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PLANT AND SHOP LAYOUT

2.1 Introduction, 2.2 Factors in plant layout, 2.3 Principles of plant layout, 2.4 Objectives of plant layout, 2.5 Advantages of a good plant layout, 2.6 Types of plant layout, 2.7 Fixed position layout, 2.8 Process layout or functional layout, 2.9 Product layout or line layout, 2.10 Comparison of process layout and product layout, 2.11 Combination layout or group layout, 2.12 Shop layout, 2.13 Layout of fitting shop, 2.14 Layout of machine shop, 2.15 Layout of welding shop, 2.16 Layout of sheet metal shop, 2.17 Layout of carpentry cum pattern making shop, 2.18 Layout of foundry shop, 2.19 Layout of smithy and forging shop.

2.1 INTRODUCTION

Plant layout is the systematic and functional arrangement of different departments, machines, equipments, tools and services in an industry to achieve the most efficient utilization of men, machines and materials. Plant layout includes all the aspects like space, ground, building, equipment, machines, factory services, manufacturing methods, flow of production, handling of materials, safety, housekeeping, labours and shipment of goods etc.

The main aim of a proper plant layout is to utilize all available resources in most efficient and economical manner to optimize production.

2.2 FACTORS IN PLANT LAYOUT

The location of a plant depends on many factors, which are as follows :

- ❖ Decision of a new product.
- ❖ Nearness to raw material, markets.
- ❖ Availability of space, power, labour, water, transport facilities.
- ❖ Good climate conditions.
- ❖ Financial and other aids.
- ❖ Local bylaws, taxes, security, hospitality etc.
- ❖ Facilities for expansion.
- ❖ Presence of related industries.

After deciding size and location of the enterprise, the next step is to plan the internal layout of the factory based on the following factors :

- ❖ Manufacturing processes to be adopted.
- ❖ Type of production.
- ❖ Specification and size of raw material and product.
- ❖ Material handling devices.
- ❖ Extent of automation.
- ❖ Scope for further expansion or modification.
- ❖ Service facilities.
- ❖ Links between various shops.

The next step is to plan the layout of a shop, which depends on following factors :

- ❖ Size and types of components to be produced.
- ❖ Types of machines available.
- ❖ No. of machines available.
- ❖ Sequence of operations.
- ❖ Power requirement.
- ❖ Store location.
- ❖ Inspection.
- ❖ Utility of individual machine.
- ❖ Interior and exterior set-up of the shop.

2.3 PRINCIPLES OF PLANT LAYOUT

A good plant layout is based on the following principles :

Integration. It means the integration of production centre facilities like workers, machinery, raw material etc. in a logical and balanced manner.

Minimum movement and Material handling. The movement of workers and materials should be minimum.

Smooth and continuous flow. Means bottlenecks, congestion points and tracking should not exist in a workshop.

Space utilization. The total space available should be utilised properly. Raw material and products should be stored in racks, if possible.

Flexibility. The plant layout must be flexible to facilitate changes in production as and when required.

Environment. The workplace should be free from pollution and safe. It should have proper light, ventilation and other amenities.

2.4 OBJECTIVES OF PLANT LAYOUT

A good plant layout serves the following objectives :

- ❖ It helps in the smooth flow of production.
- ❖ The entire space is utilised properly.

- ❖ Distance moved by the workers and material is minimum.
- ❖ There is increased flexibility.
- ❖ Plant maintenance is simpler.
- ❖ Working conditions are safer, better and improved.
- ❖ There are improved work methods, so more productivity and quality with reduced capital cost.
- ❖ There are no bottlenecks, congestion etc.
- ❖ Workstations are designed suitably and properly.
- ❖ It facilitates effective supervision.

2.5 ADVANTAGES OF A GOOD PLANT LAYOUT

- ❖ The resources (men, materials, and machines) utilization is optimized.
- ❖ The time required for material handling is minimized.
- ❖ Space utilization is effective and optimum.
- ❖ Productivity and quality is increased with reduced capital cost.
- ❖ Less paper work.
- ❖ Better supervision and reduces confusion.
- ❖ No bottlenecks and congestion.
- ❖ Better planning and effective control.
- ❖ Easy maintenance of plant and equipments.
- ❖ It increases the moral of the supervisors and workers.
- ❖ It provides better safety.

2.6 TYPES OF PLANT LAYOUT

The plant layout may be broadly classified into the following four groups :

- ❖ Fixed position layout or static product layout.
- ❖ Process layout or functional layout.
- ❖ Product layout or line layout.
- ❖ Combination layout or group layout.

2.7 FIXED POSITION LAYOUT

- ❖ In this type of layout the biggest or the major component of the product has a fixed position. All its accessories and auxiliary materials, tools, machinery, equipments and labour are brought to the work site. The location of the major component is not changed till the component is completely assembled.
- ❖ This type of layout is used in shipbuilding, automobile industry, railway wagon industry, aeroplane manufacturing etc. In the automobile industry, the chasis are kept at a fixed place and all components are brought to it for assembly from different sections.

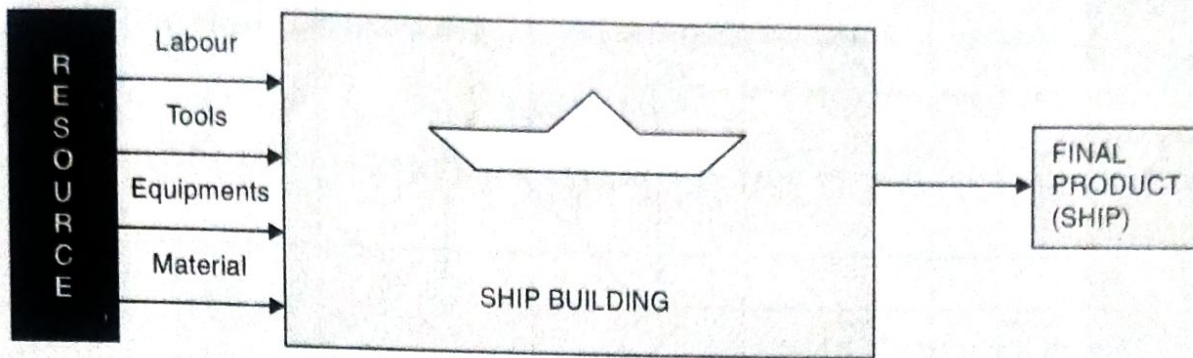


Fig. 2.1. *Fixed Position Layout.*

Advantages :

- ❖ The movement of material is reduced to a minimum.
- ❖ There is maximum flexibility to change in the product.
- ❖ All members of the team are responsible for quality work. So better coordination can be achieved.
- ❖ Continuity of operations are ensured.
- ❖ Minimum capital investment.
- ❖ Production control is easy.
- ❖ Better space utilization.
- ❖ Risk factors associated with heavy material handling are reduced.

Disadvantages :

- ❖ There is low utilization of labour and equipment.
- ❖ Equipment handling cost is high.
- ❖ It is limited to large items only.
- ❖ Highly skilled workers are required.
- ❖ Complicated jigs and fixtures are required for fixing tools and jobs.
- ❖ Not suitable for mass production.

2.8 PROCESS LAYOUT OR FUNCTIONAL LAYOUT

- ❖ It is called the process or functional layout because similar operations are performed at one location *i.e.* all lathes will be at one place, all drilling machines at another and so on.
- ❖ In this layout, each department is responsible for carrying on a particular process and not a particular product.
- ❖ Functional layout is a special type of classical layout in which various industrial facilities (machines) are grouped and arranged according to their functions.
- ❖ This layout provides some standby units because there are more than one machine of similar design and function at a particular section or department to perform the intended job so for this reason if one machine fails, the whole system does not fail.

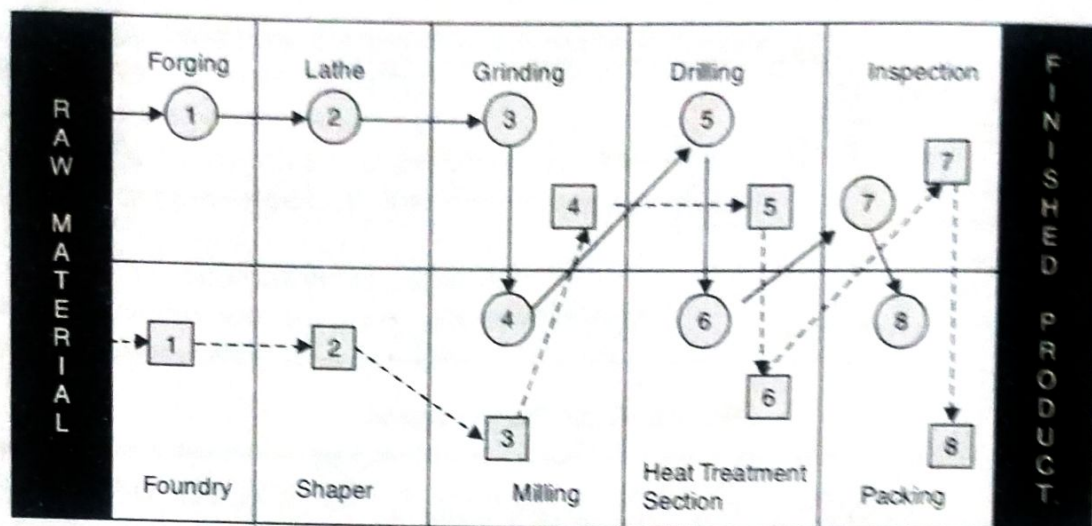


Fig. 2.2. Process Layout (Functional Layout).

Advantages :

- ❖ Better utilization of the available equipments.
- ❖ Less number of machines are needed as compared to other layouts.
- ❖ Wide flexibility exists.
- ❖ Operations performed in one section don't effect the workers of the other section.
- ❖ Experience can be utilised properly.
- ❖ New workers have better training facilities.
- ❖ Provision of standby units.

Disadvantages :

- ❖ Requires more floor area.
- ❖ More movement of materials.
- ❖ Production control is difficult.
- ❖ Large inprocess inventory (i.e. work in process is more).
- ❖ Total job completion time is more.
- ❖ Inspection of work after each operation is essential as the material passes to the next department.
- ❖ Routing and scheduling is more difficult.

Application :

This type of layout is used for job order production or manufacturing/maintenance activities of non-repetitive types.

2.9 PRODUCT LAYOUT OR LINE LAYOUT

This type of layout is called product layout because in this layout all machines are arranged according to the sequence of operations needed to form a product. For example in order to manufacture a product, the sequence of operations consists turning, drilling, milling and grinding. Then layout will consist of a lathe machine then drilling machine, then milling machine and then the grinder to perform turning, drilling, milling and grinding respectively.

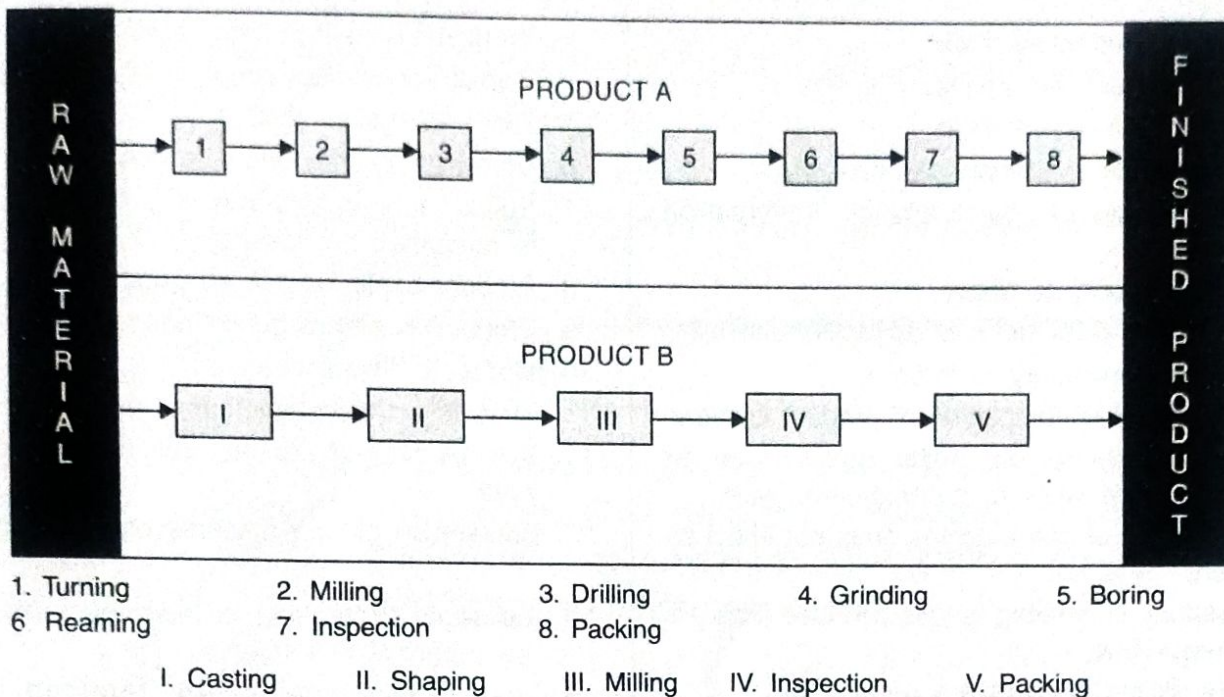


Fig. 2.3. Product Layout (Line Layout).

Advantages :

- ❖ Relatively less floor area is required.
- ❖ Material handling is less.
- ❖ Work in process inventory is less.
- ❖ Production control is better.
- ❖ Manufacturing time is less.
- ❖ Workflow is smooth and continuous.
- ❖ Automation can be easily applied.
- ❖ Requires less inspection as compared to process layout.

Disadvantages :

- ❖ More number of machines are needed, so higher capital investment.
- ❖ Less flexibility in layout.
- ❖ The rate of production is largely affected by the rate of the slowest machine.
- ❖ The breakdown of a single machine may effect the whole production.
- ❖ Manufacturing cost increases, if the production is limited.
- ❖ Specialised facilities also require a high initial investment.

2.10 COMPARISON OF PROCESS LAYOUT AND PRODUCT LAYOUT

PROCESS LAYOUT	PRODUCT LAYOUT
1. In process layout, similar machines are arranged in one location.	1. In this layout, machines are arranged according to the sequence of operations needed to manufacture the product.
2. Flexibility is more in process layout.	2. Flexibility is very less in product layout.

3. Work movement is more.
4. Capital investment required is less.
5. Work flow is not smooth.
6. Utilization of machinery is better.
7. Space required for same amount of production is more.
8. Product quality is better.
9. Production planning and control is difficult.
10. Inprocess inventory is large.
11. Time taken in completion of product is more.
12. It is used in job order production or maintenance work of non-repetitive type.
13. Breakdown of one machine does not effect so much.
14. Monotony in working is less because jobs are non-repetitive.
15. More skilled workers are required.
16. Automation in material handling is not effective.

3. Work movement is very less.
4. Capital investment required is more.
5. Work flow is smooth.
6. Utilisation of machinery is poor.
7. Space required for same amount of production is comparatively less.
8. Product quality is not so good.
9. Production planning and control is easy.
10. Inprocess inventory is less.
11. Time taken in completion of product is less.
12. It is used in mass production or assembly work.
13. Breakdown of one machine effects more.
14. Monotony in working is more because jobs are repetitive in nature.
15. Less skilled workers are required comparatively.
16. Full automation in material handling is possible.

2.11 COMBINATION LAYOUT OR GROUP LAYOUT

Advantages of process layout and product layout is combined in one layout and that layout is called the combination layout or group layout. In this layout, machines are arranged according to the sequence of operations needed to manufacture the product whereas horizontally, similar machines are arranged vertically in one location. Since this layout is based on group technology principle (*i.e.* the products which needs similar sequence of operations to manufacture inspite of their shape and size is called one group and principle is called group technology) so it is also called group layout.

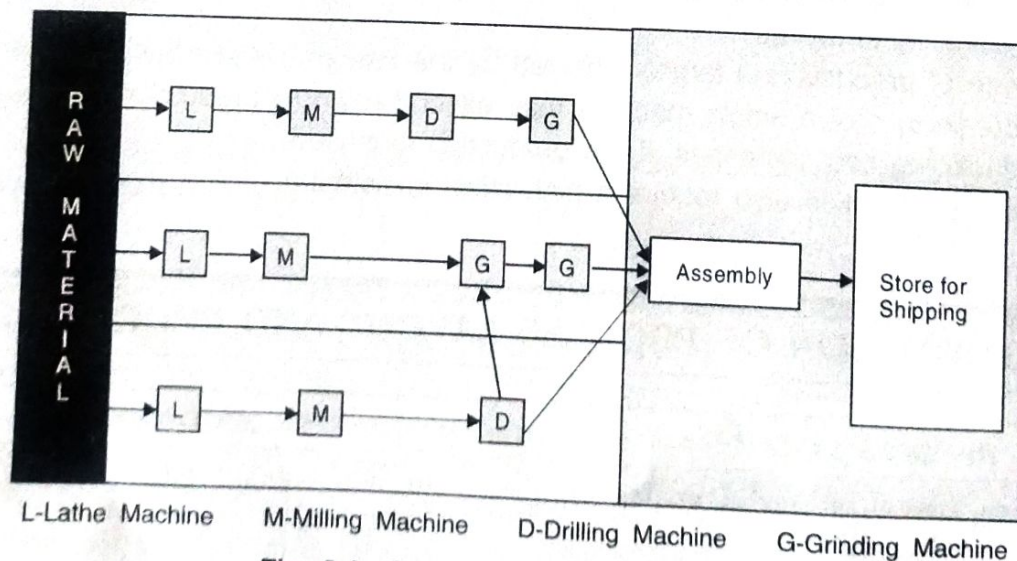


Fig. 2.4. Combination or Group Layout.