consists of plant location, structure, layout and system handling. A Muther's Systematic Layout Planning (SPL) is discussed in this paper with the layout configuration and the position.

[2] Praveen Tandon, Dr. Ajay Tiwari and Shashikant Tamrakar [2] have proposed that by improving the plant layout one can adopt the lean manufacturing and with the help of flow chart of foundry and the steps required for the implementation of SPL. They have explained the way one can adopt the system for their industry and how to use and arrange the areas and the section in the facility to maximize utilization of available resources

[3] G. Bharathi and G. Ambrish [3] has proposed the use of Algorithm or the techniques namely SPL, CRAFT and QAP in this they have try to apply this method to redesign the layout of the cub-board manufacturing by applying the concept and with the simulation they were able to reduce the total material handling cost significantly.

[4] M. Rajesh, N V R Naidu, P. Naveen Kumar [4] have proposed the plant layout optimization by using CORELAP Algorithm. For this study they have try to apply this method in oven manufacturing. By using activity relationship diagram and Total Closeness Rating (TCR) they have proposed different layouts and calculated the layout score for each individual layout and they had considered the layout having the highest score and by applying that they were able to minimize the total surplus area by 8.83%.

III. METHODOLOGY:

STEPS TO DESIGN SPL (Systematic Plant Layout) -

- Identification of the problem.
- Study of the existing system.
- Analysis of the existing system and collection of the required data.
- Defining the problem.
- Analysis of the problem and research for the solution.
- Identification of the solution and verify the solution with different methods.
- Designing the system with the help of the solution.
- Finalizing the design.

IV. LAYOUT MODIFICATION TECHNIQUE AND USE OF SUITABLE ALGORITHM:

1. Flow of material:

All the materials flow from the whole production line are to be formulated into a from-to chart that indicates the material flow pattern and frequency among different departments or sections of plant. The analysis of material flow involves determining the most effective sequence of work and material. The flow of material is shown below in Figure 2

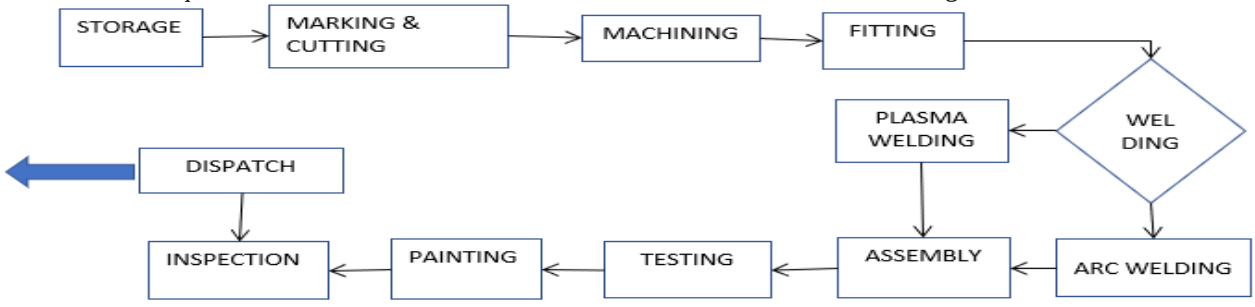


Fig 2 Flow of materials

2. Process flow chart:

This chart use to record the process required for the product to make from the initial raw material to final product in the compact manner. The chart is set out the sequence of the flow of the process for different products in appropriate manner. For example, for certain product-

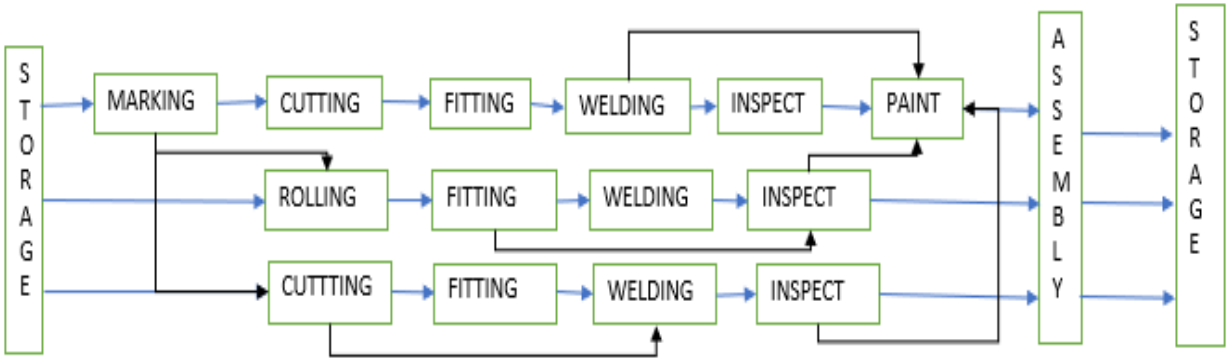


Fig 3 Process flow chart

3. Activity relationship diagram:

The preparation of activity relationship diagram is next step while performing qualitative analysis about the closeness relationship between activities and resources. The results will be displayed into an activity relationship chart. The relationship diagram was generated when the proximity and relationship are visually evident of the facility. The relationship is defined by a closeness rating system -A means Absolute necessary, E means Essential, I means Important, O means Ordinary, U means Unimportant and X means Extremely unimportant.

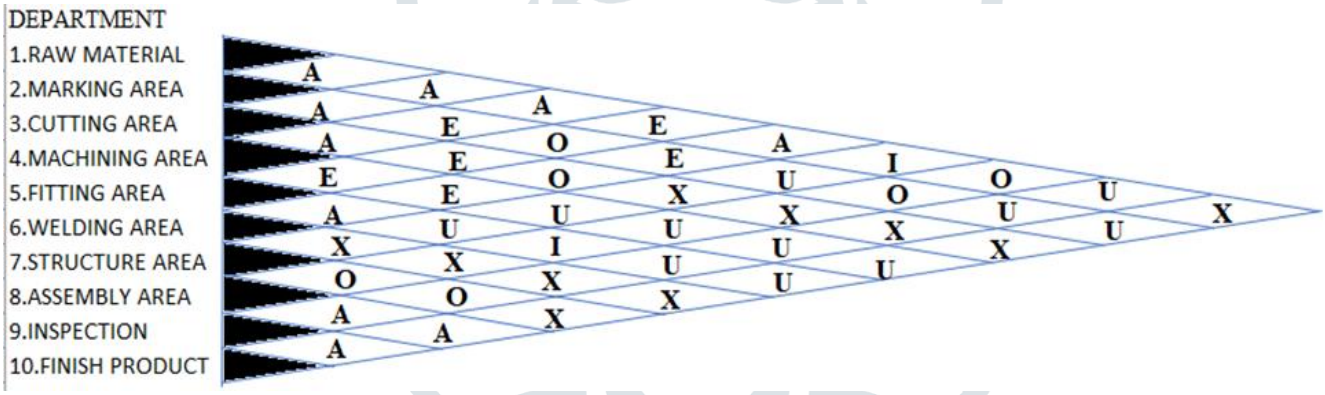


Fig 4 Activity relationship diagram

4. From-to chart:

This chart represents the flow intensity between each process. The more the flow intensity, the more important the relationship between each process. From this chart, we can see that which process have the high intensity due to both products have the same process as shown in the chart. For example, the relation the storage and the marking area and should the department should be kept close to each other or not.

DEPT.	STORAGE	MARKING	CUTTING	MACHINING	FITTING	WELDING	TESTING	PAINTING	DISPATCH	OFFICE	INVENTORY	SCRAP
STORAGE		A	O	U	U	U	U	U	U	U	U	X
MARKING			I	A	U	U	U	U	X	U	I	I
CUTTING				I	U	U	U	U	U	X	X	U
MACHINING					I	I	U	I	U	X	I	U
FITTING							A	O	U	U	E	U
WELDING							A	I	U	U	U	U
TESTING								I	U	X	O	U
PAINTING									A	X	E	U
DISPATCH										U	U	U
OFFICE											X	X
INVENTORY												U
SCRAP												U

Fig 5 From-to chart

5. CRAFT Algorithm:

Computerized Related Allocation of Facility Layout Technique were developed by Armour and Buffa in 1963 [3][8]. It is based on the exchange of position of departments. This requires input data such as -

1. Initial layout plan
2. Data on material flow
3. Data on cost incurred
4. Number of fixed departments and their location

The consideration in CRAFT is to check exchange of locations for those departments, which either are at the same location or have a common border and its mostly interchanges the departments which are adjacent to each other [3][8]. So, because of the constraints in our facility we cannot use this algorithm.

6. CORELAP Algorithm:

Computerized Relationship Layout Planning [4], given by Lee and Moore in (1967). It converts qualitative input data into quantitative data and uses this information to determine the facility to enter the layout. It constructs a layout for the facility by calculating the Total Closeness Rating (TCR) for each department. TCR is the sum of the numbers assigned or allotted to the closeness relationships between the departments or activities (A=6, E=5, I=4, O=3, U=2, X=1) where A means Absolute necessary, E means Essential, I means Important, O means Ordinary, U means Unimportant and X means Extremely unimportant between the departments [4].

CORELAP Methodology –

1.) For department give Total Closeness Rating (TCR) as [4] [8] –

											6	5	4	3	2	1	TCR
-	1	2	3	4	5	6	7	8	9	10	A	E	I	O	U	X	
1	-	A	A	A	E	A	I	O	U	X	4	1	1	1	1	1	39
2	E	-	A	E	O	E	U	O	U	U	1	3	0	2	3	0	33
3	A	A	-	A	E	O	X	X	X	X	3	1	0	1	0	4	30
4	A	E	A	-	E	E	U	U	U	U	2	3	0	0	4	0	35
5	E	O	E	E	-	A	U	I	U	U	1	3	1	1	3	0	34
6	A	E	O	E	A	-	X	X	X	X	2	2	0	1	0	4	29
7	I	U	X	X	U	U	-	O	O	X	0	0	1	2	3	3	19
8	O	O	X	U	I	X	O	-	A	A	2	0	1	3	1	2	29
9	U	U	X	U	U	X	O	A	-	A	2	0	0	1	2	4	29
10	X	U	X	U	U	X	X	A	A	-	2	0	0	0	3	4	22

Table 1: Calculation of Total Closeness Rating (TCR)

TCR= (6xA + 5xE+4xI +3xO +2xU +1xX) = (6x4 + 5x1 + 4x1 + 3x1 + 2x1 + 1x1) =39

2.) The department having higher TCR should be identified and to be placed in the layout, here we identified it as Department "1".

3.) Next the Activity relationship diagram is used to find the other departments with the higher activity relationships with the department already fixed. If there is a similar department, then select that department with the highest TCR.

4.) Repeating all the above steps till all the departments is being assigned.

5.) After assigning all the departments we have to calculate the layout score and that is determined by using the relationship weights as given below –

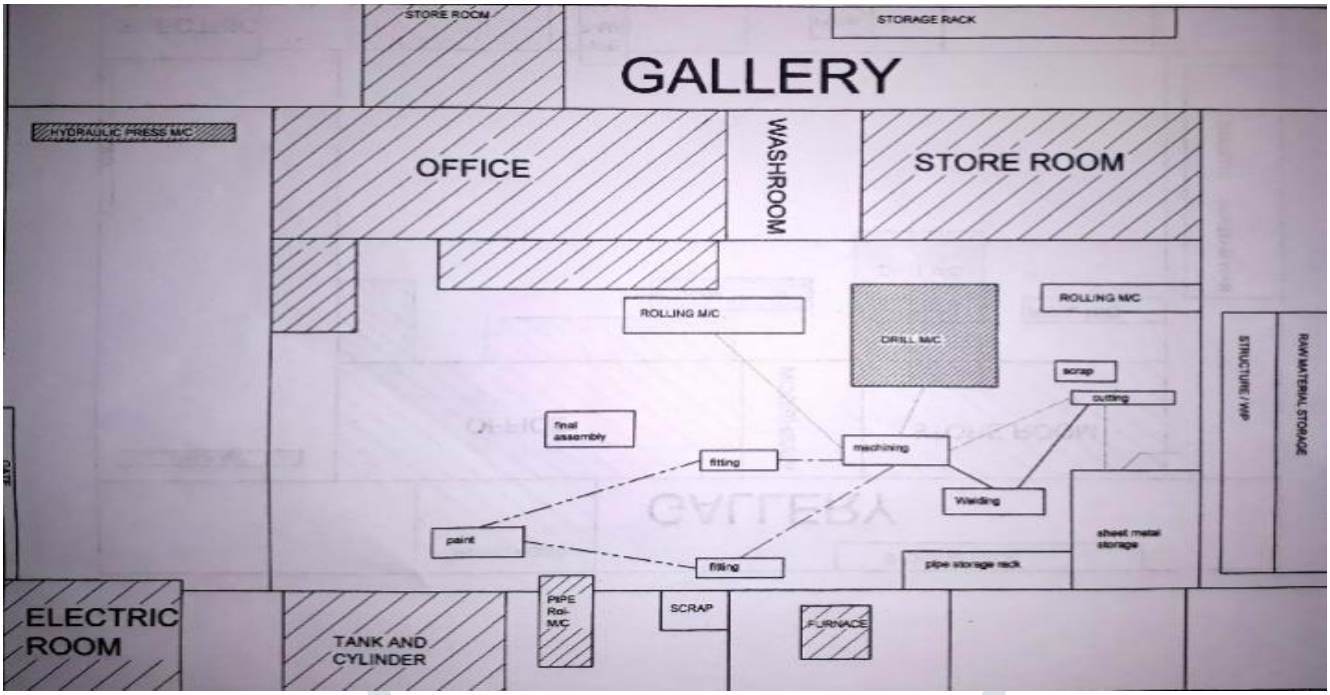
A=243; E=81; I=27; O=9; U=3; X=0

Layout score = ∑ of (department number x Relationship weights factor).

For example- for layout A, Total Layout score = (10x243+1x27+1x81+1x9+2x1+0x0) =2549Conceptual Generation of Layout Designs:

Design of the layout from the above steps -

Fig 6: Concept layout A



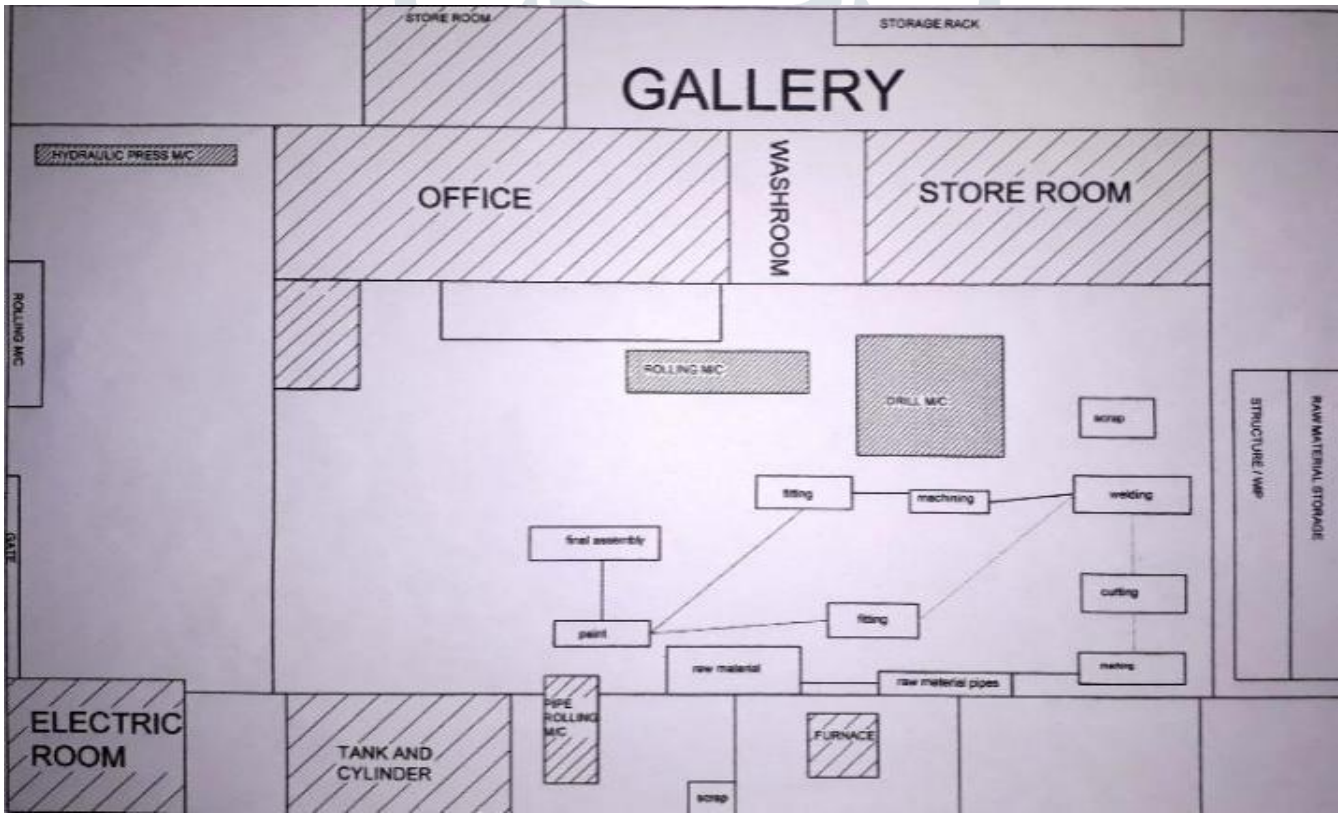


Fig 7: Concept layout B

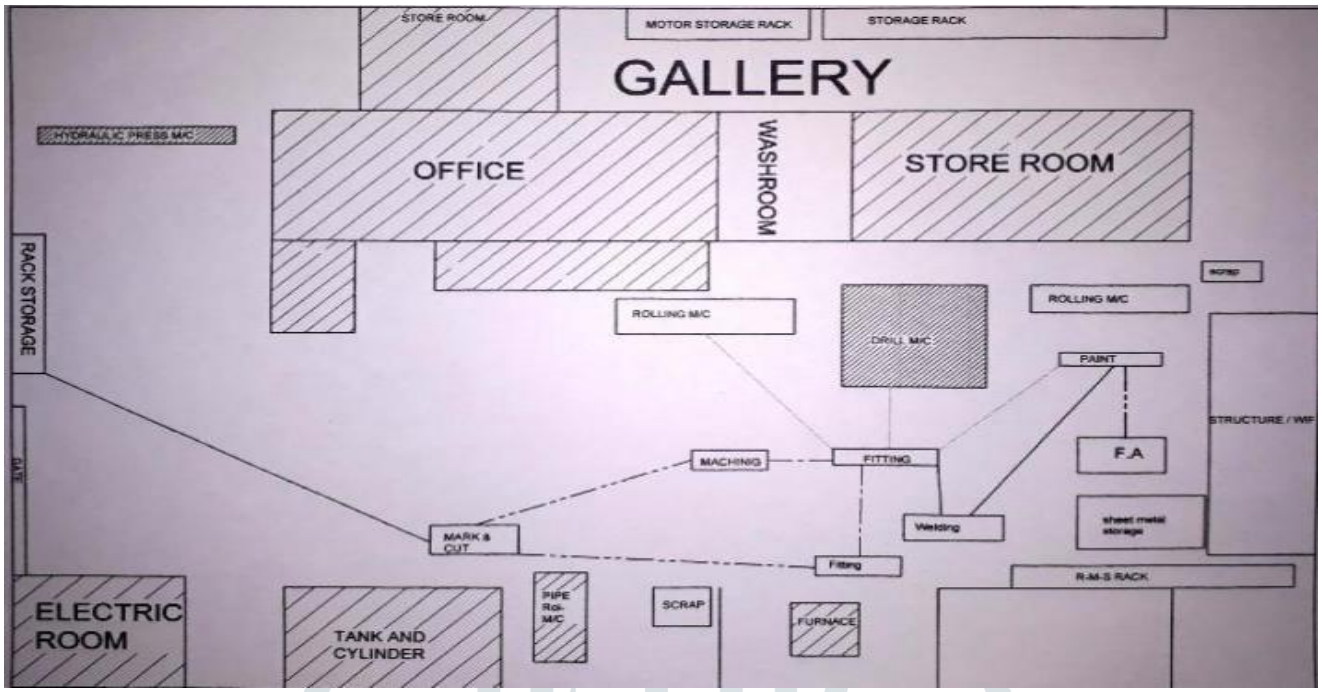


Fig 8: Concept layout C

V. Verification of the obtained result using Pugh Matrix Approach:

The Pugh Method [7] is invented by Stuart Pugh, and it is a qualitative technique used to rank the different layout parameters basically it is a method for making decision based on design.

CONCEPT SELECTION MATRIX (Pugh Matrix)				
Selection Criteria	**Concepts / Proposed Layout**			
	Initial Layout	**Layout A**	**Layout B**	**Layout C**
1. Available of storage space	0	+	+	+
2.Space available for easy movement	0	+	+	+
3.Scrap management	0	+	+	+
4.Material handling easiness	0	-	-	+
5.Safety measurements	0	0	0	+
6.Minimum material travelling	0	0	+	+
7. Proper processing area	0	+	+	+
8.Cost	0	-	-	+
9.Total + 's	0	4	5	8
10.Total – 's	0	-2	-2	0
11.Total 0 's	7	2	1	0
12. Net score	7	4	4	8
13. Rank obtained	2	3	4	1
14. Continue with the layout	NO	NO	NO	YES

Table 2: Pugh matrix approach for concept selection

The following are the steps for these method-

a) Firstly, define the selection criteria which can be used for comparing the generated design from the initial.
b) Select the initial or reference concept, against which all other concepts are to be rated and ranked.
c) The rating is assigned as better as (+) positive, some as (0) zero and worse as (–) negative in each cell rate each component and finally calculate the net score and make your decision as shown below [7].

VI. DETERMINATION OF THE SEQUENCE OF THE DEPARTMENT:

Finalization of the Layout:

The proposed layout Concept "C" is being selected based on its less material traveling time, having a good material storage location and also because of the arrangement of process which increase the speed of the production by reducing the idle time of the process.

VII. CONCLUSION:

After implementation of the layout 'C' it is found that the working area is increase by 20% and the storage area for raw material is increased by 35% and also the travelling time of material is reduced significantly as everything is arranged in order so it is simple to move the material during storage and process.

VIII. REFERENCES:

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