

BUILDING CLASSIFICATION

STRUCTURE

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1.0 OBJECTIVES

After reading this chapter, the students should be able to:

- To know the meaning of building
- To classify various types of buildings

1.1 BUILDINGS

In the field of architecture and engineering the word building may refer to one of the following:

Any man-made structure used or intended for supporting or sheltering any use or

occupancy. It can also be defined as an act of construction (i.e. the activity of building, see also builder).

Buildings come in a wide amount of shapes and functions, and have been adapted throughout history for a wide number of factors, from availability of building materials, to land prices, weather conditions, soil characteristics, specific uses and aesthetic reasons.

Buildings serve many needs of society – primarily as weather shelter from changing environmental conditions and as general living space, to provide privacy, to store households and commercials and to comfortably live and work. A building may also be considered as a physical division of the human habitat into the inside (a place of comfort, safety and security) and the outside (a place that at times may be harsh and harmful).

The buildings in the usage are different from other structures that are not intended for continuous human occupancy, the latter are called non-building structures.

Structural height in technical terms is the height to the highest architectural detail on building from street-level. Depending on how they are classified, spires and masts may or may not be included in this height. Spires and masts used as antennas are not generally included in the list of buildings. The definition of a low-rise vs. a high-rise building is a matter of debate, but generally three stories or less is considered low-rise. In this section some of the classified buildings are as follow:

1.1.1 Barn

A barn is an agricultural building used to store and as a cover workplace. It may sometimes be used to house livestock or to store farming machinery and equipment. Barns are most commonly found in a farm. A barn meant for keeping cattle may be called as a byre.

1.1.2. Chicken coop

A chicken coop is a building where chickens are kept. Interiors generally have nest boxes for laying eggs, and also have perches for the birds to sleep. Coops for meat birds don't have these features. There may also be an attached outdoor run, and both the interior and exterior floor of the chicken coop is often covered with a material, like straw or wood chips, to contain the chicken waste and to allow easier cleanup of the place. Most have provisions for ventilation.

1.1.3. Greenhouse

A greenhouse is a building where plants are cultivated. A greenhouse is a structure with a plastic or glass roof and frequently glass or plastic walls; it heats up because incoming solar radiation from the sun warms plants, soil, and other things inside the building faster than heat can escape from the structure. Air warmed by the heat from hot interior surfaces is retained in the building by the roof and walls.

These structures range in size from small sheds to very large buildings. Greenhouses are often used for growing flowers, vegetables, fruits, tobacco, and medicinal plants. Bees are kept inside the structure for pollination. This helps the plants to produce more offspring for future plantations.

1.1.4. Silo

A silo is a structure for storing bulk materials. They are used in agriculture to store grain or fermented feed known as silage. Also they are commonly used for bulk storage of grain, cement,

coal, sawdust, carbon black, wood chips, and food products. Nowadays' three types of silos are in widespread use i.e., bunker silos, tower silos, and bag silos.

1.1.5. Bins

A bin is much shorter than a silo, and is generally used for holding dry matter such as concrete or grain. Bins may be round or square in shape. The round bins tend to empty more easily due to a lack of corners for the stored material.

The stored material may be in the powder form; as seed kernels, or as cob corn. The dry nature of the stored material tends to be lighter than silage and can be more easily handled by under-floor grain un-loaders. To dry the material after harvesting, some grain bins contain a hollow perforated or screened central shaft to permit easier air infiltration into the stored grain.

1.1.6. Stable

The term "stable" is used to describe a group of animals kept by one owner, regardless of housing or location. It is a building where livestock, especially horses, are kept. It is a most common means of a building that is divided into separate stalls for individual animals. Nowadays' different types of stables are in use; such as the American barn which is a large barn with a door at each end and individual stalls inside or free standing stables with the classic top and bottom opening doors.

1.1.7. Storm cellar

Storm cellars are underground structures that are either located below buildings, or are built underground near other such buildings. They are reinforced structures used for protection from a strong wind storm. They are common in areas those have often tornadoes and hurricanes.

1.1.8. Root cellar

A root cellar is a structure built underground or partially underground. It is used to store vegetables, fruits, and nuts or other foods. Root cellars are used for keeping food supplies at a low temperature and maintained humidity to keep from freezing during the winter and cool during the summer months to prevent spoilage. Generally, a variety of vegetables are kept in the root cellar in the autumn, after harvesting. It is also used as a place to store the home made alcoholic beverages.

1.1.9. Farmhouse

Farmhouse is a general term for the main house of a farm. It is a type of building or house which serves a residential purpose in a rural or agricultural setting. Most often, the surrounding environment would be a farm. These buildings are usually 2 stories, but early buildings were single story.

1.1.10. Shed

A shed is typically a simple, single-story structure in a back garden or on an allotment that is used for storage, hobbies, or as a workshop. It is defined as a "slight structure built for shelter or storage, or for use as a workshop, either a separate building or attached to a permanent building as a lean-to; often with open front or sides".

Sheds vary considerably in the complexity of their construction and size. The size varies from small open-sided tin-roofed structures to large wood-framed sheds with shingled roofs, windows, and electrical outlets. Sheds used on farms or in industry can be large structures.

1.1.11. Bank

A bank is a financial institution licensed by a government. Its primary activities include lending and borrowing money. Many other financial activities are also allowed over time. For example banks play important role in financial markets and offer financial services such as fund investment.

1.1.12. Casino

A casino houses and accommodates certain types of gambling activities. Casinos are most commonly built near or combined with motels, hotels, restaurants, retail shopping, cruise ships and other tourist points. Some casinos are known for hosting live entertainment events, such as stand-up comedy, concerts, and sporting events.

1.1.13. Coffeehouse

(French/Portuguese: café; Spanish: cafeteria or café; Italian: caffè, German: Café or Kaffeehaus, Greek: Εστιάσι or Εστιάσιον, Turkish: Kahvehane) or coffee shop. It is an establishment which primarily serves prepared coffee or other hot beverages. It shares some of the characteristics of a bar, and some of the characteristics of a restaurant, but it is different from a cafeteria. It focuses on providing coffee and tea as well as light snacks. This differs from a café, which is an informal restaurant, offering a range of hot meals, and possibly being licensed to serve alcohol. Many coffee houses in the Muslim world, especially in West, offer shisha (Nargile in Turkish), flavored tobacco smoked through a hookah. From a cultural standpoint, coffeehouses largely serve as centers of social interaction: the coffeehouse provides social members with a place to congregate, read, talk, write, entertain one another, or pass the time individually or in small groups of 2 or 3.

1.1.14. Convention Center

It is an exhibition hall, or conference center, that is designed to hold a convention. In British English very large venues suitable for major trade shows are called as exhibition centers. The term "convention centre" is sometimes used as intermediate venues between exhibitions centers and "conference centers", which are much smaller and contain lecture halls and meeting rooms.

1.1.15. Gas Station

A gas station, fueling station, filling station, service station, petrol station, garage, gas-bar, petrol pump or petrol bunk (India) is a facility which sells fuel and lubricants for motor vehicles. The most common fuels sold are petrol, gasoline and are diesel fuel.

1.1.16. Hotel

It is an establishment that provides paid lodging on a short-term basis. The provision of basic accommodation, in times past, consisting only of a room with a bed, a cupboard, toilet, a small table and a washstand has largely been replaced by rooms with modern facilities, including en-suite bathrooms and air conditioning or climate control. Additional common features found in hotel rooms are a telephone, an alarm clock, a television, and Internet connectivity; snack foods and drinks may be supplied in a mini-bar, and facilities for making hot drinks. Larger hotels may provide a number of additional guest facilities such as a restaurant, childcare, a swimming pool, and have social and conference function services. Some hotels offer meals as part of a room and board arrangement.

1.1.17. Motel

It is a hotel designed for motorists, and usually has direct access to an open parking area. It is a type of hotel consisting of a single building of connected rooms whose doors faced a parking lot and, in some circumstances, a common area; or a series of small cabins with common parking.

1.1.18. Office Building

These can be built in almost any location and in any building. The modern requirements for offices make it more difficult to design. These requirements can be legal, technical or both. Alongside the other requirements such as security and flexibility of layout, this has led to the creation of special buildings which are dedicated only or primarily for use as offices. An office building, also known as an office block, is a form of commercial building which contains spaces mainly designed to be used for offices.

The primary purpose of an office building is to provide a workplace and working environment primarily for administrative and managerial workers. These workers usually occupy set areas within the office building, and are usually provided with desks, PCs and other equipment that they need within these areas. An office building may be divided into sections for different companies or may be dedicated to single company. In either case, each company may have a reception area, meeting rooms, singular or open-plan offices, as well as toilets.

1.1.19. Restaurant

A restaurant prepares and serves food and drink to customers. Meals are generally served and eaten on premises, but many restaurants also offer take-out and food delivery services. Restaurants vary greatly in appearance and offerings, including a wide variety of cuisines and service models.

1.1.20. Skyscraper

A skyscraper is a tall, continuously habitable building. There is no limit to height above which a building may clearly be classified as a skyscraper. In most cities the term is defined as empirically. A building of 80 meters (262 feet) or above may be considered a skyscraper; if it protrudes above its built environment and changes the overall skyline.

1.1.21. Shops

These may be on residential streets, shopping streets with few or no houses or in a shopping mall. Sometimes a shopping street has a partial or full roof to protect customers from precipitation. Shopping generally refers to the act of buying products or services. Sometimes it does the necessities such as food and clothing; sometimes it is done as a recreational activity. Recreational shopping often involves window shopping (just looking, not buying) and browsing and does not always result in a purchase.

1.1.22. Shopping Mall

A shopping mall, shopping centre or shopping center is a building or multiple buildings consisting of a complex of shops representing leading merchandisers, with interconnecting walkways enabling visitors to easily walk from unit to unit, along with a convenient parking area – a modern, indoor version of the traditional marketplace.

1.1.23. Stock Exchange

A stock exchange is a corporation or mutual organization which provides "trading" facilities for traders and stock brokers, to trade stocks and other securities. It also provides facilities to issue and redemption of securities as well as other financial instruments and capital events including the payment of income and dividends. The securities traded on a stock exchange include: unit trusts, shares issued by companies, derivatives, pooled investment products and bonds. To be able to trade a security on a certain stock exchange, it has to be listed there. Usually there is a central location at least for recordkeeping, but trade is less and less linked to such a physical place, as modern markets are electronic networks, which gives them advantages of speed and cost of transactions. Trade on an exchange is by members only. The initial offering of stocks and bonds to investors is by definition done in the primary market and subsequent trading is done in the secondary market. A stock exchange is often the most important component of a stock market. Supply and demand in stock market is driven by various factors which, as in all free markets, affect the price of stocks.

1.1.24. Supermarket

A supermarket, also called a grocery store in some parts of North America, is a self-service store offering a wide variety of food and household merchandise, organized into departments. It is larger in size and has a wider selection than a traditional grocery store and it is smaller than a hypermarket or superstore.

The supermarket typically comprises dairy, karyana, meat, fresh produce, and baked goods departments along with shelf space reserved for canned and packaged goods as well as for various nonfood items such as household cleaners, pharmacy products, and pet supplies. Most supermarkets also sell a variety of other household products that are consumed regularly, such as alcohol (where permitted), household cleaning products, medicine, clothes, and some sell a much wider range of nonfood products.

Supermarkets usually offer products at low prices by reducing their economic margins. Certain products (typically staple foods such as bread, milk and sugar) are occasionally sold as loss leaders, that is, with negative profit margins. To maintain a profit, supermarkets attempt to make up for the lower margins by a higher overall volume of sales, and with the sale of higher-margin items. Customers usually shop by placing their selected merchandise into shopping carts (trolleys) or baskets (self-service) and pay for the merchandise at the check-out. A larger full-service supermarket combined with a department store is sometimes known as a hypermarket. Other services offered at some supermarkets may include those of banks, cafés, childcare centers/creches, photo processing, video rentals, pharmacies, and/or gas stations.

1.1.25. Warehouse

A warehouse is a commercial building for storage of goods. Warehouses are used by manufacturers, importers, exporters, wholesalers, transport businesses, customs, etc. They are usually large plain buildings in industrial areas of cities and towns. They usually have loading docks to load and unload goods from trucks. Sometimes warehouses load and unload goods directly from railways, airports, or seaports. They often have cranes and forklifts for moving goods, which are usually placed on ISO standard pallets loaded into pallet racks.

1.1.26. Factory

A factory or manufacturing plant is an industrial building where workers manufacture goods or supervise machines processing one product into another. Most modern factories have large warehouses or warehouse-like facilities that contain heavy equipment used for assembly line production. Typically, factories gather and concentrate resources: workers, capital and plant.

1.2. SUMMARY

The literature survey from various sources helped to define the building and its types. These types may be; commercial, residential, government, private and domestic. Understanding the classification may help to solve many managerial and non-managerial problems.

Practice Questions

1. Define building in details and classify them on the basis of use.
2. Explain factory building in details and differentiate it from warehouse.

References

- Department of Energy (DOE), Office of Laboratory Operations and ES&H—For examples of facilities to support instruments of science, see DOE's Brookhaven National Laboratory website
- Department of Veterans Affairs (VA), Office of Construction & Facility Management (CFM)—VA Research Laboratory Design Guide
- Environmental Protection Agency (EPA), Office of Administration (OA)
- General Services Administration (GSA), Office of Chief Architect (OCA)
- National Aeronautics and Space Administration (NASA), Facilities Engineering Division (Code JX)
- National Institutes of Health (NIH)—NIH's Office of Research Facilities Development and Operations (ORF) developed the NIH Design Policy and Guidelines to provide standards to assist planners, architects, and engineers in designing biomedical research and animal facilities for the NIH.
- http://www.wbdg.org/images/go_btn.gif



Lesson 1

BUILDING CLASSIFICATION STRUCTURE

1. What is the primary purpose of a storm cellar?
 - A) Livestock housing
 - B) Protection from windstorms
 - C) Storage of agricultural produce
 - D) Residential living
2. Which building is commonly used for storing grain or fermented feed?
 - A) Stable
 - B) Greenhouse
 - C) Silo
 - D) Warehouse
3. What is the purpose of a chicken coop?
 - A) Growing plants
 - B) Housing livestock
 - C) Storing machinery
 - D) Sheltering from storms
4. What term is used for a building where plants are cultivated with a plastic or glass roof?
 - A) Stable
 - B) Greenhouse
 - C) Warehouse
 - D) Root cellar
5. Which building is designed for short-term paid lodging and may include amenities like a swimming pool?
 - A) Hotel
 - B) Motel
 - C) Restaurant
 - D) Office Building
6. What does a convention centre primarily provide facilities for?
 - A) Gambling
 - B) Trade shows and conferences

C) Banking activities

D) Growing plants

7. Which of the following is a financial institution primarily involved in lending and borrowing money?

A) Hotel

B) Casino

C) Bank

D) Coffeehouse

8. What is a characteristic feature of a skyscraper?

A) Short height

B) Single-story structure

C) Continuously habitable and tall

D) Underground location

9. Where are goods usually stored in a warehouse?

A) Industrial areas

B) Residential areas

C) Agricultural fields

D) Shopping malls

10. What is the primary function of a supermarket?

A) Selling cars

B) Offering lodging

C) Providing medical services

D) Selling food and household merchandise

11. What does a coffeehouse primarily focus on providing?

A) Prepared coffee and hot beverages

B) Gambling activities

C) Financial services

D) Conference facilities

12. Which type of building is specifically dedicated for administrative and managerial workers?

A) Skyscraper

B) Restaurant

C) Office building

D) Warehouse

Answer key: 1(B),2(C),3(B),4(B),5(A),6(B),7(C),8(C),9(A),10(D),11(A),12(C)

BUILDING CONSIDERATIONS

STRUCTURE

- 2.0. Objective
- 2.1. Building attributes
 - 2.1.1. Functional consideration
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 - 2.1.3. Accessibility
 - 2.1.4. Energy efficiency
 - 2.1.5. Exterior design aesthetics
 - 2.1.6. Comfort
- 2.2. Green factory building
- 2.3. National priorities addressed in rating system
- 2.4. Summary
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2.0 OBJECTIVES

This chapter shall help the students to understand building attributes and their selection for a particular type of building. These considerations can also help to design better structures.

2.1. BUILDING ATTRIBUTES

In buildings design, the primary consideration is on planning or designing of space to ensure a highly functional, operationally efficient facility, safe, flexible, cost-effective, energy efficient facility that is aesthetically pleasing and comfortable to the occupants. The some of the building attributes are as hereunder:

2.1.1. Functional Considerations

The functional requirements and intended usage of individual spaces may vary considerably. Each project should be developed individually considering specific project requirements, local conditions, and codes in order to arrive at the appropriate design solution. Some of the considerations are hereunder:

Administration Area: The administration area consists of office and support space. The office spaces are intended for the training of staff personnel, performing necessary paperwork for administration activities. These functions can be separated into spaces dedicated to owners, managers, supervisors and full/part-time employees. It also includes the common spaces shared by non-supervisory personnel and administrative support activities.

Administration support spaces may include; reception, reproduction rooms, message rooms, conference/meeting rooms, training seminars/classrooms, library and administration storage. The requirements for these spaces shall depend upon the needs of the individual activities. Message centers serve as a mailroom and distribution point for all inter/and intra/office correspondence.

This support area may consist of space for these activities with audiovisual learning, library, and related facilities. These areas should be located close to an outside entrance for easy access without going thorough the administration area. Depending on the requirements of the anticipated

instructions, the designer shall consider;; size, lighting and sound , and equipment such as desks, black/white boards, audio/video devices, moveable partitions, etc. Specialty learning centers may be required to provide focused occupational capacity and training/equipment needs. The library/classroom provides a space for storing training; books, journals, newspapers and other training related material, as well as a reading area and space for the same. Additional storage space may be provided for miscellaneous training needs as; Photostat, computer typing and internet services etc.

Employee assembly Area: The assembly area may consist of an assembly hall, food service, and additional storage area for furniture. The assembly hall should also provide space for maintenance of equipment, food service seating, and large group assemblies for instructional training and public gatherings. It also may also act as a neighboring community place of public assembly for planned functions as well as for a place of refuge in the event of natural disasters. These latter functions may control the design when considering fire/accidental protection requirements, accessibility, and bathroom layout. The assembly hall is an important functional element and should be centrally located within the facility for easy approach. It should be immediately adjacent to the kitchen and food storage spaces. Food preparation areas used to clean, prepares, and to cook food as per requirements. However food storage areas used to store different types of food items, and scullery area is used to clean and store utensils, trays, pots and dishes, etc.

Inventory Storage Area: Storage areas include spaces to manage the inventory of organizational equipment in a separate and secure area. The issue and return of organization clothing and equipment is conducted from this area that consists of a supply office and storage area. It should also include the security arrangement for the inventory.

General Support/Amenities Area: General support areas include toilets and bathrooms, change area, showers, mechanical/electrical equipment, telephone equipment, janitorial and facility maintenance storage.

Ventilation: All applicable and safety environmental regulations must be satisfied. It essential to ensure laminar airflow with an adequate air speed evenly distributed across the entire cross section along with sunlight.

Medical Services: Medical spaces provide spaces for physical examination of recruits and patients their treatment and professional medical training. Where required, these spaces shall be designed for the specific intended requirements not only to for treatment of staff but also for disaster requirements.

Maintenance Area: The maintenance area, if required, contains the spaces used to maintain proper service level, maintain, and store the organizational equipment as well as to train reserve mechanics. The area may contain shop offices, work bays, tools and parts storage and issue, equipment and vehicle storage, battery charging and storage, flammable material storage, mechanical equipment room, and personnel spaces including toilet, lounge, and locker rooms. There also may be requirements for special areas including small arms shop and vault and electronic/communication repair shop.

The maintenance area may also require spaces for the storage of heavy vehicles and equipment that are used during training periods. This area may contain provisions for a parking hardstand, fuel dispensing system, loading ramp, wash platform, and an indoor equipment storage warehouse.

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The facilities layout should have functional relationship with each other also should be flexible in nature to cope with additional requirements.

2.1.2. Safety and Security Consideration

Designs for buildings shall consider the life-safety, health concerns, and estate and inventories security common to all buildings by following all applicable by government building code guidelines.

- A fire alarm and evacuation system shall be installed with illuminated exit signs and emergency lighting according to life-safety codes.
- Comprehensive fire protection features and systems shall be developed for each area depending upon the requirements.
- The facility design and construction must incorporate proven environmentally safe provisions to ensure adequate ventilation of harmful fumes. It should also consider the cleaning of the facility, and properly contain and dispose of potential contaminants. Appropriate signage and operational procedures shall be laid down to clearly direct personnel to take appropriate precautions.

2.1.3. Accessibility

All applicable state and/or federal standards for handicapped parking and accessibility shall be considered. All areas of a facility accessible to the public will typically be required to meet the accessible standards, when newly constructed or renovated, according to the standards set forth in the

2.1.4. Energy Efficiency

Energy conservation opportunities shall be evaluated and incorporated into the design of buildings. The most efficient and cost-effective systems, based on life-cycle cost, should be utilized. The following areas for energy-efficient design are recommended for consideration:

- o Landscaping to should be designed to shade and block prevailing winter winds.
- o Building orientation should be done to optimize winter sun and land forms.
- o Pipe and duct should be insulated for energy efficiency.
- o Provide proper thickness and insulation for vapor barriers.
- o Protect windows from direct sun with overhangs, shades, films, etc.
- o Provide proper weather stripping.
- o Install energy-efficient windows.
- o Provide entrance vestibules.
- o Construct partial wall breams or underground structures.
- o Maximize winter solar gain and natural day lighting.
- o Adjustable flow rate fans and pumps to carefully match load to save energy.
- o Systematized zones based on user profile.
- o Install high efficiency equipment.
- o Install waste heat recovery devices.
- o Provide time clocks and set back thermometers.
- o Install computer-based energy management systems.
- o Insulate water heaters and storage tanks.
- o Addition of water conserving fixtures.
- o Add time clocks on hot water heaters.

- o Add waste heat recovery for water heating.
- o Install on demand instant hot water heaters.
- o Decreased light levels in non-critical areas.
- o Use high efficiency lamps and ballasts.
- o Use task lighting.
- o Provide day lighting as per requirement only.
- o Install time clock, photocell, or motion control lighting.

2.1.5. Exterior Design Aesthetics

Building design should reflect characteristics of business being carried out inside, as well as a community support facility representing a sense of security, local pride, and community participation. These are generally designed to blend into the existing architecture of the surrounding region, and other characteristics of that area.

The exterior design should consider the following:

- The facility should fit well into the surrounding environment and accommodate existing and future requirements.
- A buffered area of the site should be provided from the surrounding community to mask the noise pollution.
- Landscaping should be provided to outshine the architectural character of the facility and provide color, texture, and form to the living environment. Plant and tree should be selected to provide a permanent low maintenance solution appropriate to the facility's location.
- Proper and match able fencing shall be provided where appropriate for security considerations. It is typically required around any exterior equipment parking and maintenance areas where threat is more.

2.1.6. Comfort

The interior environment of the buildings should respond to the organizational needs for facilities and work centers. It should provide a humane setting that promotes a sense of belongingness and well-being. The designers should look at the following recommendations in a design:

- There should be proper ventilation in all circumstances.
- Proper exhaust is must for restrooms, kitchens, laboratories, gen-sets, photo-copy rooms, maintenance shops, and flammable material storage areas, etc.
- Use furnishing, furniture, and equipment that are ergonomically designed for their intended use.
- Design equipment and furnishings in an effort to ease motions.
- Design lighting systems that are appropriate for the space utilization and adjustable to satisfy the occupants.
- Design the functional arrangement of the spaces to maximize efficiency and comfort.

2.2. Green Factory Building

With the advancement of green building movement in India, many companies have evinced keen interest in having a holistic green design and construction framework for upcoming factory buildings. The national GDP expected to grow at about 7% and the contribution of the manufacturing sector to the national GDP being quite significant at 25%, more and more factories

would be set up in the country. While the growth is imminent it is imperative that the development should happen in an environmentally sustainable manner. In this context the development and launch of a green rating programme for factory buildings would have far reaching impacts on saving natural resources, betterment of working conditions and enhanced productivity, thereby leading to substantial national benefits.

Green concepts and techniques in the industry can help address national issues like energy efficiency, conservation of natural resources, handling of consumer waste, water efficiency and reduction in fossil fuel use in commuting. Most importantly, these concepts can enhance occupant health, happiness and wellbeing. The concept of a rating would encourage designers to address these by design.

IGBC has set up the Green Factory Building Core Committee to develop the rating programme. This committee comprised of key stakeholders including corporate, architects, developers, manufacturers and institutions. The committee, with a diverse background and knowledge has enriched the rating system both in its content and process. This rating system would address the factory buildings and not the processes. It would be applicable to all sectors of industry and for all climatic zones of India.

National Benefits:

The anticipated long term benefits, assuming a 200 green factory building stock erected in the next 5-6 years are the following:

- Reduction in power demand by factory buildings
- Reduction in GHG emissions
- Reduction in potable water consumption
- Increase of green cover in new factory premises, thereby reducing heat island effect
- Recharge of aquifers with storm water
- Enhanced indoor air quality leading to at least 1% productivity gains

Benefits of Green Factory Building:

Green factory building can have both tangible and intangible benefits. The most tangible benefits are the reduction in water and energy consumption right from day of occupancy. The energy savings could be high (30 – 40 %) and water savings could be around 20 – 30%. Intangible benefits of green factory include good indoor air quality, health, good day lighting, well being and safety of the employees.

2.3. National Priorities Addressed in the Rating System:

Water Efficiency: India is the second most populous nation in the world with a billion people. 70 percent of India's irrigation needs and 80 percent of its domestic needs are met by groundwater. According to World Bank estimates, by the year 2020 India is expected to experience severe water stress with the per capita availability of water projected to fall below 1000 cubic meters per year as compared to 2000 cubic meters per year in 1997. Water demand is expected to rise with the expanding urbanization and industrialization. Effective water management strategies need to address the crisis. The green factory building rating encourages use of water in a self-sustainable manner through reduce, recycle and reuse strategies.

1. Handling of Waste:

With expanding industrialization and urbanization, the quantity of waste generated is increasing. Several studies indicate about 25 million tons of municipal waste and 10 million

tons of hazardous waste is generated annually. In the present waste management scenario almost 90% of the waste generated requires around 1200 hectares of land per year for disposal. The waste is either dumped or burnt, producing hazardous gases and leeching of toxins into the soil. Segregation of waste at source, diverting the material to the local recycling facilities and reuse of materials, thereby reducing waste dumped in the landfills are some of the strategies encouraged by the rating system.

2. **Energy Efficiency:**

Buildings consume significant amount of energy of which there is a potential to save 30 to 40%. This rating system mainly addresses the efficiency in the factory building energy consumption. Considering the tremendous knowledge and awareness levels amongst factory owners and designers, factory buildings are well positioned to embrace the latest trends and technologies in enhancing energy efficiency.

3. **Reduced Use of Fossil Fuels:**

Due to rise in standard of living economic activities are increasingly becoming energy and technology intensive. Fossil fuel consumption is increasing worldwide to keep up with the changing needs. The dependence on fossil fuels also raises the risk of climate change. Major contribution to atmospheric pollution and climate change are believed to be from carbon emissions produced from combustion of fossil fuels. The rising fossil fuel demand has evoked a fear of running out of fuel reserves in the future. To reduce the dependency on fossil fuels and the resultant air pollution, the rating system encourages the use of alternate fuels for transportation, public transportation, bio fuels for captive power generation, green power and onsite renewable energy generation.

4. **Reduced Dependency on Virgin Materials:**

Rising industrial needs demand greater use of materials for various activities. Use of non renewable, virgin materials would pose a risk of depleting the available natural resources. The rating system encourages projects to use recycled & reused material and discourages the use of virgin wood thereby addressing environmental impacts associated with extraction and processing of virgin materials.

5. Occupational Health: Occupational Health is the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations which requires good health, adaptation to work and controlling risks. Occupational health is one of the major concerns in providing safety and good working conditions in the industrial sector to reduce the risk of problems related to work. The rating system addresses some of the issues related to occupational health such as avoiding the use of asbestos in construction, provision of breakout spaces etc.,

2.4. **Summary**

Building attributes are very important for effective and efficient utilization of cubic space. These attributes may vary depending on the requirement of the activities however proper building attribute selection may not only save resources but also environment.

Practice Questions

1. Explain building attributes in details. What are their advantages?
2. Explain the role of building attributes in developing energy efficient building.
 - Sources http://www.wbdg.org/images/go_btn.gif

Lesson 2

BUILDING CONSIDERATIONS

1. What is the primary focus in building design according to the text?
 - A) Cost-effectiveness
 - B) Energy conservation
 - C) Exterior design aesthetics
 - D) Administrative efficiency
2. Which area is described as intended for the training of staff personnel and administrative activities?
 - A) Inventory Storage Area
 - B) Employee Assembly Area
 - C) Administration Area
 - D) Maintenance Area
3. What is the primary consideration in the Safety and Security Consideration of building design?
 - A) Exterior design aesthetics
 - B) Administrative efficiency
 - C) Life safety and health concerns
 - D) Energy conservation
4. What does the chapter recommend for proper ventilation in building design?
 - A) Use of energy-efficient windows
 - B) Proper exhaust in selected areas
 - C) Installation of waste heat recovery devices
 - D) Implementation of a green rating system
5. Which attribute emphasizes the reflection of the business characteristics inside a building?
 - A) Accessibility
 - B) Energy Efficiency
 - C) Exterior Design Aesthetics
 - D) Comfort
6. In the context of Green Factory Building, what is the expected reduction in power demand by factory buildings?

- A) 10%
- B) 20%
- C) 30%
- D) 40%

7. What does the Green Factory Building rating system primarily address?

- A) Industrial processes
- B) Building processes
- C) Factory buildings
- D) National GDP

8. Which national priority is addressed through the reduction in potable water consumption in the Green Factory Building rating system?

- A) Energy Efficiency
- B) Water Efficiency
- C) Handling of Waste
- D) Reduced Dependency on Virgin Materials

9. What tangible benefits are mentioned for Green Factory Buildings?

- A) Increased waste generation
- B) Increased energy consumption
- C) Increased water consumption
- D) Reduction in water and energy consumption

10. What is the primary concern addressed under Occupational Health in the rating system?

- A) Provision of breakout spaces
- B) Use of recycled materials
- C) Avoidance of asbestos in construction
- D) Promotion of mental well-being

Answer key: 1(B), 2(C), 3(C), 4(B), 5(C), 6(C), 7(C), 8(B), 9(D), 10(C)

PLANT LAYOUT**STRUCTURE**

- 3.0. Objective
- 3.1. Definition
- 3.2. Why plant layout problem exists?
- 3.3. Objectives of plant layout
- 3.4. Principles of plant layout
- 3.5. Factors influencing design of plant layout
- 3.6. Characteristics of a good layout
- 3.7. Classifications of plant layout
- 3.8. Summary
- References

3.0 OBJECTIVES:

This chapter shall help the students to understand plant layout and its types. Understanding these concepts the decision making can be simplified to select suitable layout for any industrial purpose.

3.1. DEFINITION:

Plant layout is defined as the physical arrangement of various production facilities and utilities in a systematic manner for efficient use of resources. According to Moore "Plant layout is a plan of an optimum arrangement of facilities including personnel, operating equipment, storage space, material handling equipment and other supporting services along with the design of best structure to contain all these facilities". The overall objective of plant layout is the systematic arrangement of various facilities for economic use of resources.

3.2. WHY PLANT LAYOUT PROBLEM EXISTS?

The need for plant layout is recognized due to the following reasons:

1. Fluctuations in demand pattern.
2. Change in supply pattern
3. Innovations in technology
4. Changes in processing techniques, machinery and equipment
5. Changes in working conditions
6. Changes in environmental or working conditions
7. Competitive dynamics
8. Multi product production flexibility
9. Efficient use of resources
10. Changes in market location

3.3. OBJECTIVES OF PLANT LAYOUT

The primary objective of plant layout is to maximize the profit quantum earned by the organization. This can be achieved by the efficient use of existing resources. Some of the important and most common objectives are hereunder:

1. To get the high return on investment
2. Ease the production processes by efficient arrangement of existing facilities
3. Facilitate the production processes
4. Efficient use of men, material, equipment and space.
5. Minimize the movement and cubic space utilization
6. Provide safety, comfort and convenience to the employees.

3.4. PRINCIPLES OF PLANT LAYOUT

The layouts are designed based on the following principles:

1. The Principle of minimum movement

The layouts are designed based on the principle that men, material, machinery and equipment have to move minimum possible distance. This help to save time and reduce fatigue.

2. The principle of Cubic Space Utilization

This principle helps the utilization of vertical space. The rising land cost shall add more to cost if it is utilized horizontally and also need more care.

3. The principle of Flexibility

The changes in demand and supply patterns pressed the organizations to be flexible in anticipation to these changes.

4. Principle of Safety, Security and Satisfaction

The existing layout should safeguard the employees against accidents and health hazards. Designing the layouts to provide safety and security shall satisfy the employee satisfaction and it shall improve production efficiency.

5. Principle of Smooth flow

A good layout shall help the smooth flow of various activities and chance of bottlenecks can be reduced.

3.5 FACTORS INFLUENCING DESIGN OF PLANT LAYOUT

The following factors influence the design of a layout:

1. Volume to be manufactures: The selection of a production depends on the quantum of manufacturing volume. The design considerations vary with volume of output. For small and uncertain demand to be produced the Job shop can be developed, and for limited number of items to be produced at irregular interval product type of layout can be designed. Some times for production in bulk and identical items mass production layout can used.
2. Availability of Space and cost: Based on this factor for small areas multiple stories can be developed and in case of more space availability at lower cost, single story or ground space can be used.
3. Future expansion: Future expansion also plays an important role in designing layouts. The expectations of future demand increase makes the designer to think more and complex layout may be designed.
4. Government rules and regulations and geographical location: This factor also plays an important role. In many situations the closeness to defense area may restrict the height,

also the geographical location of the plant may also consider natural disaster factors like earthquake and flood. These factors may also compel the designer to develop a unique layout.

3.6. CHARACTERISTICS OF A GOOD LAYOUT:

A good layout helps to improve the efficiency and effectiveness of a production system. Some of the characteristics of a good layout are as follow:

1. It provides the maximum flexibility to the production system in changing circumstances.
2. It helps to coordinate various activities within and outside the plant.
3. It needs minimum control.
4. The speed of communication is very high.
5. It is easily accessible.
6. It is economical also.
7. The distance to be moved is minimum and chances of accidents are also very less.
8. It is designed for smooth and efficient flow of various production activities.
9. It helps to identify different employee and locations.
10. It has inherent safety.

3.7. CLASSIFICATION OF PLANT LAYOUTS:

Plant layouts are classified based on the volume of production. Some of the important classifications are hereunder:

1. **Process layouts:** These are also called functional, or job shop layouts, and are designed to accommodate a variety of products in design and processing. Generally these are used for small scale production. Here general purpose machines can be used to cope with large variety of products to be produced in small volume.
2. **Product layouts:** these are also called production lines or assembly lines, are designed to produce only a few identical products. These layouts typically use specialized machines that are set up to perform specific tasks over a longer period of time.
3. **Cellular Layouts:** In this type the machines are grouped into cells. These cells function somewhat like a product layout within a larger job/product layouts.
4. **Fixed Position Layouts:** Sometimes the product to be manufactured is large in shape and can't be moved, like ships, aero planes, etc. The product is fixed at one place and men, machinery, material and equipment perform the basic operations to give shape to the finished product.
5. **Hybrid Layouts:** In most of the situations single type of layout is not desirable. A special layout can be designed to have good characteristics of all these layouts. Such a combination layout is called hybrid layout.

3.8. SUMMARY:

The plant layout problems are very complex in nature due to changing environment of demand and supply. The selection of suitable layout plays very important role to add to the organizations' revenue as well as to meet the future demands. These guidelines shall not only help to simplify the future demands but also minimize uncertainties.

Practice Questions

1. Explain plant layout problems in details.
2. Classify various types of plant layouts. How a suitable layout selection can be made?



Lesson 3

PLANT LAYOUT

1. Why does the plant layout problem exist?
 - A) Fluctuations in environmental conditions
 - B) Changes in market conditions
 - C) Innovations in machinery design
 - D) All of the above
2. What is the primary objective of plant layout?
 - A) Maximizing employee satisfaction
 - B) Maximizing the profit earned by the organization
 - C) Minimizing production processes
 - D) Maximizing the movement within the facility
3. Which principle of plant layout emphasizes the efficient use of vertical space?
 - A) Principle of safety, security, and satisfaction
 - B) Principle of minimum movement
 - C) Principle of cubic space utilization
 - D) Principle of flexibility
4. What factor influences the design of plant layout based on the quantum of manufacturing volume?
 - A) Availability of space
 - B) Volume to be manufactured
 - C) Government rules and regulations
 - D) Geographical location
5. Which characteristic is associated with a good plant layout?
 - A) Maximum control
 - B) Slow communication
 - C) Maximum distance to be moved
 - D) Minimum chances of accidents
6. Which type of layout is suitable for small-scale production with a variety of products?
 - A) Process layout
 - B) Product layout

C) Cellular layout

D) Fixed Position layout

7. What type of layout is used for large products that cannot be moved during manufacturing?

A) Process layout

B) Product layout

C) Cellular layout

D) Fixed Position layout

8. What is the overall objective of plant layout according to Moore's definition?

A) Maximum utilization of vertical space

B) Maximum control over processes

C) Maximum arrangement of facilities

D) Maximum return on investment

9. What layout type combines the characteristics of various layouts and is termed as a hybrid layout?

A) Process layout

B) Product layout

C) Cellular layout

D) Hybrid layout

10. Which factor does NOT influence the design of plant layout?

A) Volume to be manufactured

B) Availability of space and cost

C) Future expansion

D) Employee salary preferences

Answer key: 1(D),2(B),3(C),4(B),5(D),6(A),7(D), 8(D),9(D),10(D)

PLANT LAYOUT TOOLS AND TECHNIQUES

STRUCTURE

- 4.0. Objective
- 4.1. Tools and techniques to design plant layouts
 - 4.1.1. Charts
 - 4.1.2. Diagrams
 - 4.1.3. Models and Templets
 - 4.1.4. Computer packages for layout analysis
- 4.2. Trends in facility layout observed in industry
- 4.3. Summary

4.0 OBJECTIVES:

This chapter shall help the students to understand the tools and techniques of plant layout design.

4.1. TOOLS AND TECHNIQUES TO DESIGN PLANT LAYOUT

A layout has to plan, organize, co-ordinate and control various activities. These activities needed for men, material, machinery, equipment, and management. The following tools and techniques can be used for the same:

4.1.1. Charts

- a) Outline Process Charts
- b) Flow Process Chart (Men/Machinery/Equipment) type
- c) Two-handed Process Charts
- d) Multiple Activity Charts
- e) Simultaneous motion Charts (SIMO)

4.1.2. Diagrams

- a) Flow Diagram
- b) String diagram
- c) Travel Charts

4.1.3. Models and Templets

- a) 3-D Models
- b) Templets

Outline Process Charts: An outline process chart gives an overall picture of sequences of operations and inspections. It represents different activities or events likely to be encountered in any office or factory. It includes the basic activities as; operation (O), inspection (\square), transport (\rightarrow), permanent storage(Δ) and delay (D).

Flow Process Chart: It shows the flow of a product or a procedure by recording all events using appropriate process chart symbols.

Two-handed Process Charts: It shows the activities of a worker's hands (or limbs) and develops interrelationships to on another.

Multiple Activity Charts: It shows the activities of more than one subject (men, machinery, or equipment) to develop interrelationship between them.

Simultaneous motion Charts (SIMO): These charts are based on film analysis of on a common time scale of therbligs or group of therbligs in relation to different parts of the body. These therbligs represents the motion of human body at workplace and the mental activities associated with them.

Flow Diagram: It records what the workers do. It records the events of men, material, and equipment.

String diagram: These are the diagrams on a scale plan or model on which a thread movement is used to trace the path of men, machinery, and equipment movement.

Travel Charts: It is a tabular record of quantitative data about the movement of men, material, and equipment between any numbers of places over a given period of time.

3-D models: These models are used to scale various facilities and develop inter-relationship between them. They are generally made of plastic or wood. Layout designer generally develops the interrelationship between them for developing efficient and effective layouts.

Templets: These are 2-Dimensional models prepared by colored papers, cardboards, etc. They are made to scale and are placed at the selected locations of the building plans on the board. They help to understand the plan of various activities.

4.1.4. Computer Packages for Layout Analysis:

Many computer programmes have been developed for developing layouts. Some of them are as follow:

CRAFT: Computerized Relative Allocation of Facilities is a computerized improvement algorithm developed by Gordon Armour and Elwood Buffa. The maximum departments to be allocated in this programme are 40 in number. The maximum size of the layout is 30×30. The data input information in the form of material flow per unit time, cost/unit distance moved and space requirement. The flow diagram for this program is as:

CORELAP: Computerized Relationship Layout Planning uses input as; number of departments and area requirement, relationship chart and their weightage, maximum building length/width ratio, and location for pre assigned department. In this program total closeness rating (TCR) is calculated and appropriate values are selected.

ALDEP: Automated layout design programme requires input data for specifications of the building and locational relationship matrix. It has the capacity to layout 63 departments. This program can design layout for multi-story plants.

4.2. TRENDS IN FACILITY LAYOUTS OBSERVED IN INDUSTRY

The modern manufacturing facility faces significant changes in process designs, product plans, demand quantum, product mix, product life cycles and production routings. In the modern run flexible manufacturing machines and cells are being extensively used. Advancements in shop floor management technology and material handling systems have reduced the impact of travel distances and inter-operation separation on the type of physical layout designed for a facility. The traditional facility layouts were usually not suitable for these changes. The manufacturers nowadays expect for systematic and efficient methods to layout their facilities those were earlier

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designed using traditional design strategy of process layout or the principle of "place where space is available".

Electric Box & Enclosures (E-Box), Trussville implemented Multi-Channel Manufacturing (MCM). It is based on the simple observation that in an effective manufacturing system, multiple channels (or paths) are provided for each manufactured products as it flows through the system. Instead of having one channel through the manufacturing facility for each product, multiple routes/channels are provided which allows the product to flow through the facility by choosing the channel that allows for the greatest manufacturing system efficiency at that time.

Modular Multi-Station CNC Machining Center: It may allow simultaneous machining using up to 7 machining units and retrofitting of additional machining units. Automatic loading and unloading systems can be added without difficulty with full potential for full integration into equal or other machine systems. Here a single machining unit can be fitted to a long base slide which enables the machining of all sides of a work piece in one station and machining of the front face in another station. Therefore, machining from the 5-sides is possible, by just making use of 2-machines.

Modular Manufacturing Systems: Modular system architecture may allow manufacturers to reconfigure lines and utilize 70%-80% of their original manufacturing system investment. Also, the time to install modular machines may be reduced by 33% as compared to conventional manufacturing lines. The Industrial Automation Systems group of UNOVA Inc. provides the automotive industry; modular high-volume flexible machining systems that can be changed with global market conditions.

4.3. SUMMARY

Plant layout can be effectively drawn with the help of charts, diagrams, models and Templates. Also various software packages are available for the same. The selection of an appropriate technique can simplify the layout problem.

Practice Questions

1. What are various tools and techniques for plant layout development? What are their advantages?
2. Discuss computer software's available for plant layout design?



Lesson 4

PLANT LAYOUT TOOLS AND TECHNIQUE

1. What is the primary purpose of tools and techniques for plant layout design?
 - A) Organizing financial resources
 - B) Controlling external factors
 - C) Planning, organizing, coordinating, and controlling various activities
 - D) Monitoring employee satisfaction
2. Which tool is used to represent the overall picture of sequences of operations and inspections in a layout?
 - A) Flow Diagram
 - B) String Diagram
 - C) Outline Process Chart
 - D) Travel Charts
3. What does a Flow Process Chart primarily show in plant layout design?
 - A) Employee satisfaction levels
 - B) Material flow per unit time
 - C) Building length/width ratio
 - D) Flow of a product or procedure
4. Which layout tool records the events of men, material, and equipment, and is based on a scale plan or model?
 - A) Two-handed Process Charts
 - B) String Diagram
 - C) Travel Charts
 - D) Flow Diagram
5. What do 3-D models in plant layout design represent?
 - A) Building length/width ratio
 - B) Interrelationship between various facilities
 - C) Employee satisfaction levels
 - D) Travel distances

6. Which computer program uses the Computerized Relative Allocation of Facilities algorithm?
- A) CORELAP
 - B) ALDEP
 - C) CRAFJ
 - D) Multi-Channel Manufacturing
7. What is the purpose of Multi-Channel Manufacturing (MCM) in plant layout design?
- A) Maximizing employee satisfaction
 - B) Providing multiple routes/channels for product flow
 - C) Controlling external factors
 - D) Designing traditional facility layouts
8. What is the key advantage of Modular Multi-Station CNC Machining Center in plant layout?
- A) Reducing travel distances
 - B) Simultaneous machining from 5 sides
 - C) Maximizing employee satisfaction
 - D) Implementing traditional manufacturing lines
9. Which type of system architecture allows reconfiguration of manufacturing lines with minimal investment?
- A) Multi-Channel Manufacturing
 - B) Modular Manufacturing Systems
 - C) Automated Layout Design
 - D) Flexible Manufacturing Machines
10. What is the common goal of trends observed in facility layouts in the industry?
- A) Maximizing travel distances
 - B) Reducing the impact of travel distances
 - C) Traditional facility layouts
 - D) Employee satisfaction levels

Answer key: 1(C), 2(C), 3(D), 4(D), 5(B), 6(C), 7(B), 8(B), 9(B),10(B)

PRODUCTION MANAGEMENT

STRUCTURE

- 5.0. Objective
- 5.1. Definition
- 5.2. Objectives of production management
- 5.3. Types of production systems
- 5.4. Production interface with other functional areas
- 5.5. Summary

5.0 OBJECTIVES

The objective of this chapter is to understand various types of production systems applicable to manufacturing setup. These guidelines can be taken as a reference to select a suitable manufacturing system for the same.

5.1 DEFINITION

Production is creation of utility by transformation of raw material into finished goods. Edward Buffa defines the production system as, "a process by which goods and services are created. Production management is the process of planning, organizing, directing and controlling the activities of the production function"

5.2 OBJECTIVE OF PRODUCTION MANAGEMENT

Production is the organized processing of the input activities to produce products and services as per standards. Broadly speaking the objectives are classified as to produce:

1. The right Quality
2. The quantity or volume
3. Produce at the predetermined time
4. Produce at the minimum cost.

5.3 TYPES OF PRODUCTION SYSTEMS

The production systems are classified based on the type of the product to be produce, its characteristics and demand. Broadly speaking the production systems are classified as:

1. Job Shop Production

Job shop production systems are characterized by small quantity of the products to be produced as per customer specifications. The distinguishing character of this system is low output and high variety. This system uses general purpose machines, highly skilled labor, large inventories, frequently changing setups, needs more job instructions, erratic movement of material, and complex production planning.

2. Batch Production

Batch production is characterized by the production of limited number of products at regular interval of time. This production system is characterized by; shorter production runs, output in batches, higher setup cost but lower than job shop, high level of work in progress, flexible plant and machinery, and less supervision is required as compared to job shop production system.

3. Mass Production

This system is used for manufacturing large volume of output of identical items. The machinery is arranged in a systematic manner to link the continuous run of finished and semi-finished products during the process of transformation. This system can further be classified as mass and flow production. In mass production some flexibility is possible but flow production is not flexible and it is used to produce very high quantity of identical outputs.

Mass production system is characterized as; standardized product and process sequence, high volume production, shorter cycle time, automated material handling, less supervision required, and perfectly balanced production lines.

4. Cellular Production

This production system is based on the group technology, which seeks to achieve the superior performance by exploiting similarities inherent in the parts. Here the groups having similar processing requirements are grouped as a family. In this system the group team is responsible for organizing the tasks within the cell. The important characteristics of this system include; reduced material handling, reduced setup time, lower work-in-progress inventory, simplified shop floor, lower investment, and combined advantages of job shop.

5.4 Production interface with other functional areas

The production systems are one of the subsystems of a large business organization. The other functional areas may include; finance, marketing, purchasing, personal etc. All the areas have to work as a team to achieve the objectives.

Marketing function translates the customer requirements and sells the finished products in the market. So, what type the requirements customers have production department has to create it based on the feedback of marketing department.

On the other hand the required finance is arranged by the finance department and purchases are made by the purchase department. These departments also work in coordination to production department. If it lacks coordination then input to the production may be either inappropriate or defective resulting in bad output.

To get the work done in the most efficient and effective manner standardized manpower is required. So to select the right person, at the right time with right skill is the responsibility of personal department. This function shall help the production department by satisfying the personal requirements.

5.5 Summary

Production is the process of creation of utilities. This creation process has three components as; input, processing and output. The coordination of these three components gives rise to various types of productions system called as, product, process, mass and cellular manufacturing. However the selection of a suitable system for manufacturing needs the detailed knowledge of these systems. Also it is pertinent to mention that production function should have good coordination with other departments to produce desirable quality and quantity.

Practice Questions

1. Define production management. What are the objectives of the production management?
2. What are various production systems? Mention the advantages and disadvantages of each.

Lesson 5

PRODUCTION MANAGEMENT

1. What is the primary objective of this chapter on production management?
 - A) Financial planning
 - B) Understanding various types of production systems
 - C) Human resource management
 - D) Marketing strategies
2. According to Edward Buffa, how does he define the production system?
 - A) A process of creating customer satisfaction
 - B) A method for organizing human resources
 - C) A process of planning, organizing, directing, and controlling production activities
 - D) A system of financial control
3. What are the broadly classified objectives of production management?
 - A) Quality, cost, and time
 - B) Quantity, cost, and variety
 - C) Profit, marketing, and human resources
 - D) Quality, quantity, time, and cost
4. Which production system is characterized by low output, high variety, and frequently changing setups?
 - A) Batch production
 - B) Mass production
 - C) Job shop production
 - D) Cellular production
5. In which production system is production organized into systematic lines for continuous transformation?
 - A) Cellular production
 - B) Mass production
 - C) Batch production
 - D) Job shop production
6. What is the primary characteristic of mass production?

A) High flexibility

B) Low volume production

C) Automated material handling

D) Frequent changes in setups

7. What does cellular production system exploit to achieve superior performance?

A) Differences in parts

B) Similarities in parts

C) Mass production lines

D) Flexible plant and machinery

8. Which functional area translates customer requirements and sells finished products in the market?

A) Finance

B) Human Resources

C) Marketing

D) Production

9.. What is the responsibility of the personal department in the production interface with other functional areas?

A) Arranging finance

B) Coordinating marketing

C) Selecting the right personnel with the right skills

D) Purchasing raw materials

10. What is the key to achieving desirable quality and quantity in production?

A) Financial planning

B) Effective marketing

C) Coordination with other departments

D) Mass production techniques

Answer key: 1(B), 2(C), 3(D), 4(C), 5(B), 6(C), 7(B), 8(C), 9(C), 10(C)

MATERIAL HANDLING

STRUCTURE

- 6.0. Objective
- 6.1. Introduction
- 6.2. Objectives of material handling
- 6.3. Principles of material handling
- 6.4. Types of material handling equipments
- 6.5. Summary

6.0. OBJECTIVES

According to American Material Handling Society; material handling amounts to 15-25% of the total cost. Understanding this concept and its techniques shall help the student not only to select appropriate machinery but also to minimize the cost.

6.1. INTRODUCTION

To convert the raw material into finished goods, it is essential to move the basic four elements, i.e. material, men, machinery and equipment. In most of the cases material move relatively more as compared to other elements. Hence the term "Material Handling" is widely used in practice.

Haynes defines material handling, "It embraces the basic operations in connection with the movement of bulk, packaged and individual products in a semi-solid or solid state by means of gravity, manually, or power-actuated equipment and within the limits of individual producing, fabricating, processing or service establishment."

6.2. OBJECTIVES OF MATERIAL HANDLING

- 1. To minimize the movement cost.
- 2. To minimize the delays and interruptions.
- 3. To send the right material at right place, at right time and to the right person.
- 4. To maximize the efficiency and output of the production system.
- 5. To minimize the investment for material handling.
- 6. To prevent material damages.
- 7. To avoid accidents during movement of the material.
- 8. To ensure health, safety and security of the employees and the system.

6.3. PRINCIPLES OF MATERIAL HANDLING

- 1. Utilization of Cubic Space: Make optimum utilization of cubic space.
- 2. Use of Gravity: Use gravity for material flow wherever possible.
- 3. Safety Principle: Use safe handling methods and procedures.
- 4. Flexibility: The machinery and methods used should be applicable to changing requirements.
- 5. Dead Weight Reduction: Minimize the dead weight of machinery to save energy.
- 6. Capacity Utilization: The machinery used should be used to full capacity.
- 7. Obsolescence Principle: Replace obsolete handling equipment and methods to maximize the efficiency and effectiveness.

6.4. TYPES OF MATERIAL HANDLING EQUIPMENTS

The material handling equipments are classified based on the types of movement, types of equipment, location of the equipment and requirements. Some of the widely used types are as hereunder:

1. Conveyers

These are used to move uniform loads between fixed position. Some of the types are given below:

- a) Belt conveyer
- b) Screw conveyers
- c) Roller conveyers
- d) Trolley conveyers

These are useful to move relatively uniform load between fixed points continuously.

2. Hoists and Cranes

Hoists are used for handling heavy objects for short and long distance. They are classified as; chain hoists, pneumatic hoists and electric hoists. On the other hand cranes are overhead devices capable of moving material vertically and laterally in the area of limited length and width of height. They are classified as; overhead traveling cranes, jib cranes, and gravity cranes.

3. Industrial Trucks

These are power operated vehicles used for movement of fixed or uniform loads over varying paths which have suitable running surfaces and clearances and where the main function is transportation between variable locations. They are classified as: forklift tractors, platform trucks, and tractor trailer.

6.5. SUMMARY

Material handling is one of the important areas in the manufacturing where cost saving practice can be applied. In this section the basic principles are concerned with the movement of material in the economic and safe way. The material handling equipments are classified in a systematic way may help to select suitable equipment.

Practice Questions

1. Define material handling. What is the significance of efficient material handling?
2. Classify various material handling equipments. What are their advantages and disadvantages?

Lesson 6

MATERIAL HANDLING

1. What percentage of the total cost does material handling amount to, according to the American Material Handling Society?

- A) 5-10%
- B) 10-15%
- C) 15-25%
- D) 25-30%

2. How does Haynes define material handling?

- A) Movement of people and machinery
- B) Transportation of finished goods
- C) Operations related to the movement of products
- D) Packaging of materials

3. Which element tends to move relatively more compared to others in the process of converting raw material into finished goods?

- A) Men
- B) Machinery
- C) Material
- D) Equipment

4. What is one of the objectives of material handling?

- A) Maximizing movement cost
- B) Minimizing efficiency
- C) Minimizing investment
- D) Maximizing delays and interruptions

5. What principle in material handling emphasizes the utilization of cubic space?

- A) Flexibility Principle
- B) Utilization of Cubic Space
- C) Safety Principle
- D) Dead Weight Reduction

6. Which type of material handling equipment is suitable for moving uniform loads between fixed positions continuously?

- A) Hoists and cranes
- B) Conveyors
- C) Industrial Trucks
- D) Elevators

7. What are examples of conveyors used in material handling?

- A) Forklift tractors
- B) Screw conveyors
- C) Chain hoists
- D) Platform trucks

8. What are cranes capable of moving in the material handling process?

- A) Only vertically
- B) Only horizontally
- C) Both vertically and laterally
- D) Only diagonally

9. What is the main function of industrial trucks in material handling?

- A) Static storage
- B) Transportation between variable locations
- C) Fixed point movement
- D) Material processing

10. What is the primary focus of the principles of material handling mentioned in the text?

- A) Maximizing costs
- B) Minimizing safety
- C) Safe and economic movement of material
- D) Maximizing equipment weight

Answer key: 1(C), 2(C),3(C), 4(C), 5(B), 6(B), 7(B), 8(C), 9(B), 10(B)