

# RRB-JE

# 2024

**Railway Recruitment Board**  
Junior Engineer Examination

## Mechanical Engineering

## Industrial Management

Well Illustrated **Theory** *with*  
**Solved Examples** and **Practice Questions**



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# Industrial Management

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## Plant/Store Location and Layout

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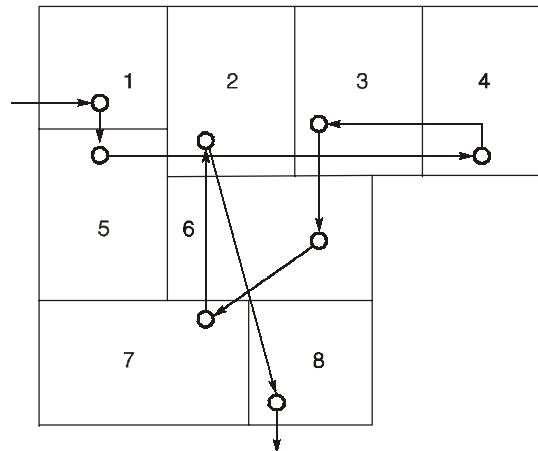
### 2.1 Plant Layout

- Plant layout means the disposition of the various facilities (equipment, materials, manpower etc.) and services of the plant within the area of the site selected previously.
- Plant layout begins with the design of the factory building and goes upto the location and movement of the work table. All the facilities like equipments, raw materials, machinery, tools, fixtures, workers etc. are given a proper place.
- In a good plant layout bottlenecks and points of congestions are eliminated so that it permits materials to move through the plant at the desired speed with the lowest cost.
- A good layout minimizes the movement of finished and semi-finished product. So that material handling cost is reduced.

### 2.2 Principles of Plant Layout

1. **Principle of integration:** A good layout is one that integrates men, materials, machines and supporting services and others in order to get the optimum utilisation of resources and maximum effectiveness.
2. **Principle of minimum distance:** This principle is concerned with the minimum travel of man and material.
3. **Principle of cubic space utilisation:** The good layout is one that utilise both horizontal and vertical space, height is also to be utilised effectively.
4. **Principle of flow:** A good layout is one that makes the material to move in forward direction towards the completion stage.
5. **Principle of maximum flexibility:** The good layout is one that can be altered without much cost and time.
6. **Principle of safety, security and satisfaction:** A good layout is one that gives due consideration to workers safety and satisfaction and safeguards the plant and machinery against fire, etc.
7. **Principle of minimum handling:** A good layout is one that reduces the material handling to the minimum.

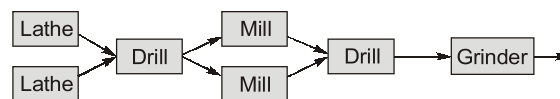
## 2.3 Process Layout



**Fig. 2.1**

1. Store room
  2. Inspection Department
  3. Broaching section
  4. Milling section
  5. Lathe section
  6. Shaper section
  7. Drill section
  8. Stock room
- It is also known as functional layout.
  - It is characterized by keeping similar machines or similar operations at one location. In other words, all lathes will be at one place, all milling machines at another and so on.
  - Process layout generally employed for industries engaged in job order production and non-repetitive kind of maintenance or manufacturing activities.
  - It gives *better product quality*, because supervisors and workers attend to one type of machine and operation.
  - For same amount of production, process layout needs more space.

## 2.4 Product Layout

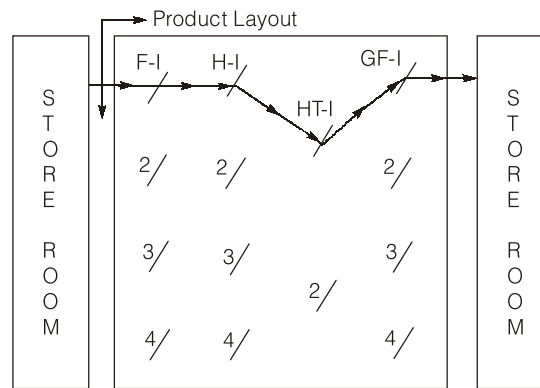


**A Simple product layout**

- It is also known as line (type) layout.
- It implies that various operations on raw materials are performed in a sequence and the machines are placed along the product flow line, i.e., machines are arranged in the sequence in which the raw material will be operated upon.
- This type of layout is preferred for *continuous production* i.e. involving a continuous flow of in process material towards the finished product stage.

- In it less space requirement for the same volume of production.
- In it automatic material handling, lesser material handling movements, times and costs benefits are gained.

## 2.5 Combination Layout



**Fig.2.2**

F = Blank forging hammers

H = Hobbing machines for cutting gear teeth

HT = Heat treatment furnaces

GF = Gear finishing machines

- A combination of process and product combines the advantages of both types of layout.
- A combination layout is possible where an item is being made in different types and sizes. In such cases machinery is arranged in a process layout but the process grouping (a group of number of similar machines) is then arranged in a sequence to manufacture various types and sizes of products.
- No matter the product varies in size and type, the sequence of operations remain same.
- For example, hacksaws, circular metal saws, wood saws etc. to be manufactured on a combination layout.

## 2.6 Fixed Position Layout

- In other types of layouts discussed earlier, the product moves past stationary production equipments, where as in this case the reverse applies, men and equipment are moved to the material, which remains at one place and the product is completed at that place where the material lies.
- It is used in ship building, aircraft manufacturing and big pressure vessel fabrication.
- There is maximum flexibility for all sorts of changes in product and process.
- It involves high equipment handling cost.

## 2.7 Group Layout (or Cellular layout)

It is a combination of the product and process layout. If there are m-machines and n-components, in a group layout (group-technology layout), the m-machines and n-components will be divided into distinct number of machine-component cells (groups) such that all the components assigned to a cell are almost process within the cell itself.

- Here the main objective is to minimize inter-cell movements.

**Example 2.1**

Which one of the following combinations is valid for product layout?

- (a) General purpose machine and skilled labour.
- (b) General purpose machine and unskilled labour.
- (c) Special purpose machine and semi-skilled labour.
- (d) Special purpose machine and skilled labour

[ESE : 2001]

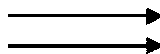
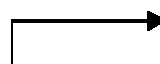

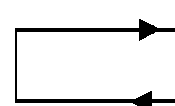
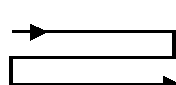
**Solution: (c)**

- Special purpose machine
- Semi-skilled labour

## 2.8 Flow Pattern

- One of the most important objectives of plant layout is to achieve an optimum effective flow of materials (raw materials and in process materials) through the plant. Naturally the principle of minimum movements forms the basis for optimum effective flow.
- The principle of minimum movements reduces material handling costs; in process inventory and space for processing.
- While designing a new plant layout, generally the flow patterns are decided earlier.

### 2.8.1 Types of Flow Pattern

- Line flow 
  - ❖ Preferred in building having long lengths and smaller widths.
- L-type flow 
  - ❖ Used where building are more wide but less long as compared to line flow type buildings.
- Circular flow 
  - ❖ Preferred for rotary handling systems. Different work stations are located along the circular path.
- U-type flow 
  - ❖ Supervision is simpler as compared to others preferred in square-shaped buildings.
- S or inverted S 
  - ❖ Preferred for production lines longer than U-type and in square shape buildings. The system is compact, space has been better utilized and supervision is efficient.

- Combination of line flow and circular type.



- ❖ As compared to line flow, this system needs smaller building lengths.

## 2.9 Product Planning

- It may be defined as evaluation of the range, mix, specification and pricing of existing and new products in relation to meet the future market requirements and competition.
- Product planning serves as an input to process design.
- The product planning function often includes.
  - ❖ Marketing and marketing analysis.
  - ❖ The performance of feasibility studies.
  - ❖ Advanced planning.

## 2.10 Product Development

- Development involves design/redesign and fabrication of new or modified product and then testing it to find out its usefulness.
- Product development is essential to meet changing customer needs.
  - ❖ Manufacture improved and low cost products.
  - ❖ For maintaining sales position and profit margin.

### Products can be developed by:

- (i) **Imitation:** Marketing another product similar to one in the market.
  - (ii) **Adaptation:** Developing an improved product from one already existing in the market.
  - (iii) **Invention:** Thinking about a new advance and acceptable product which is not existing in the market and producing it.
- Product development may involve a small refinement or a major redesign.

## 2.11 Process Planning

- Finding the most economical process of doing a work and (then) deciding how and where the work will be done.
- Process planning means the preparation of work detail plan.
- Different steps involved in process planning are:
  - ❖ Selection of process.
  - ❖ Selection of Material.
  - ❖ Selection of Jigs, Fixtures and other special attachments.
  - ❖ Selection of cutting tools and inspection gauges.
  - ❖ Make the process layout indicating every operation and the sequence in which each operation is to be carried out.
  - ❖ Find set up time and standard time for each operation.
  - ❖ Manifests process planning by documents such as operation and route sheet.

- **Material Control:** It determines the requirement and control of material.
- **Tool Control:** Tool control implies
  - ❖ Determining tool requirements.
  - ❖ Procuring necessary tools.
  - ❖ Controlling/maintaining tools once they have been procured.
- In order to facilitate tool control and to limit the investment in tool inventory, it is important to standardize wherever possible all the tools within an organization.

## 2.12 Group Technology

- Group technology or cellular manufacturing has become an increasingly popular concept in manufacturing that is designed to take advantages of mass production layout and techniques in smaller batch production systems.
- Group technology is the realization that many problems are similar and that by grouping similar problems, a single solution can be found to set of problems, thus saving time and effort.
- Group technology, in manufacturing, is the replacement of traditional jobbing shop manufacturing by the analysis and grouping of work into families and the formation of groups of machines to manufacture these families on a flow-line principle with the objective of minimizing setting time and throughout time.

### **Example 2.2** Travel chart mainly helps

- (a) In improving the existing plant layout
- (b) While selecting plant location
- (c) While introducing new products
- (d) None of these

**Solution: (a)**

Improving the existing plant layout. If the existing plant layout is designed in such a way that there is no optimum utilization of resources, then travel chart technique is applied to minimize the wastage of time, manpower and money.

## 2.13 Job Design and Job Standards

### 2.13.1 Job Design

- Even though, automation is making strong in roads, processes usually involve some combinations of human and machines. This topic deals with blending of technology and people as components of a productive systems.
- **Two views of job design process will be discussed:** The technological view that has been dominant one and the socio-technical view that has gained prominence following world war II.

#### 2.13.1.1 Technological View of Process Planning and Job Design

- **Product Analysis:** The product or service to be produced is first analyzed primarily from technological view to determine the process required. For this the following may be used.





## STUDENT'S ASSIGNMENT

- Q.1** The layout suitable for the low demand and high variety product is  
 (a) Group layout (b) Process layout  
 (c) Product layout (d) Static layout
- Q.2** Which one of the following pairs is not correctly matched?  
 (a) Job production — Process layout  
 (b) Mass production — Product layout  
 (c) Job production — Special purpose machine  
 (d) Job production — Production on order
- Q.3** Match **List-I** (Types of layout) with **List-II** (Uses) and select the correct answer:  
**List-I**  
 A. Product layout  
 B. Process layout  
 C. Combined layout  
 D. Fixed position layout  
**List-II**  
 1. Where a large quantity of same products is to be produced  
 2. Where a large variety of products is manufactured  
 3. Where item is being made in different types of sizes  
 4. Where too heavy or huge item is used as raw material
- Codes:**
- |     | A | B | C | D |
|-----|---|---|---|---|
| (a) | 1 | 2 | 3 | 4 |
| (b) | 2 | 1 | 4 | 3 |
| (c) | 1 | 2 | 4 | 3 |
| (d) | 2 | 1 | 3 | 4 |
- Q.4** In manufacturing management, the term "Dispatching" is used to describe  
 (a) dispatch of sales order  
 (b) dispatch of factory mail  
 (c) dispatch of finished product to the user  
 (d) dispatch of work orders through shop floor

- Q.5** The routing function in a production system design is concerned with:  
 (a) Manpower utilization  
 (b) Machine unitization  
 (c) Quality assurance of the product  
 (d) Optimizing material flow through the plan

- Q.6** Match **List-I** (Type of Products) with **List-II** (Type of layout) and select the correct answer using the codes given below the lists:

### List-I

- A. Ball bearings  
 B. Tools and gauges  
 C. Large boilers  
 D. Motor cycle assembly

### List-II

1. Process layout  
 2. Product layout  
 3. Combination of product and process layout  
 4. Fixed position layout

### Codes:

	A	B	C	D
(a)	1	3	4	2
(b)	3	1	4	2
(c)	1	2	4	3
(d)	3	1	2	4

## ANSWER KEY

## STUDENT'S ASSIGNMENT

1. (a)    2. (b)    3. (d)    4. (d)    5. (d)  
 6. (c)

## HINTS & SOLUTIONS

## STUDENT'S ASSIGNMENT

### 6. (c)

In ball bearing, design of product is fixed, hence process layout is used whereas in tools and gauges, the specification of every product is different. Hence product layout should be used. Motor cycle assembly requires greater flexibility of operation hence a combination of both must be used.

