

## UNIT-2

### PLANT LAYOUT

#### WHAT IS PLANT LAYOUT, EXPLAIN THE PRINCIPLES AND TYPES OF LAYOUTS?

The concept of plant layout has great significance in industrial organizations. Today every organization is giving much importance to plant layout. The success of an organization is also based on its plant layout. The systematic arrangement of men, machinery and equipment in a given plant area. So, as to achieve maximum production with minimum cost is called plant layout. It means keeping the machinery and equipment with in a given plant area. It can be defined as the process of determining a spatial location for the creation of physical production facilities suitable to manufacture a product.

#### Principles of plant layout:-

The main principles of plant layout are:

1. Minimizing per unit cost.
2. Optimizing quality.
3. Effective use of manpower, machinery, equipment and space.
4. Employee's convenience, safety and comfort.
5. Realization of production targets with in a stipulated time period.
6. Achieving organizational goals in most efficient and effective manner.
7. To achieve maximum production with minimum cost.

#### Types of plant layout:-

The pattern of plant layout is based on number of products (P) and production quantity(Q). There are there types of plant layouts.

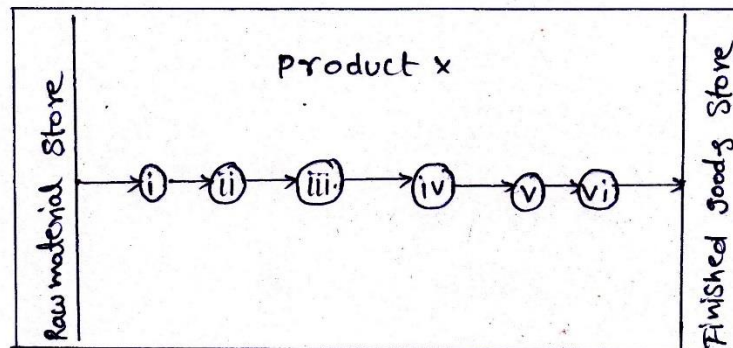
1. Product layout
2. Process layout
3. Fixed layout

#### **1. Product layout:-**

If the layout is designed for a particular product to be produced, it is called product layout. The logical sequence in the production process forms the basis for the arrangement of machinery under this layout. It means in this case the machinery is arranged in the logical sequence for different operations. It facilitates greater degree of automation to minimize errors and fatigue's. The following chart shows the production of commodity 'X' and its operations it requires six operations.

- i. Drilling
- ii. Boaring
- iii. Grinding

- iv. Milling
- v. Reaming
- vi. Inspection.



#### Advantages:-

- a. Faster and greater production.
- b. Lower cost of material handling.
- c. Easy monitoring.
- d. Effective use of resources.
- e. Team work benefits.
- f. Maximum production with minimum cost.
- g. Smooth and continuous work flow.
- h. Product completes in lesser time.
- i. Better coordination.
- j. Simple production planning and control.
- k. Less in process inventory.
- l. Less space requirements for the same volume of production.

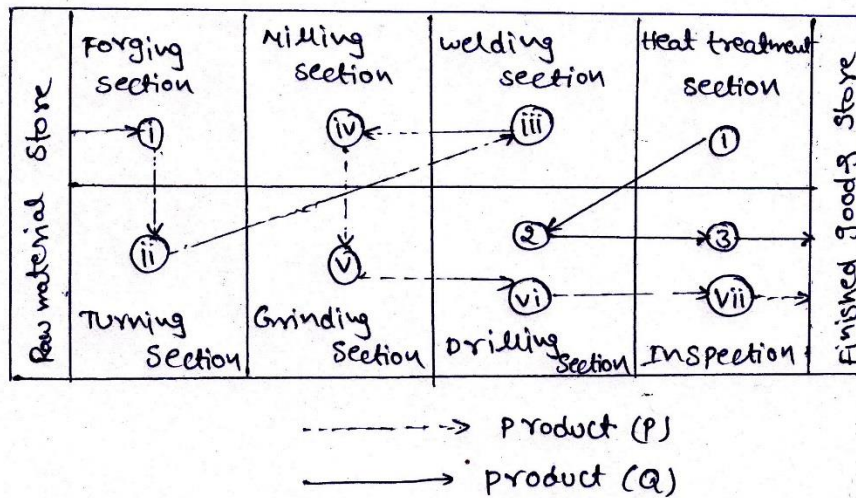
#### Disadvantages:-

- a. Little flexibility.
- b. Discontinuity in production lightly.
- c. Monitoring each worker made difficult.
- d. Use capital outlays.
- e. Threat of duplication.

#### 2. Process layout:-

It is also called functional layout. If the layout is designed for different products and for different processes, it is said to be called process layout. In this case the machinery and equipment is arranged in a separate sections. For different products and for different operations. For example there are two products P and Q to be produced. For producing two products different types of

machinery and processes to be followed. The process layout can be understood with the help of the following chart.



#### Advantages:

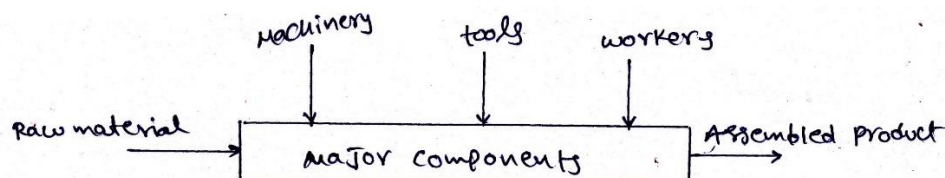
- Maximum utilization of resources.
- Flexibility.
- Continuity.
- Interesting to workers.
- Easy to monitoring.
- Convenient to workers.

#### Disadvantages:

- Higher material handling cost.
- Larger production cycle.
- Monitoring may be complex.
- Higher inspection cost.
- Higher wageable.

### 3. Fixed layout:-

If the layout is designed in a fixed position it is said to be called fixed layout. Here the material components remains stationary. Men, machinery tools ... Etc. are brought to that location and assembled the product. Generally we can observe this type of layouts in large projects.



**Advantages:**

- a. Does not involve large investment.
- b. High degree of flexibility.
- c. Workers find it very interesting.

**Disadvantages:**

- a. Material handling cost will be very high.
- b. At times the resources may be under-utilized.

**WHAT IS MEANT BY PLANT MAINTENANCE?**

A plant is a place where men, money, material, machinery, equipment ...Etc are brought together for manufacturing products.

**Plant maintenance:**

Keeping the plant in good working condition to achieve maximum production with minimum cost by minimizing breakdowns is called plant maintenance. Today in modern industry equipment and machinery is a very important part of the total productive effort than was the case years ago. More over with the development of special purpose and sophisticated machines equipment and machinery cost a lot more money and therefore idle and down time becomes much more expensive.

**Objectives of plant maintenance:**

1. To minimize production breakages.
2. To keep the plant in good working condition.
3. Optimum utilization of machine capacity.
4. Optimum utilization of plant capacity.
5. To prevent accidents.
6. To provide security and safety to workers.

**Importance of plant maintenance:**

1. The importance of plant maintenance varies with that type of plant and its production.
2. Equipment breakdown leads to an inevitable loss of production. If a piece of equipment goes out of order in flow production factory, the whole line will soon come to a halt. Other production lines may also stop unless the initial fault is cleared.
3. An un properly maintained plant will sooner require expertize and frequent repairs, because with the passage of time. All machines facilities buildings wear out and need to be maintained to function properly.
4. Plant maintenance place a prominent role in production management. Because plant break down creates problems such as loss in production time, rescheduling of production spoilt materials failure to recover over headed.

To avoid all the above difficulties and problems proper maintenance of plant is essential.

### **WHAT ARE FACTORS THAT GOVERN PLANT LOCATION?**

A plant is a place where men, money, machinery and equipment ...etc are brought together for manufacturing products. Plant location plays a vital role in the organization.

#### **Governing factors:**

1. Nearness to raw material.
2. Transport facilities.
3. Nearness to markets.
4. Availability of labor.
5. Availability of fuel and power.
6. Availability of water.
7. Climatic conditions.
8. Financial and other aids.
9. Land
10. Community attitude.
11. Presence of related industries.
12. Existence of hospitals marketing centers, schools, banks, post offices, clubs.. etc.
13. Local byelaws, taxes, building ordinances.
14. Housing facilities.
15. Security.
16. Facilities for expansion.

#### **1. Nearness to raw material:**

This is one of the factor that influence plant location. The plant must be located very nearer to raw material. The raw material can be easily available to the plant.

#### **2. Transport facilities:**

This is also one of the factor that influence plant location. Transportation plays a vital role in transporting finished goods from manufacturing unit to market centers.

#### **3. Nearness to markets:**

The plant must be located nearer to the markets. If it is located nearer to markets, the transportation charges can be minimized.

#### **4. Availability of labor:**

The plant should be located where the labor force is available in plenty. Labor force plays a vital role in production.

**5. Availability of fuel and power:**

The plant should be located where the fuel and power is available in sufficient. Power and fuel plays a vital role in production.

**6. Availability of water:**

The plant should be located where the availability of water is in sufficient.

**7. Climatic conditions:**

The plant should be located where the climate is congenial. Climate also play a vital role in production.

**8. Financial and aids:**

The plant should be located where the financial institutions and support is in sufficient. Finance is the life blood of an organization. Adequate financial resources are necessary to produce goods.

**9. Land:**

The plant should be located where the topography of land is good. Earth quakes floods... etc may creates so many problems.

**10. Community attitude:**

The plant must be located in the place where the local community attitude is fine. The local community and their attitudes may influence the plant.

**11. Presence of related industries:**

The plant must be located in the place where related industries are present. If there are related industries mutual help and cooperation may exit.

**DISCUSS ABOUT PREVENTIVE AND BREAKDOWN MAINTENANCE?****Preventive maintenance:**

Preventive maintenance means maintaining the plant to prevent accidents. The main principle of preventive maintenance is that prevention is better than cure. It tries to minimize the problems of breakdown maintenance. It is a stich in time procedure. It locates weak spots in all equipment provides them regular inspection of the minor repairs there by reducing the danger of unanticipated break down.

**Preventive maintenance involves the following aspects:**

1. Periodic inspection of equipment and machinery.
2. To uncover conditions that lead to production break down and harmful depreciation.
3. Up keep of plant equipment to correct such conditions while they are still in a minor stage.

### Objectives of preventive maintenance:

1. To minimize the possibility of unanticipated production interruption breakdown by locating and condition which may lead to it.
2. To maintain the value of equipment and machinery by periodic inspection repairs over hauls.
3. To make plant equipment and machinery always available and ready for use.
4. To maintain the optimum productive efficiency of the plant equipment and machinery.
5. To maintain the operational accuracy of the plant equipment.
6. To achieve maximum production at minimum repair cost.
7. To reduce the work content of maintenance jobs.
8. To ensure safety of life and limbs of the workmen.

### Departments responsible for preventive maintenance:

1. Production departments.
2. Maintenance department.
3. A separate division of inspectors, crafts and supervisors. The above departments and persons are responsible for preventive maintenance.

### Where to start preventive maintenance:

One should not apply preventive maintenance to the entire plant at once. This program should be built up in pieces when one piece is finished, start the next. The entire preventive maintenance program hangs on inspectors and their related duties of adjustments and repairs.

Machine Number	Machine Description	1	2	3	4	5	6	7	8	9
1201	lathe				C					O
162	Shaper		C					O		
980	Surface grinder			F						
650	Milling					F				

weekly PM schedule

C – clean

O – overhauling

F – functional check

### **DISCUSS ABOUT BREAKDOWN MAINTENANCE?**

It implies that repairs are made after the equipment is out of order and it cannot perform its normal function any longer.

Ex: an electric motor will not start a belt is broken.

Under such conditions production department calls on the maintenance department to rectify the defect. The maintenance department checks into the difficulty and makes the necessary repairs. After removing the fault maintenance engineers do not attend the equipment again until another failure brake down occurs. This type of maintenance may be quite justified in small factories.

#### **Typical causes of equipment break down:**

1. Failure to replace worn out parts.
2. Lack of lubrication.
3. Neglected cooling.
4. Indifference towards minor faults.
5. External factors.
6. Indifference towards equipment vibrations, unusual sounds, equipment getting too much heated up...etc.

#### **Disadvantages:**

1. Excessive delays in production.
2. Reduction of output.
3. Faster plant deterioration.
4. Increased chances of accidents and less safety to both workers and machines.
5. More spoilt material.
6. Direct loss of profit.

### **EXPLAIN THE QUANTITATIVE TECHNIQUES FOR OPTIMAL DESIGN OF LAYOUTS?**

The concept of plant layout have great significance in industrial organizations. The systematic arrangement of men, material, machinery equipment in a given plant area. So as to achieve maximum production with minimum cost is known as plant layout.

#### **Quantitative techniques:**

There are so many. They are process flow chart. There show how different component parts assembled in sequence of operations to form such assembles which in term lead to finished products. This chart how different parts can produce.



## METHODS OF PLANT AND FACTORY LAYOUTS:

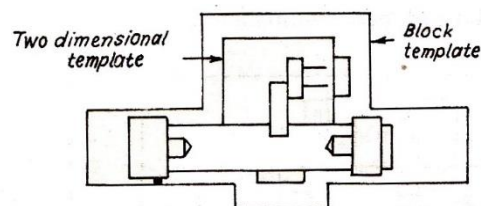
A layout furnishes details of the building to accommodate various facilities (like workers, material, machinery, etc.). In addition, it integrates various aspects of the design of a production system. The information required for plant laying out includes, dimensions of work places, sequence of operations, flow pattern of materials, storage space for raw material, in-process inventory and finished goods, offices, aisles, toilets, etc. During different development stages of a layout the following methods may be used.

**(1) Process Flow Charts:** They show, how different component parts assemble, in sequence of operations to form sub-assemblies which in turn lead to assemblies (finished products).

**(2) Material Movement Patterns:** The flow pattern of materials-in-process is traced and layout is built around it.

**(3) Layout Analogues.** They cover two-dimensional cutouts or templates and three-dimensional models.

**(a) Templates or 2-D model:** They are used to develop plant layout. They are two-dimensional or block templates made up of cardboard, coloured paper or celluloid. They are made to scale (a typical scale being 1/50) and are placed on the scaled outline plan of the building. Templates or cutouts show the plan of the various facilities and the building. They show the actual floor space utilization. The templates can be placed and attached with a tape either on a board or on a cross-hatched surface or on a graph paper and thus being known as Graphic Technique.



Two-dimensional and block template.

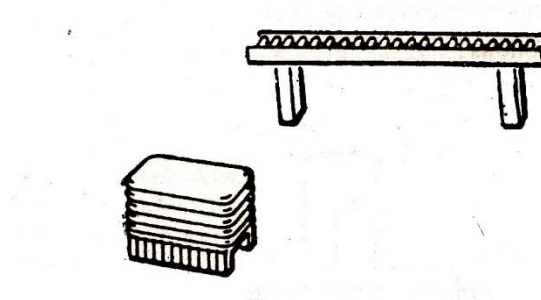
### Advantages of Two-Dimensional Templates

- (1) They are the least costly.
- (2) They can be readily interpreted and followed by technical hands.
- (3) Duplicate copies can be made.

### Disadvantages

- (1) Non-technical persons find it difficult to grasp the clear picture.
- (2) Overhead facilities cannot be visualized.

**(b) Three Dimensional Models:** They are scale models of a facility and, more near to the real situation as, besides length and width they show the height of a facility also. Models are especially suitable for persons who are not familiar with plant layout practice. Models are made up of wood or die cast plastic. They show minor details and can be mounted on a thick plastic sheet acting as the floor plan. Models are used mainly to develop floor plans and elevations. Models can be made for production machines, workers, material handling equipments or any other facility.



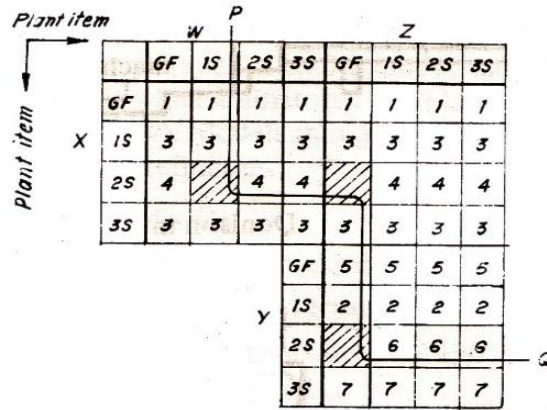
**Advantages of Three-Dimensional Models:**

- (1) Layout is easier for the lay men to understand.
- (2) Layout can easily be explained to management.
- (3) Models can be shifted easily and quickly to study operational arrangements.
- (4) Overhead structures can be easily checked.
- (5) They convey more or less a real situation.

**Disadvantages:**

- (1) They require more storage area.
- (2) They are expensive.

**(4) The Correlation Chart:** It involves drawing a grid with rows presenting alternative solutions (See Fig). Plant items can be ground floor, first floor or other floors of a multi-storey building. After the grid has been drawn the next step involves applying the constraints and objectives of layout. For example, the constraints to the layout may be that, (1) X cannot be done on ground floor (G.F.), (2) Y cannot be performed on first storey (1S). Similarly there can be objectives, (3) W should be done on second storey, and so on there are other objectives (4), (5), etc. Constraints and objectives are then applied to the squares. When a constraint stops an item going into a square, then in that square the number of that constraint is marked. After that the objectives or preferences are applied.



Correlation chart.

(5) **Travel Chart.** A travel chart as the name suggests is a chart or record of the amount of travel by the material in-process while going from machine to machine or from one department to another. The amount of travel depends upon the frequency of movements between sections or departments. A travel chart helps improving the existing plant layout.

The following example will explain a travel chart :

Existing plant layout showing the locations of various departments (A to F) is given in Fig. 4.11.

A	B	C
D	E	F

Fig. 4.11. 1st Step : (Existing layout).

**2nd step :** Movements A to B are 20 ; B to A, 10 ; B to C, 15 ; A to F, 25 ; C to D, 30 ; D to C, 50 ; D to F, 40 ; E to F, 10 and F to E, 15.

**3rd step :** A square grid is drawn and the various movements are marked.

FROM TO	A	B	C	D	E	F
A		10				
B	20					
C		15		50		
D			30			
E						15
F	25			40	10	

Fig. 4.12 3rd step.

FROM TO	A	B	C	D	E	F
A						
B	30					
C		15				
D			80			
E						
F	25			40	25	

Fig. 4.13. 4th step.

**4th step :** Fig 4.12 is simplified by combining movements like A to B (20) and B to A (10) which involve same distance and therefore total movements  $A \rightleftharpoons B = 20 + 10 = 30$ .

The simplified travel chart (See Fig. 4.13) shows the movements as follows :

- $A \rightleftharpoons B = 30$
- $B \rightleftharpoons C = 15$
- $C \rightleftharpoons D = 80$
- $A \rightleftharpoons F = 25$
- $D \rightleftharpoons F = 40$
- $E \rightleftharpoons F = 25$

According to these figures maximum number of movements are between departments C and D, hence in the plant layout these two departments should be side by side. The next lesser number of movements are between D and F, hence D and F should also lie closer to each other and so on. As a result the existing plant layout can be modified as follows :

C	D	A
E	F	B

Fig 4.14. Modified Layout.

Departments *C* and *D* (80), *D* and *F* (40), *A* and *B* (30), *A* and *F* (25), *E* and *F* (25) are closer to each other whereas *B* and *C* which have minimum number of movements (*i.e.*, 15) between them are away from each other.

A travel chart is advantageous because it brings out the relative importance of having different pairs of departments close to each other but it gives an optimum linear arrangement which may not be always required.

(6) **Load Path Matrix Method.** The method aims at reducing the transportation of in-process inventory from section to section. Like travel chart it also helps deciding the position of one department in relation to the other. The ultimate purpose is to modify the existing layout or the preliminary plant layout made by other techniques. The departments having mass flow of material or goods are placed close to each other. The following example will illustrate the method.

\*Kgs of material moved per day.

FROM \ TO	A	B	C	D	E	F
A		10				
B			15			
C	20*			20		
D	40				25	5
E			28			
F					15	

Fig. 4.15 From-to matrix constructed from the actual given data. (Step 1).

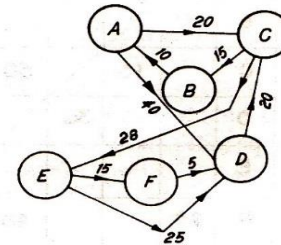


Fig. 4.16. (Step 2).

From the matrix (step 1) a diagram (See Fig. 4.16) is made showing the locations of different departments and the amount of material flowing among various departments (like *A*, *B*, *C*, etc.). Line joining *AC* shows that 20 kg. of material moves per day from department *A* to department *C* and so on. It can be seen that 40 kgs. of material while going from *A* to *D* passes *B*. If *D* department is brought in place of *B* then 40 kgs (*i.e.*, maximum) of material will move comparatively less distance. Similarly, material movements from *C* to *E* and *E* to *D* can be considered. The aim is to reconstruct this sequence diagram so that bigger loads travel small distances.

*Step 3.* Trial and error method can be used in order to modify the sequence diagram of step 2 and a comparatively better sequence diagram is drawn in Fig. 4.17. This has been obtained by placing those departments close to each other which involve movements of larger amounts of materials.

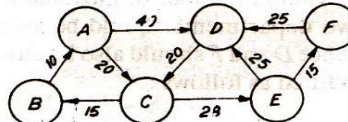


Fig. 4.17. Modified sequence diagram.



## **FACTORY BUILDING**

### **Introduction**

- After the plant location has been selected and plant layout decided upon, the next step is to construct plant or factory building to house and protect employees, equipments, tools, machinery, materials, etc.
- The factory building is the primary tool required to carry on production and into which all other production tools, processes and mechanisms must fit.
- *A good factory building*
  - (i) helps performing different operations most effectively ;
  - (ii) reduces material handling costs ;
  - (iii) minimizes production cycle time ;
  - (iv) reduces bottlenecks, stoppages and interruptions
  - (v) increases plant flexibility and efficiency ;
  - (vi) lowers down the maintenance costs ;
  - (vii) increases equipment and employees' safety ; and
  - (viii) has good appearance and provides healthy and pleasant working conditions.