OVERALL PRODUCTIVITY IMPROVEMENT IN CASTING AND FASTENING INDUSTRY

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Abstract: The purpose of this research is to improve productivity for small and medium scale casting industry. This research focused on the company, which produce various mechanical components by casting processes. This research used changes in plant layout, flow of material movement for better utilization of plant area for improve the productivity. Objectives towards accomplished this study is to identify problems in the casting and fastening process and improved it in terms of reduction in production time, number of manual process and back flow of materials by proposing an efficient plant layout and design of components used for loading of material used in fastening process. This research used systematic plant layout technique, concept of semi automation in casting process, solid edge model with design, which is used for loading of fasteners. The improvement in productivity was executed by eliminating back flow of work process, which reduces production time, number of process and effectively utilization of plant area. Reduce in time of loading fasteners in rotary retort furnace by suggestion implementation of hopper with mechanism with it proper design. Overall productivity improvement by solve problems of ergonomics, manual process, material handling, ineffective utilization of plant area, back flow of materials, etc.
Field of research: Plant layout, Productivity, Ergonomics, Sequence of processes, Design of hopper, Proposed change in layout, Semi-automation, Material handling.

I. INTRODUCTION

In the present day scenario, there is a major production of metallic components done by casting process. Casting is one of the best methods for production of mechanical components due to it provides good strength and reliability of components. There are various casting processes by which the production of metallic components is done. The various processes are such as Induction casting, Die casting, Investment die casting (wax pattern), centrifugal casting, permanent mould casting, sand casting, etc. Out of them investment die casting is the best method for produces components. There are different casting industries which produces metallic components by casting processes. There are generally two casting processes existing in casting companies. There are die casting & induction casting. Die casting is specially use for aluminum parts and induction casting is use for all types of metallic components.

The company is basically a casting industry where production of mechanical components by casting process as well as balancing of rotating parts and machining work is also done.

As we all know that all the company always want to improve their productivity continually by solving the highly occurred problem which directly affect to the productivity. So company want to produce more output by effectively utilizing the available resources and company's owner want to same. Biggest problem which are associated such as ineffective layout, back flow of material, material handling problem, ergonomics, storage problem , loading problem in hardening furnace, etc. so applying knowledge of engineering and trying to solve the problem as far as possible and improving productivity.

Associated company were production of fasteners is done by automatic machines but at the time of hardening the loading of fasteners in to the rotary retort furnace is manual which creates problem. So provide a design hopper with mechanism for solving the loading problem. So increases productivity by reducing in loading time.

1.1 Objective of the project research

The main aim of this project is to improving the productivity in small and medium scale casting industry and fastening industry which is benifecial for company's future.

1.2 Scope of the project research

The scopes of this research are:

- This study concentrates on small and medium scale industry, where production of metallic components using casting process by company, fasteners production & hardening of same by company.
- There are lots of scope for fulfill the objective of project research. Which are change in plant layout, process layout, using ergonomics, providing semi-automation in processing and material handaling methods. By using these scope the project reaches to the higher hights of success without compromising the quality of products.

II. LITERATURE REVIEW

According to Prof. DR S.M. sane, promod p. shewale, Manmath S. shete, they are working on "Improvement in plant layout using systematic layout planning for increased productivity". According to them the research is to study about

plant layout of compressor manufacturing based company on the systematic layout planning pattern theory (SLP) for increased productivity. In them research, amount of equipments and tools in compressor 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 stores until dispatch. The research describes original plant layout & proposed new plant lay out. By this it was found that there was wasted time or delay in manufacturing. According to these, 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, and effective utilization of resources for improving productivity.

1. Reduction of back flow of material.
2. Improvement in productivity.
3. Space utilization.
4. Avoiding delay in transportation.
5. Time reduction in processes.

2.1 Productivity

ILO defines total productivity as the ratio of aggregate output to aggregate input.

Productivity implies development of an attitude of mind and constant urge to find better, cheaper, easier, quicker and safer means of doing a job, manufacturing a product and providing services.

The basic objective behind productivity measurement is:

1) To study performance of a system over time.

2) To attain a relative comparison of different systems for a given level.

3) To compare the actual productivity of a system with its planned productivity.

Simply the productivity is defined as p= output / input.

P= Productivity,

O= Output from the system,

I = Effective Utilization of the input resources,

III. PROBLEM IDENTIFICATION: (Dividing problems in two sections)

3.1 Casting industry (section 1)

1. Manual Process

At present situation in the casting company whole process is done manually. There is no semi or fully automation. This required skill workers. The manual processes are more time consuming in doing works.

2. Problem of Storage

There is a problem of storage of semi finished and finished goods in to the existing plant area. There is no proper storage space were semi finished & finished goods are stored. There is no specified & selective place were semi & finished parts stored properly.

3. Ergonomics Problem

Here considered environmental temperature conditions. In general there is no problem of rising temperature exists but at the time of metal pouring temperature is increased 50° and more than. So working efficiency of worker is reduced.

4. Material Handling Problem

The main problem of material handling is exists in the company. There are lots of heavy components which required machining & dynamic balancing more than 1 tonne & having big size, also this required for transporting from one place to another. There is the problem of equipment handling, co_2 cylinders are required to move one place to another, so man power & more time both are consumed.

5. Material Movement

There is a problem of flow of material is improper and required more time for material movement in the plant area. Back flow is exists in material movements. So results more time consumption which directly reduces productivity.

6. Ineffective Layout

The existing layout of company is not highly effective for achieving higher productivity. There is ineffective utilization of plant area.

7. Requirement of Space for Investment Casting

There are lots of problems already exists at same time owner of company want to implement investment die casting in to the same plant area. This task is much difficult at this time because of already exists lots of problems stated above. There is providing space for investment die casting (wax-pattern), which required storage space and A.C. room is difficult in existing layout.

3.2 Fastening industry (section 2)

1.1 Problem of loading material in to rotary retort furnace for hardening

There is a problem occur while loading the fasteners such as bolts, screws in to the furnace is done by manually process. The door used for loading of material of the rotary retort furnace is too small & heighted from base is about 6.3 fit. This operation is difficult, more risk, create worker fatigue while doing loading operation. There is more time consumes during this manual loading process so productivity is reduces.

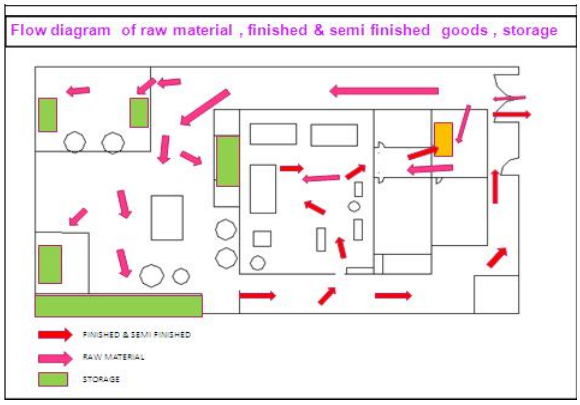
1.2. Problem of loss of heat energy during loading of fasteners

When material loading in to the furnace, it's taking 12 to 15 minutes. So at same time door is open & the

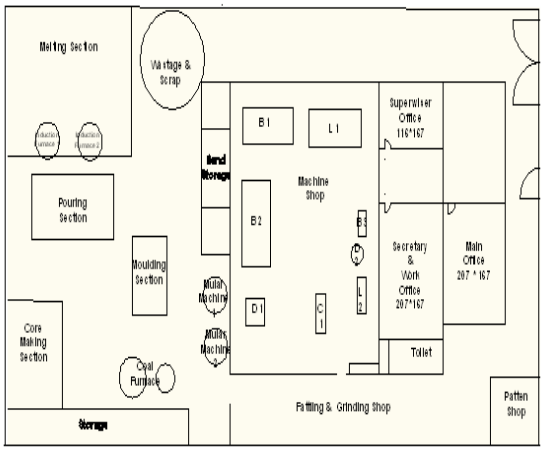
heat loss in to the atmosphere. More electricity consumption & overall cost is increased.

IV. DATA COLLECTION

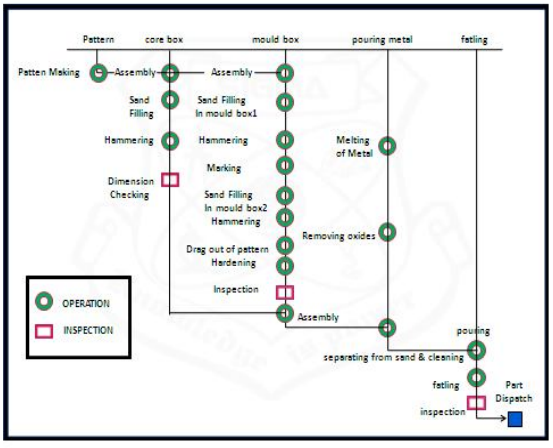
4.1 Material movement:-



4.2 Existing layout (which provides less productivity)

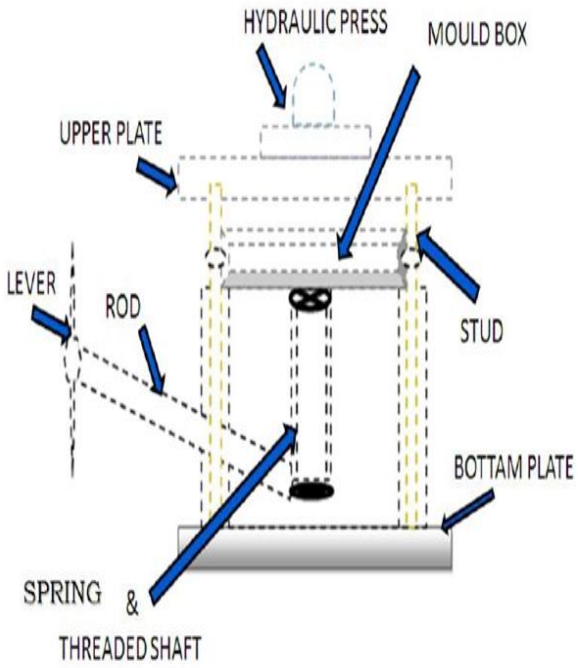


4.3 Existing operational process chart



V. DATA ANALYSIS AND PROPOSED METHODOLOGY

I. Concept generation of semi automatic machine:-



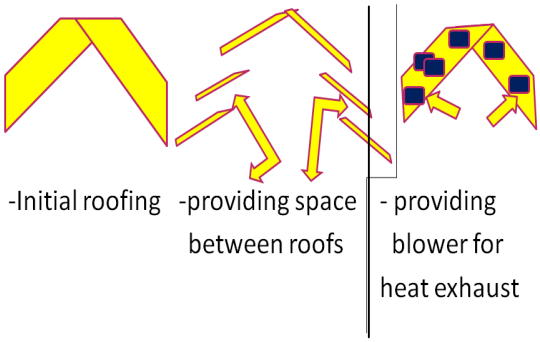
(FIG-5.1)

Here shown semi automatic machine concept which usefull for mould making process. This machine requires a robust structure and a hydraulic press. The lower part of the mould box (drag part) is mount on the table. Then fix the upper part (cope part) on the drag part. Both cope & drag part having hole at its two boundary end, which is match with stud. So the mould boxes are adjusted automatically without marking & adjusting. The lever with suitable mechanism (any hydraulic or mechanical) is used for adjusting the height of table according to required thickness. We have also using the screw jack at the place of lever mechanism. The hydraulic press is used for impacting the load on the mould box. This process is avoiding the hammering & foot pressing of sand into the mould box. Also we have implies a vibrator with this structure for better filling of send into the mould box.

II. Ergonomics:-

As discussed above problems the problem of higher temperature exists during pouring. So by providing proper roofing condition there is possibility of temperature reduction.

Here provides three alternate solutions for roofing condition. This shows below.



(FIG-5.2)

Also in the place of blower use of self propelling fan is more efficient and better.

III. Material handling solution:-

For handling of co_2 cylinder and its transportation provide a wheeler stand for moving one place to another place. (This is shown in to below fig.)

Wheeler stand (FIG-5.3)

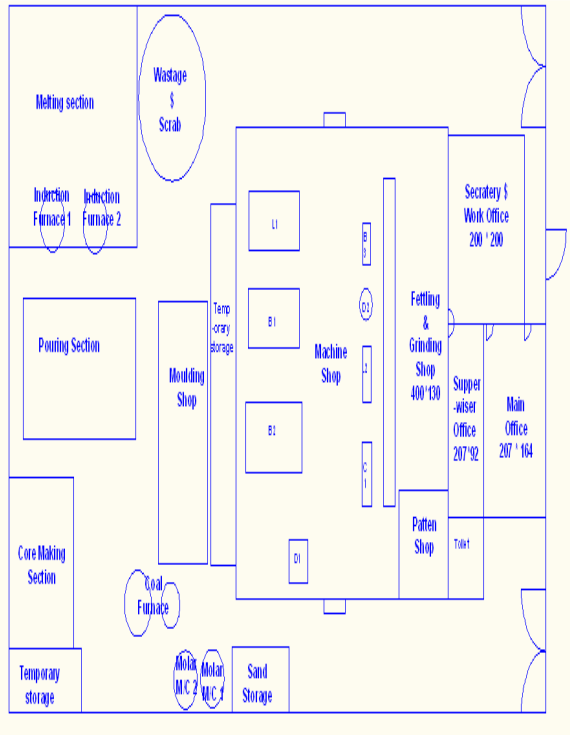
Other problem for handling components having weight more than 1tones is solve in to the plant layout alternate solution 2, by clear shown of the over head crane. By using this crane the parts or components which having 1 or more than tone weight is easily handle.

IV. Proper flow of material:-

As the change in layout the change of place of machines and equipments are change. So there is new flow of material is exists. As seen from the solution of change in layout the flow of material is generally inward to out ward by the "U shape "line of flow is exists. This reduces the possibility of back flow. These changes are shown in below figures. There are two alternative solutions provides which make proper flow of material.

- **Changing in layout place of existing:-**

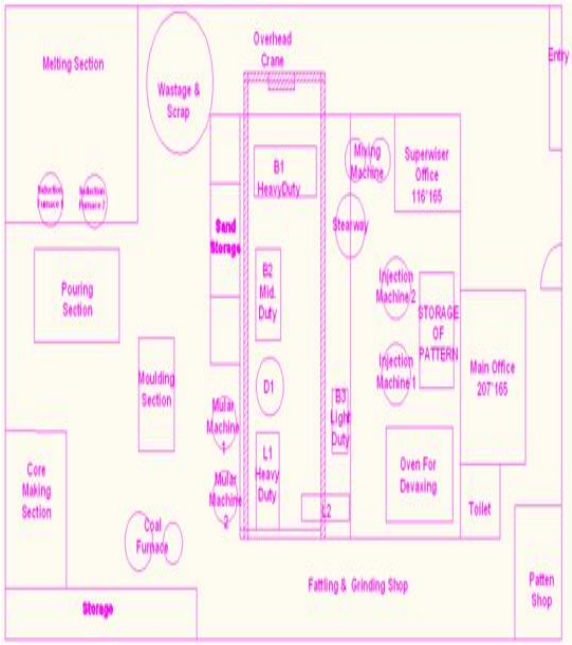
1. Alternate solution -1



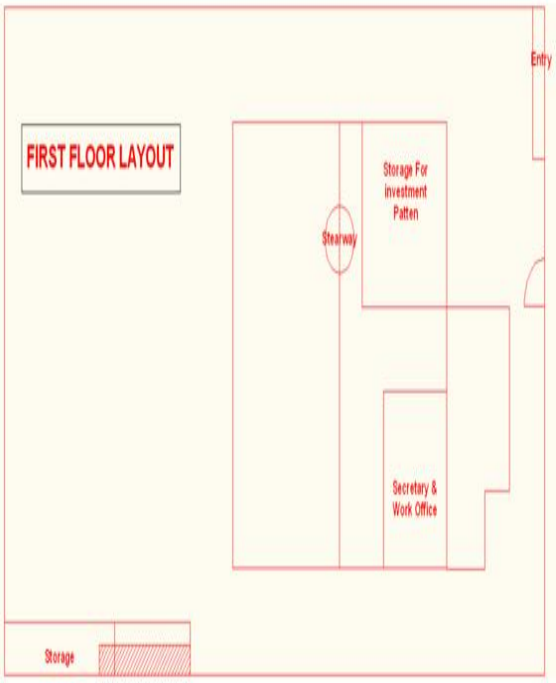
(FIG-5.4) Alternate solution-1

In this type of layout make the flow of material in to "U" shape. So there is no back flow of material and reduction in the bottleneck in processes. This is directly affecting productivity.

2. Alternate solution-2



(Ground floor) (I)



(First floor) (II)

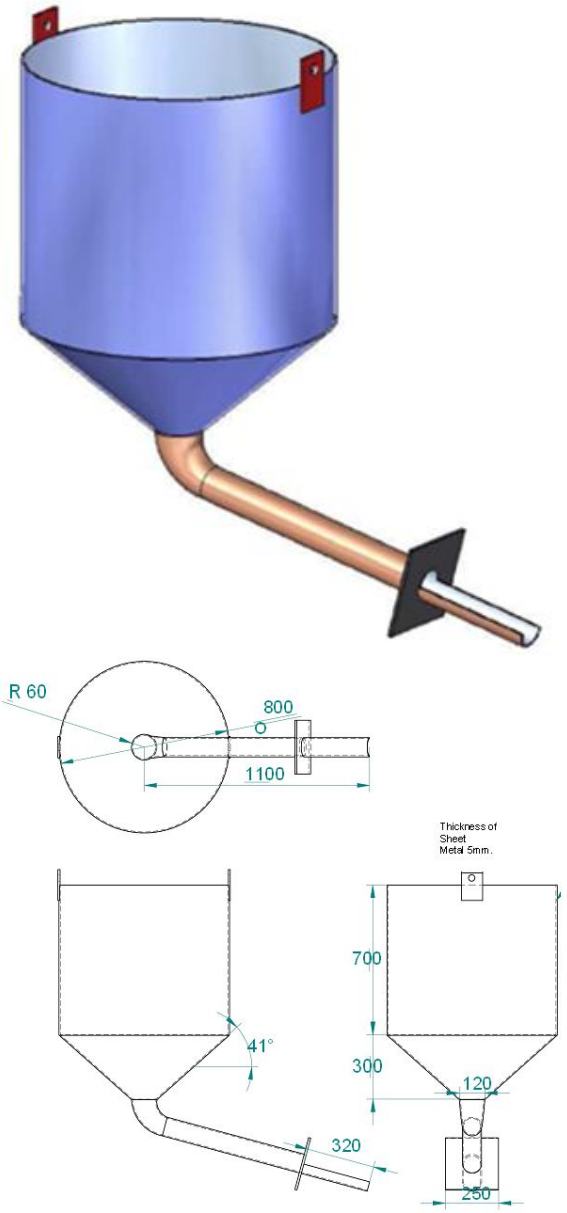
(FIG-5.5)Alternate solution-2

In this layout creating space for investment casting process as well as implementing a overhead crane for material handling (requirement of balancing of heavy components more than 1 tone weight) directly taken from truck & loading on the balancing machine. This is very effective & efficient layout which generates breakthrough improvement in productivity. Also creates more & proper space for storage of semi-finished goods.

V. Design of hopper:- (for rotary retort furnace solving loading problem)

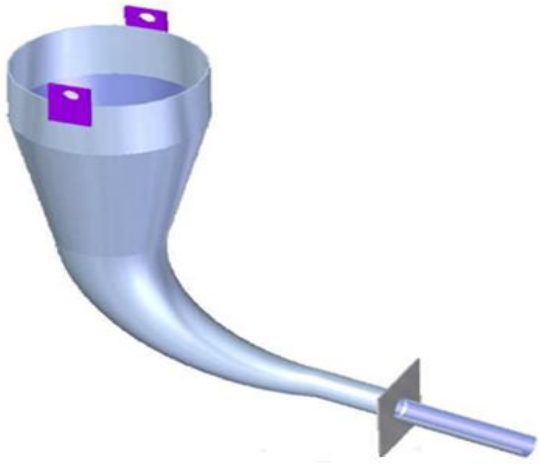
Here two alternate solutions are providing.

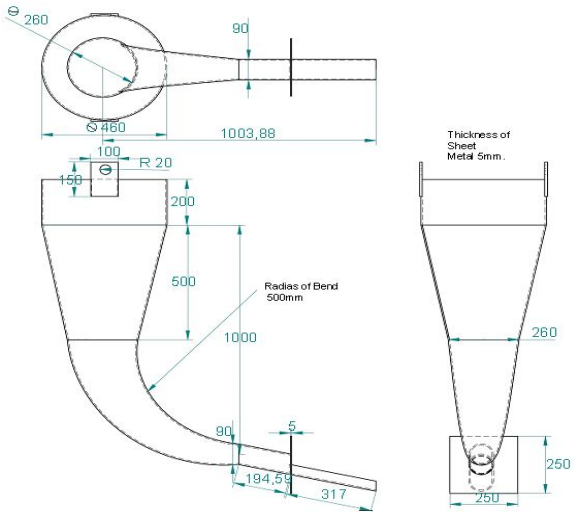
1. Alternate solution 1



(FIG-5.6) Alternate solution-1

2 Alternate solution 2





(FIG-5.7) Alternate solution-2

For loading material in to the rotary retort furnace end part of hopper inserting into the door & open the gate for flow of material in to the furnace from hopper. The up & down movement of the hopper is done by using suitable mechanism either electric crane or mechanically. We have also using the small air vibrator for more smooth flow of material into hopper.

CONCLUSION AND SUMMARY

6.1 Section-1 (at casting industry)

- By using semi automatic moulding machine:-

1. Avoiding skill worker requirement
2. Time reduction per mould making 5 to 6 minutes expected
3. Reduction in man power
4. Avoiding marking & adjustment of the cope & drag part

- By implementing 1st alternate solution in plant layout changing-Solved problems:-

1) Material movement.
2) Material handling.
3) Storage problem.

If implementing 1st alternate solution "U shape" line layout is achieved.

So possibility of back flow is neglecting, as well as overall production time is reduced due to reduction of time cons

- By implementing 2nd alternate solution in plant layout changing:-

Solved problems:-

1) Storage problem.
2) Material handling problem.
3) Space for Investment casting.
4) Material movement.

Same benefits are achieved as stated above as well as, fulfill the requirement of implementation of investment die casting is achieve. Fewer changes are required for this implementation. So produce more output by doing fewer changes.

- Ergonomics also affecting workers efficiency of doing work, by changing roofing temperature is reduced.
  -solving problems:
  1)5º temperature reduction after providing 5 blowers or (self propelled fan), up to 10 blowers, temperature reduction is possible.
  2) Workers doing work with good effort.

- "By providing wheeler stand" for cylinder
  -Solving problems:-
  1) Time reduction from gate to foundry.
  2) Ease of transportation.
  3) Work force reduction.

6.2 Section-2(at fastening industry)

- Both designs are feasible

-1st one in this Flow of material blocked due to sudden contraction of shape of hopper. But this problem is also solved by providing one air vibrator at side of on the outer surface.

-2nd design is easy as well as more effective for solve the loading problem. Also the flow of material is smooth and control of flow is possible.

- **Outcome**

1) Time reduction in loading up to 60% expected.

2) Heat loss is reduced up to 70º to 90º c expected.

3) More safe operation.

4) Reduce electricity consumption 10 to 15 % expected.

5) Overall total cost (maintenance cost, life cycle cost, etc) reduced.

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