# UNIT-5

# PORT AND HARBOUR ENGINEERING

## DEFINITIONS:

## HARBOUR :

A harbour can be defined as a sheltered area of the sea in which vessels could be launched, built or taken for repair; or could seek refuge in time of storm; or provide for loading and unloading of cargo and passengers.

## PORT:

A port is a man-made coastal facility where boats and ships can load and unload. It may consist of quays, wharfs, jetties, piers and slipways with cranes or ramps.

In short a port is used mainly for marine trading and a harbour is used as a parking space or a storage space for ships

## TERMS RELATED IN PORT AND HARBOUR:

- **Approach channel**: The dredged clear channel through which ships proceed from the open sea to the harbour basin is known as approach channel.
- **Barges:** The vessels which require less depth of water are called barges.
- **Basin:** The water area formed in a port on the sea coast protected by an out laying break water is called Basin
- **Berth**: The space where cargo is unloaded or loaded into a vessel is known as berth.
- **Hinter land:** The area on the land side of the port from where the port may get freight and passengers for transportation is known as hinterland.
- **Piers:** The structures constructed perpendicular or oblique to the shore of the sea or river to provide bathing facilities are known as piers.
- **Quays**: The platforms constructed parallel to the shore to allow ships to berth along sides these platforms for loading and unloading purposes are called quays.

## REQUIREMENTS OF HARBOUR:

- The depth of a harbor should be sufficient for every type of visiting ships.
- The bottom of harbor should provide secured anchorage to hold the ships against high winds.
- To prevent destructive wave action, break water are provided.
- The entrance of a harbor should be wide enough to provide the easy passage of ships.

## REQUIREMENTS OF PORT:

- A port should possess simple link with the railways to make transportation of commodities to and from the port easily and rapidly.
- A port must be located at the fertile hinterland and should possess good density.
- The anchor facility must be perfect when the ship reach the harbour at berth during loading and unloading of cargo , fuel and supplies etc.
- The port should have own provision to store the commodities during transportation.
- The port should include the arrangements to undergo servicing works of ship whenever it is required.

**CLASSIFICATION OF PORTS:** Ports are classified into

**SEA PORT :** The ports used to handle ocean going is called as sea port

**RIVER PORT:** The river traffic such as shallow draft vessels and barges are controlled by river port .

**FISHING PORT**: To land and distribute fish a fishing port is suitable.

**WARM WATER PORT**: The place where there is no freeze of water in winter is called warm water port

**DRY PORT :** A place where containers or cargo is placed is called dry port. Normally it is connected to a sea port by road or rail.

**INLAND PORT**: the direct access of ports on river , lake or canal to ocean or sea is called as inland port

**CLASSIFICATION OF HARBOUR:** Harbours are classified into

1. Natural harbour
2. Semi natural harbour
3. Artificial harbour

**Natural harbour :**

- These are formed naturally by creaks and basins.
- It is protected from storms and waves by prominence of land.
- Consist of part of body of water which is protected and deep enough for anchorage.

**Semi natural harbour:** The ones who are protected on sides by land and require man-made protection only at entrance

Ex. Vishakhapatnum port

**Artificial harbour:**

This is a Man-made harbour constructed with break waters, sea walls , jetties, and also dredging is done there. This harbour requires maintenance by periodic dredging **Ex. Madras harbour**

**Classification based on function to be performed**

1. **Harbor of refuge-** used for ships in storms or emergency condition.

2. **Commercial harbor-** Facilities for loading and unloading of cargo are provided.

3. **Fishery harbor-** For loading unloading the catch . It should have refrigeration stores with plenty of storing space for preserving catch.

4. **Military harbor or navel base harbours-** This harbor is meant for accommodating naval crafts and serves as a supply deport.

**PLANNING OF HARBOUR :**

The planning of harbor should be carried out after collecting the necessary information of the existing features at the proposed site.

The following important facts should be studied:

- To carry out a thorough survey of the neighborhood including the fore shore and depths of water in the vicinity is necessary.
- The nature of the harbor, whether sheltered or not should be studied.
- The problem of silting or erosion of coast line should be studied carefully.
- To ascertain the character of the ground, borings and soundings should be taken.
- The natural metrological phenomenon should be studied at site with respect to frequency of storms, rainfall, range of tides, maximum and minimum temperatures, direction and intensity of winds, humidity, direction and velocity of currents etc.

**FEATURES OF HARBOUR**: The various features of harbor are classified into :

1. Break water
2. Docks
3. Entrance channel
4. Jetty
5. Light house
6. Berthing Basin
7. Turning Basin
8. Pier Head
9. Wharves

## BREAK WATERS:

Breakwater are the structures constructed to enclose the harbours to protect them from the effect of wind generated waves by reflecting and dissipating their force or energy.

- Helps to use the area thus enclosed as a safe anchorage for ships and to facilitate loading and unloading of water by means of wave breakers.
- Height depends upon the its purpose, extent of enclosed water area and nature of existing shipping work.
- Generally the height of breakwater is kept as equivalent to 1.2 to 1.25 times the waves expected.
- It also helps to prevent beach erosion
- Most common breakwater used has a core of small rocks or rubble with a covering of large rocks to keep the core from being washed away.

## DOCKS:

Docks are enclosed areas for berthing the ships to keep them afloat at a uniform level to facilitate loading and unloading cargo.

- A marine structure for berthing of vessels for loading and unloading cargo and passengers.
- As ships require a number of days for discharging cargo, during which period they need a uniform water level.
- Docks can be classified into following two categories:

❖ Wet docks.
❖ Dry docks.

**Wet docks-**

Docks required for berthing of ships or vessels to facilitate the loading and unloading of passengers and cargo are called wet docks. These are also known as harbor docks.

**Dry docks**

- The docks used for repairs of ships are known as dry docks.
- It is long excavated chamber, having side walls, a semi circular end wall and a floor.
- The open end of the chamber is provided with a gate and acts as the entrance to the dock.

**ENTRANCE CHANNEL:**

Depth and width are kept more at entrance .Width depends upon density of traffic and no. of entrances

**JETTIES:**

- A narrow structure projecting from the shore into the water with berths one or both sides and sometimes at the end also.
- These are structures in the form of piles projections.
- Built from the shore to the deep water.
- They may be constructed in the sea or in a navigable river.
- The jetties extend from the shore to the deep sea to receive the ship.

## BERTHING AND TURNING BASINS

Berthing basins are used for the parking of ships

While turning for the turning of ships

## PIER HEAD:

The structure provided at the tip of break water such as light house

**WHARVES:** The landing platforms or places in the form of walls built near the shore for vessels to berth are known as wharves.

**APRON** : The open space left immediately in front of a berth of a ship is known as apron.

## TRANSIT SHED AND WARE HOUSES:

Transit sheds and ware houses refer to building sheds to store cargo. Cargos requiring storage for shorter duration are kept in transit sheds while those requiring storage for longer duration are stored in ware houses.

This characteristic has an influence on location , structural stability and durability of buildings.

Transit sheds have lesser structural stability and durability , since storage of cargo in transit sheds are change over in nature , they are located very close to berthing places.

## NAVIGATIONAL AIDS:

The devices such as lights, signals used to guide and warn safe, efficient, economic and comfortable travel of ships in rivers, oceans and harbors are known as navigational aids.

### Necessity for signals:

The mariner and his ship have to be guided by proper signals during navigation, especially,

- To avoid dangerous zones like hidden rocky outcrop and sand bars,
- To follow proper approaches and
- To locate ports.

**Types of navigational aids:**

**Fixed type : (a) light house, (b) Beacon lights**

**Floating type: ( c) floating buoys , (d) lightship**

- The light stations when they are built on land are called fixed as in the case of permanent lighthouse structures. Such structures are located either in the hinterland close to the shore or in the sea on submerged outcrops and exposed to the fury of the waves.
- Alternately, where there are difficulties in establishing proper foundations; floating light stations in the form of a light vessel may be adopted.
- Buoys of standard shapes also belong to the 'floating type and are generally used to demarcate boundaries of approach channels in harbour basins.

**(a) Light house:**

- It is a structure built of masonry or reinforced concrete in the shape of a tall tower on a high pedestal.
- The tower is divided into convenient number of floors, the topmost floor containing powerful lighting equipment and its operating machinery.
- The lower floors are used, as stores and living rooms necessary for the maintenance and working of the light station.

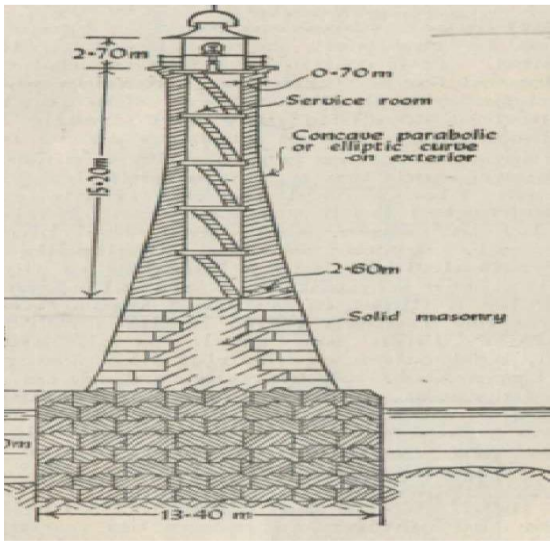
The main parts of a typical lighthouse tower are illustrated in fig.

In case as a matter of convenience and urgency, all the requirements for the efficient and unfailing maintenance and working of the lighthouse, like stores and staff quarters are provided in the lighthouse shaft.

**Lighthouse construction:**

- It is quite evident that the type of foundation to be adopted for a particular situation will depend on the characteristics of soil of that area.

- On good rock or hard soil, a thick bed of concrete may serve while on submarine or marshy locations, piles or caissons could be used.
- The superstructure is generally a masonry or an R.C.C tower constructed on a prominent basement.
- The tower is divided into a number of floors and the light is housed at the summit in a glazed room.
- The floors are accessible by a flight of winding stairs from bottom to top.
- Just below the lantern room is the service room and other rooms lower down are used for oil and general stores, personnel, and other accessories like water storage and fire fighting apparatus.
- The light should be identified and its distance ascertained, for the mariner to locate his position.
- These lights are made 'fixed' or flashing for easy identification by the navigator and are classified accordingly to their illuminating power.




**(b) Beacon lights:**

- Beacon light are fixed or flashing for easy identification by the navigator.
- They are used for means of alignment or indicating changes of direction.

**( c) floating buoys:**

- Floating buoys are signals used to indicate approach channel boundaries.
- They are held in position through proper anchorages.
- They are made up on iron and steel plates with a minimum thickness of 6 mm.
- They are hollow structures and are constructed as water tight.

- These buoys are denominated **'Star board-hand' or 'port-hand'** buoys according to their positions being to the **left or right** of the navigator respectively as he approaches the harbour.

**(d) lightship:**

- Light ship is a small ship of about 500 tonnes capacity.
- It has got accommodation for operating staff.
- A steel tower is built in a ship which projects about 10 m above water surface and carries light source.
- Ship maintains its position by suitable anchorage or moorings.

**MAINTENANCE OF PORT AND HARBOUR:**

Various services are required for proper maintenance of port and harbour. They are

- **Lighting:** The terminals are to be provided with suitable illumination during night for proper functioning. At places where ships load and unload , and places on roads and walkway proper illumination should be provided.
- **Electric power:** The electrical design of terminal is based on the material to be handled by it. In the areas where explosive and combustible materials are used specially designed electrical equipments should be used.
- **Communication and water supply**
- **Fire protection:** for every warehouse proper fire protection should be provided in order to safe the goods.

## Dredging:

Dredging is the removal of sediments and debris from the bottom of lakes, rivers, harbors, and other water bodies.

**CLASSIFICATION:**

- There are two methods of dredging: mechanical excavating and hydraulic excavating.
- Mechanical excavating is applied to cohesive soils. The dredged material is excavated and removed using mechanical means such as grabs, buckets, cutter heads or scoops.
- Hydraulic excavating is done with special water jests in cohesionless soils such as silt, sand and gravel. The dredged material which has been loosened from the sea-

bed is sucked up and transported further as a mixture (solid material and water) using centrifugal pumps.

**USES OF DREGDED MATERIALS**

- Dredged material such as sand, clay and gravel can be used as an alternative for some primary resources. These may be used as construction material for many applications such as land or mine reclamation, replacement fill, land-fill cover, road foundations and noise barriers