

Module No. 2: Plant Location and Layout

Meaning and Definition- Factors affecting location, Theory and practices, Cost factor in location- Plant Layout principles – Space Requirements – different types of facilities- Organisation of Physical facilities – Building, Sanitation, Air Conditioning and Safety.

Plant Location and Layout:

Meaning and Definition:

Plant location refers to the choice of region and the selection of a particular site for setting up a business or factory.

Plant layout is a plan of optimum management of facilities which include; personnel, operating equipment, storage space, material handling equipment, and all other support services

It includes the arrangement and location of work centres and various service centres like inspection, storage, and shipping within the manufacturing/factory building.

According to Riggs, “the overall objective of plant layout is to design a physical arrangement that most economically meets the required output – quantity and quality.”

Factors Affecting the Plant Location:

Many factors are considered while selecting a plant site. According to their importance these are classified as primary factors and secondary factors.

Primary factors:

- **Raw material supply:** Production process will continue properly when adequate supply of raw material is there. Raw material cost is a part of total production cost. Inadequate supply of raw material will result in the reduction in production. It will increase downtime and hence reduce efficiency of industry. Due to this inadequacy, profit maximisation may not be obtained. The time to transport & cost of transportation is also important. Hence, industries are situated where raw material is available easily.
- **Nearness to market:** This factor will produce the product to customer in short time period and hence it will be less damage to the product. It also reduces transportation cost. Also it will help the supplier to know the requirement of customers.
- **Transportation Facility:** While selecting a site one thing has to be considered that is transportation of any raw material, semi- finished & finished goods should be as less as possible. By this factor material will be transported less, which will affect the material quality, cost of transportation, time to transport etc. Hence for all above

reasons producer has to select cheap and speedy transportation with various sources like road, airways, railways, waterways etc.

- **Labour Supply:** Labour is most effective part of the industry, which produces the product(s). The prospective plant owner has to choose the site in such a way that labour should be present in adequate numbers with low cost. The labour should also be skilled to a good level. If labour is not present in sufficient numbers it will increase downtime of production and decrease plant efficiency.
- **Power Supply:** Electrical, diesel, automatic etc. energies are required to produce the product and also required for transportation. For continuous production process regular and sufficient power supply is necessary. Many companies go to the industrial areas because of availability of regular & sufficient power supply.
- **Supply of Capital:** Capital is required for the industries for production, day to day working, expansion, marketing etc. Large scale production requires large amounts of capital which may be raised by shares, debentures etc.

Secondary factors:

- **Natural factors:** Factors like land, water, climate etc. are very important for industries.
- **Government Policy:** in particular areas, a new plant can not be started due to some rules and regulations made by government. There are also some subsidies and other facilities to support small scale industries to grow.
- **Availability:** Availability of housing, hospitality, entertainment, education facilities also helps in deciding plant location.

Miscellaneous factors:

1. Sufficient water supply
2. Danger of attack during war
3. Personal factors
4. Environmental and ecological factors
5. Availability of safety facilities like fire- fighting, police etc.

Theory and practices:

Alfred Weber propounded his famous industrial location theory in 1909 which was written in German language. In 1929, it was translated into English and published

in 'The Theory of Location of Industries'. This theory is also known as 'Pure Theory' and 'Least Cost Theory'.

The basis of this theory is the study of general factors which pull an industry towards different geographical regions. It is thus deductive in approach. In his theory he has taken into consideration factors that decide the actual setting up of an industry in a particular area.

Assumptions of the theory:

1. The area is typically uniform or isotropic in form of terrain or relief, climate, soils, economic system, technology and distribution of population.
2. Manufacturing involves single product at a time and the product is supplied to a single market.
3. Raw materials are not evenly distributed in space but at a few known and fixed locations which are available at equal transportation cost throughout.
4. Markets are known as fixed at specific places

Aim of the Theory:

Weber Classified the factors affecting location of industries into two broad groups:

- a) Regional factors or primary causes of regional distribution of industries.
- b) Agglomerative and degglomerative factors or secondary causes responsible for redistribution of industry

a) Regional factors: According to Weber, there are two general regional factors which affect the cost of production

- i) Transportation costs and
- ii) Labour costs

b) Agglomerative and degglomerative factors: Agglomerative factors make industries centralize at a particular place. Such factors may include banking and insurance facilities, external economies and the like. Degglomerative factors are those which decentralize the location of industries. Examples of such factors are local taxes, cost of land, residence, labour costs and transportation costs. Weber formulated his theory within the context of heavy manufacturing industry in Germany in the 19th century,

where transportation costs played a fundamental role in determining location decision.

The validation of the Weber's theory is still seen in present time where examples can be seen in the location of industries like sugar and iron and steel industries which are located near the availability of raw materials. The availability of cheap labour have encouraged General Motors to locate their manufacturing plants in Vietnam. But with the technology and transport revolution as well as effect of globalization, the industrial composition and organization have changed due to new products and production processes, advance in communication and transportation technologies and most recently the rise of a knowledge based economy. Knowledge inputs, in the form of human capital, training and skill development and research need to be brought together for development of industries. Apart from these, major expenditure is accounted for by advertising and branding which has become far more important in this tough competing market.

Cost factor in location:

Cost location factors, also referred to as location factors or area cost factors, are multiplying factors for instantaneously translating the total overall construction cost of projects, from one geographic location to another. Cost Location factors take into account various local components that contribute to construction costs, such as labor cost, material cost, logistic costs and business environment which are as follows:

- **Labor cost.** It includes wage rates, directly paid benefits, and other expenditures incurred by the employer to employ a worker, as well as the difference in local productivity data.
- **Material cost.** It considers steel prices, import needs, availability of local equipment, need of spare equipment, and freight, taxes, and duties on imported and domestic materials.

- **Logistic costs.** It refers to all costs associated with a country's infrastructure, such as: availability and quality of ports, roads, airports, and rails; communication technologies; warehouse infrastructure; border clearance; and local incentives.
- **Business environment.** It takes into account the costs associated with doing business in the country, such as: readiness of bureaucratic procedures; legal protection of investors; enforcing contracts; and getting credit.

All components that make-up the previous major components are then weighted according to their relative importance. Finally, the factors are calculated in a comparative manner,

Principles of Plant Layout:

- **Overall integration of factors**

A good layout is one that integrates men, materials, machines and supporting activities and others in a way that the best compromise is obtained. No layout can satisfy each and every principle of a good layout.

- **Minimum Movement**

A good layout is one that permits the minimum movement between the operations. The plant and machinery in case of product layout and departments in case of process layout should be arranged as per sequence of operations of most of the products.

A straight line is the shortest distance between any two points. Men and materials should be made to move along the straight path.

- **Uni-direction flow**

A good layout is one that makes the materials move only in the forward direction, towards the completion stage.

When a straight line flow is not possible, other flows like a U-shaped flow, circular or zig-zag flow may be adopted but the layout must ensure that materials move in a forward direction.

- **Effective use of available space**

A good layout is one that makes effective use of available space both horizontal and vertical

Backtracking and duplicated movements consume more time, involve unnecessary materials handling, add to costs and lead to inefficiency.

Raw materials, work-in-progress and finished goods should be piled vertically one above another rather than being strewn on the floor.

Pallets or equivalent should be made use of to pile up several layers one above another.

- **Maximum Visibility**

A good layout is one that makes men, machines and materials ready and observable at all times

All departments should be integrated, convenient to service and easy to supervise

Enclosures, cupboards, offices, partitions should be avoided except when their utility is established beyond doubt.

- **Maximum Accessibility**

A good layout is one that makes all servicing and maintenance points readily accessible

Machines should be kept sufficiently apart and with reasonable clearance from the wall so that lubrication, adjustment, replacement of belts, removal of parts at times of repair can be done conveniently by the maintenance staff

The area of electrical panels and fire extinguishers should be kept free from obstructions.

Space Requirements:

Different types of facilities:

The following facilities are provided in most organizations.

- **Educational facilities** for the workers and their children in the form of provision of schools, reading room, libraries, etc.
- **Medical facilities** for workers and their families in the form of well equipped first aid centres, ambulance rooms, dispensaries for the treatment of diseases.

. • **Recreational facilities** to provide the worker an opportunity to develop a sense of physical and mental discipline in the form of music, dance, drama, games and sports, paintings , hobbies and other cultural activities.

• **Housing facilities** are made available in the form of self contained tents. They contain all facilities like electricity, sanitation, water supply etc.

• **Washing facilities:** In every factory (a) adequate and suitable facilities shall be provided and maintained for the use of workers; (b) separate and adequately screened facilities shall be provided for the use of male and female workers; (c) such facilities shall be easily accessible and shall be kept clean.

• **Facilities for sitting:** In every factory, suitable arrangements for sitting shall be provided and maintained for all workers who are obliged to work in a standing position so that the workers may take advantage of any opportunity for rest which may occur in the course of work. If in any factory workers can efficiently do their work in a sitting position, the Chief inspector may ask the employer of the factory to provide such seating arrangements as may be practicable.

• **Canteen facilities:** In every factory canteen facilities are provided for the use of workers.

• **Shelters, rest rooms and lunch rooms:** In every factory shelters, rest room and a suitable lunch room are provided to workers, where workers can eat meals brought by them with provision for drinking water. Where a lunch room exists, no worker shall eat any food in the work room. Such shelters or rest rooms or lunch rooms shall be sufficiently lighted and ventilated and shall be maintained in a cool and clean condition.

• **Crèches:** In every factory where more than 30 women workers are ordinarily employed, a room or rooms shall be provided and maintained which can be used by their children. Such rooms shall provide adequate accommodation, proper lightning and ventilation, maintained in clean and proper sanitary conditions and children will be cared by women who are given adequate training.

Organisation of Physical facilities – Building, Sanitation, Air conditioning and Safety:

The actual physical structure of the building may initially seem like something which requires relatively little effort on the part of the engineering department. The stone, brick, asphalt, and steel of the most of the building would appear last for ever. However, there are a large number of basic maintenance activities which must be undertaken.

The environment around building sometimes results in rapid deterioration of building surfaces. In some urban areas, the exterior surfaces suffer pitting and erosion due to materials in the air, cleaning of exterior surfaces may be repaired, but the engineer must be certain that the cure will not be worse than the disease since the use of some cleaning materials result damages of surfaces.

Other types of maintenance include the application of protective materials to surfaces to retard corrosion and repel the attack of moisture entrained pollutants. The element of building

maintenance which is unavoidable and continual problem is roofing. Whether it is the repair of minor leaks or the de-roofing of the entire building (a capital cost), roofing system maintenance is important concern.

Maintenance of Guestrooms, Furnishings and Fixtures From the perspective of the lodging property guest, the guestrooms, furnishings and fixtures of the property are very visible features which contribute to the overall experience of the establishment either positively or negatively. The proper maintenance of these elements is usually a direct responsibility of the engineering department staff. Since these elements receive a lot of use, they are often replaced within first ten years (a capital expenditure).

Sanitation refers to the safe disposal of human waste and sewage, and the provision of adequate services and facilities for that. Sanitation systems are designed to preserve human health by creating a clean environment that prevents disease transmission, particularly via the fecal-oral pathway. Improved sanitation helps to minimize many diseases. Sanitation is usually better in low population areas as management of waste disposal is easier. Areas that are densely populated tend to have more likelihood of disease spread, thus the importance of introducing good sanitary practices. There are a variety of sanitation systems and procedures available for excreta management. They are;

- Basic Sanitation
- Container-based sanitation
- Community-led total sanitation
- Dry Sanitation
- Ecological sanitation
- Emergency sanitation
- Environmental sanitation
- Onsite sanitation
- Safely managed sanitation
- Sustainable sanitation

Air conditioning and Safety:

Providing good ventilation in the workplace is considered to be a key factor in helping to reduce viral infection within the workplace along with good hygiene standards. Proper ventilation and air conditioning can help to prevent the spread of nasty bugs that thrive in warm, damp conditions.

The link between employee well-being and productivity is now a well established fact. It is becoming all the more common for employers to dedicate time and resources to ensuring their staff are comfortable and well looked after, there are a number of ways employers can improve well being for their employees.

One key element central to employee comfort and well-being is the temperature and air quality of the working environment. It's pretty tricky to concentrate when employees unable to get comfortable in the sweltering heat of summer or shivering on the edge of your chair on a frosty winter morning.

There is no legal requirement for air conditioning in offices, to the employer, there are certain obligations under the law regarding what's referred to as thermal comfort. According to the HSE, "thermal comfort describes a person's state of mind in terms of whether they feel too hot or too cold.

Importance of Proper Air Conditioning:

Beyond the legal obligations, there are a number of reasons why proper air conditioning is important.

Employee Health and Well-Being

Proper ventilation and air conditioning can help prevent the spread of nasty bugs that thrive in warm, damp conditions. Likewise, many conditions such as joint pain, arthritis and the like are massively worsened by overly cold temperatures. Air conditioning can also help prevent other health risks, such as mould and damp.

Increased Productivity

Employee comfort has a tremendous impact on productivity. Understandably, employees who are too cold or too hot are less able to concentrate on assigned tasks and more likely to take extended breaks. Adaptive behaviour only goes so far.

Improved Morale

A comfortable workplace is a happy work place. By creating a positive and pleasant work environment, you're showing your employees that you value them. This can make a significant difference to the company culture.
