# BUDDHA SERIES

## (Unit Wise Solved Question & Answers)

## Course – B.Tech (Civil)

## College – Buddha Institute of Technology

**(AKTU CODE-525)**

## Department: Civil Engineering

## Subject: Railways, Airport & Waterways (KCE 070)

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## Unit - 5

# Unit - 5

**Que 1. What is Harbour? Briefly explain the various types of harbours.**

**Answer**

**Harbour:** A harbour is a place where ships get shelter and protection against the destructive elements of the sea and where facilities are provided for hip to discharge or receive cargo and passengers.

**Types of Harbour:** Following are the types of harbour:

1. **Classification of Harbour Depending upon the Protection Needed:** Depending upon the protection needed, harbours are broadly classified as

i. **Natural Harbours or Natural Roadsteads** : Natural formations afforcling safe di charge facilities for ships on sea coasts, in the form of creeks and basins, are called natural harbours.

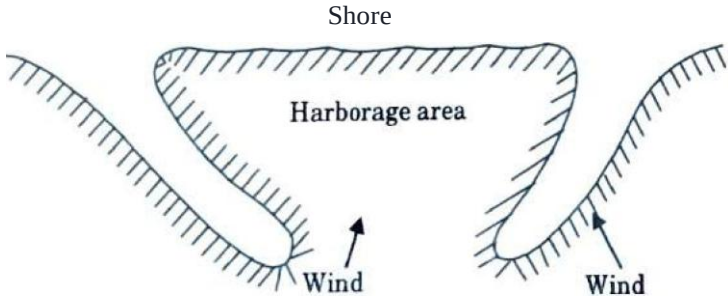



**Fig. 5.1.1.** Natural harbour.

ii. **Semi-natural Harbours** : This type of harbour is protected on sides by headlands and it requires man-made protection only at the entrance as shown *in* Fig. 5.1.2. Visakhapatnam is a semi-natural harbour.

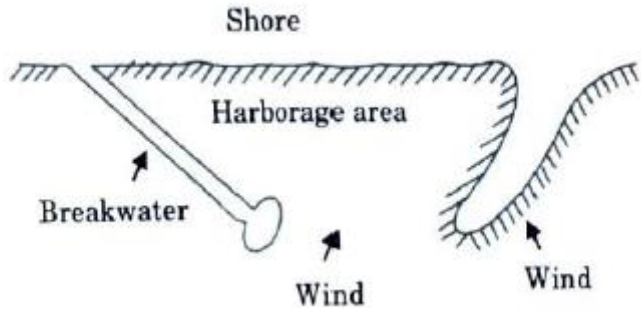



**Fig. 5.1.2.** Semi-natural harbour.

iii. **Artificial Harbours or Artificial Roadsteads: Where such natural**

facilities are not available, countries having a sea board had to create or construct such shelters making use of engineering skill and methods, and such harbours are called artificial or man-made harbours.

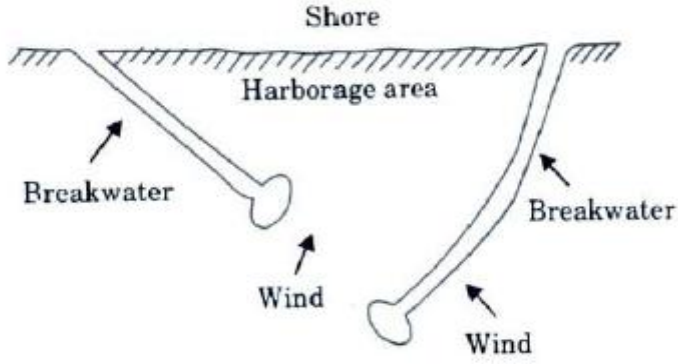



**Fig. 5.1.3.** Artificial harbour.

2. **Classification of Harbour Depending upon the Utility** : From their utility, harbours are further classification into five major types:

   i. **Harbour of Refuge: A** harbour of refuge should fulfill the following requirement:

      a. It should be readily accessible from the high seas.

      b. It should provide protection and shelter against the sea.

      c. It should provide facilities for repair and supplies.

   ii. **Commercial Harbour** : A commercial harbour should provide the following requirements:

      a. Adequate quay space for berthing, receiving and delivering cargo. This area should be protected.

      b. Suitable transit sheds and warehouses.

      c. Adequate accommodation for the mercantile maria .

   iii. **Fishery Harbour** ; A fishery harbour hould provide the following facilities:

      a. Quick loading, unloading and dispatch facilities for the perishable fish catch.

      b. Refrigerated storage for preservation of the catc

      c. Round the clock availability of the harbour for arriving and departing ships.

   iv. **Military Harbours:** A military harbour should provide the following facilities :

      a. These harbours are the naval bases which are meant to accommodate the naval vessels.

      b. They serve as supply depots also. Bombay and Cochin harbours have naval bases.

   v. **Marina Harbours** : Marina is harbour providing facilities of fuel, food, showers, washing machines, telephone, etc. for small boat owners, having temporary or permanent berths.

3. **Classification of Harbour based upon the Location** : Harbours are further classified into the following four major types :

   i. **Canal Harbour** : The harbour located along the canals for sea navigations and inland, is known as canal harbour. It is found that the

maintenance dredging of canal harbour basins is generally negligible.

ii. **Lake Harbour** : The harbour constructed along the shore of lake is known as lake harbour. If the lake is large, then the conditions are similar to those in ocean except that tidal action does not occur.

iii. **River or Estuary Harbour** : The harbour constructed along the banks or river is known as river or estuary harbour. Rivers and estuaries create the main transportation route to join the hinterland and the sea.

iv. **Sea or Ocean Harbour:** The harbour located on the coast of a sea or an ocean is called the sea harbour. They are intended for sea-going vessels.

**Que 2. What is a port ? What are the requirements of a good port?**

**Answer**

**Port:**

1. A port is an area where marine terminal facilities are provided.
2. The terminal is served by rail-road, highway, or inland waterway connections.
3. It is a development which contains both a harbour and the facilities for handling of cargo and the servicing of ships.
4. The ports can be either natural or artificial.
5. They can also be either river ports or seaports.
6. A river port is an upstream development for handling the freight of river boats and barges.

Railways, Airport & Water Ways

**Requirements of a Good Port** :

1. It should have easy connections with rail and highway so that commodities may be transported to and from the port easily and quickly.
2. It should be situated at a place where a hinterland is fertile with a good density of population. The passage to open sea must have sufficient depth and width and must be suitably marked to aid navigation.
3. Ships reaching harbour must be able to anchor while waiting for a berth to discharge or take on cargo, fuel and supplies.
4. The port must possess adequate facilities for handling and storing the r.ommodities passing through the port.
5. The port must have facilities for servicing the ships.

**Que 3. What are the factors to be considered for the selection of harbours on a sandy coast and lower reach of a river?**

**Answer**

1. **Factors for Harbour on a Sandy Coast** : Following are the factors for selection of harbours on sandy coast:

i. Variations of the water level, due to the astronomical tide and the meteorological conditions.

ii. Waves, approaching the coast from various directions.

iii. Seiches.

iv. Moderate tidal currents.

v. Movement of sand along the coast.

2. **Factors for Harbour on the Lower Reach of River:** Following are the factors for selection of harbours on the lower reach of river :

i. Variations of the water level, due to the astronomical tide and the meteorological condition.

ii. Moderate to strong tidal currents.

iii. Secondary current, due to the differences in density of the salt water from the sea and the fresh water from the river.

iv. Restricted width of the fairway.

v. Considerable movement of silt and fine sand up and down-stream.

vi. Shallow bar seaward of the river mouth.

**Que 4. Draw a layout of any one harbour in India, explain its salient features and list available terminal facilities.**

**Answer**

**Salient Features of Mundra Harbour** : FolJowi.ng are the salient features of mundra harbour :

1. Mundra Harbour is located in the north of Gulf of Kutch, Gujarat.
2. Draft ranges from 15 to 32 meters.
3. It has 8 multipurpose berths.
4. It is capable ofhandling super post panamax and capesize.
5. It exports clinker, salt, automobile, container etc.
6. Imports are coal, iron ore, mineral, containers fertilizer, etc.
7. Muodra Harbour is an all weather, independent and commercial port.
8. The pilotage within Mundra Harbour limits is compulsory.

**Fig.** 5.4.1. Layout of Mundra Harbour.

9. The tidal range is between + 0.37 m and + 6.40 m, tidal streams flow 0700- 2500 at an average rate of 3 kts and 4-5 kt during pring tides.
10. Deepest Inner harbour on the west coast **with** 15.40 m depth at the entrance channel.
11. First among the major harbour of India accredited with International Ship & Harbour Security USPS)code certification.
12. Largest LPG handling harbour in India.
13. 3rd Largest POL handling harbour in India.
14. Easily accessible to various National Highways, South Western, Konkan & Southern Railway and also Air Port.

**Terminal Facilities:** Following are the terminal facilities of Mundra harbour:

1. 24/7 Operations.
2. All-weather, deep water (Channel Depth 14 meters).
3. Year-round night navigation.
4. Shortest berth waiting time in the country.
5. Vessel tum-around time of one day.
6. Spacious and Secure warehouses liquid tanks and storage yards.
7. Efficient cargo evacuation with rail/road linkage.
8. EDI-connected customs office at harbour for speedy clearance.
9. Fully-mechanized alumina handling ystem.
10. Fully-mechanized coal handling facility.
11. Fully mechanized new yard for handling of granite blocks.
12. Hazardous liquid handling system, including liquid ammonia.
13. Exclusive, state-of-the-art off-shore supply terminal for oil and gas.
14. Modern ship rig repair facility with floating dry dock for vessels up to panama.x size.

**Modern Container Terminal Facility** : State-of-the-art automatic handling system for fertilizer imports.

**Que 5. Describe any eight factors of site investigation of harbours and the significance of each one of them.**

**Answer**

FolJowing are the factors of site inve tigation of harbours:

1. **Site Access and Obstructions:** Access to the dredging or dispo al sites and along transport routes between the sites may be constrained by, in addition to limited water depths:

i. The presence of bridges with limited headroom.
ii. Locks.
iii. Width restrictions.
iv. Timing constraints.

2. **National and Local Laws:** L-Ocal and nationa] laws may also influence the manner in which the work must be undertaken. These may relate to:

i. The disposal of dredged materials.
ii. Use of the local labour force.
iii. Importation or foreign labour or foreign-registered plant.
iv. Working times.
v. Use of explosives.

3. **Harbour Regulations** :

i. Local harbour regulations may affect the works and their cost.
ii. The potential effects of matters such as pilotage and harbour dues on the efficiency and the cost of the works should be established.
iii. Communications with harbour and marine authorities and any reporting

requirements should also be established.

4. **Navigation Marks:**

   i. Dredging operations may involve the temporary or permanent relocation of buoys and other navigation aids.

   ii. This should be planned well in advance, in cooperation with the relevant authorities, in order to ensW'e the least disruption to operations and to reduce the risk of accidents.

5. **Timing Constraints:** It is also important to identify any constraints to onshore access to working areas such as reclamation sites. In remote areas, it is useful to provide information condemning ttie existing infrastructlU'e, e.g., roads and railways.

6. **Local Support Services** : Information about local support facilities which could be used by dredging contractors is useful at the tender stage, especially in developing or undeveloped countries.

   The principal items of interest to contractors are :

   **i.** The availability of floating equipment as tube, floating cranes.

   **ii.** Availability ofland machinery such as excavators, bulldozers, trucks.

   **iii.** Fuel and electricity supplies.

   **iv.** Mechanical and electrical workshops. v, Shipyards and/or dry-docks.

7. **Safety:**

   **i.** All maritime operations involve a degree of risk and it is important that local regulations concerning safety procedures are established.

   **ii.** Rescue services (e.g., air-sea rescue, lifeboats etc.) and lines of communication with those services should be identified.

   **iii.** Areas where vessels can **seek** shelter du.ring storms should also be identified. In some countries, there are special.

8. **The Effect of Marine Traffic**: The investigation for harbour site is also depend upon the marine traffic conditions.

**Que 6. What is the role of the following processes in harbour layout and suggest remedies**

**A. Wind wave.**

**B. Tidal current.**

**Answer**

**A. Effect of Wave in Harbour Layout Design** :

1. Waves play important role in deciding port location and the design of a harbour layout.
2. Waves are generated in the offshore regions by the interfacial shear exerted by the wind blowing over the ea surface.
3. The nearshore currents are mainly governed by action of waves.
4. The effect of waves causes edimentation inside the harbour.

**Remedy** : By extending the main breakwater the sedimentation inside the harbour can be controlled.

**B. Effect of Tidal Currents in Harbour Layout Design** :

1. Tidal currents are generated due to rise and fall of water level caused by tides.
2. Tidal currents play important role in deciding port location and the design of a harbour layout.

3. The effect of tidal currents causes sedimentation inside the harbour.
**Remedy** : By deepening the navigation channel and swing basin the tidal currents can be controlled.

**Que 7. What are a harbour and a port? Briefiy explain harbour site investigation and site analysis.**

**Answer**

**A Harbour:** Refer Q. 5.1, Page 5-2E, Unit-5.

**B. Port:** Refer Q. 5.2, Page 5-4E, Unit-5.

**C. Harbour Site Investigation** : The site investigation will generally consist of the following items of work :

1. A hydrographic survey of the harbour and channel area.
2. A topographic survey of the marine terminal area on shore.
3. Soil investigation by making boring and/or probing on water.
4. Tide and current observations.
5. Obtaining information on wind, waves and earthquakes if in an area of seismographic disturbance.
6. Cost of materials and labour.
7. Available housing.
8. Local ordinances and building codes.

**D. Site Analysis of Harbour** :

1. Site analysis, the process of understanding existing site qualities, considers factors that determine a site's character, the purposes each factorserves, the location of each factor, the category into which each factor will fit in the design process.
2. Factors which determine a site's character include:

i. **Natural Factors** : Water, Physiography, Orientation, Vegetation, View, Climate, etc.

ii. **Man-made Factors** :Location, Cultural attraction, Utilities, Services, Buildings, Roads, etc.

3. Site analysis involves following four inter-related steps in which all readily available information are recorded:

i. **Site Visits** : Careful field trips over the site and through the abutting neighbourhood.

ii. **Resource Research** : Analysing existing data sources: aerial photographs, topo maps, soil surveys utility maps, well logs, etc.

iii. **Questioning and Interviewing** : Knowledgeable people, *i.e.*, residents living nearby, local historians, city officials,experts, delivery men, etc.

**iv. Interrelating Data** : Testing and comparing the information from one source with another.

4. The exact bo!llldary of the site should be determined and information divided into two groups:

1. On-site.
11. Off-site.

**Que 8. What is shipping lane** ? **Write the advantages and disadvantages of shipping lane.**

**Answer**

**A Shipping Lane:**

1. A sea lane, sea road or shipping lane is a regularly used route for vessels in oceans and large lakes.
2. 1n the age of sail they were not only dt:termined by the distribution of land masses but also the prevailing winds, whose discovery was crucial for the success of long voyages.
3. Sea lanes are very important for trade by sea.

**B. Advantages** : FolJowing are the advantages of shipping lane :

1. Although most ships no longer use sails (having switched them for engines), the wind still creates waves, and this can cause heeling.
2. The overall direction of the trade winds and westerlies is still very useful. However, any vessel that is not engaged in trading or is smaller than a certain length is best to avoid the lanes.
3. This is not only because the slight chance of a collision with a large ship can easily cause a smaller ship to sink, but also because large vessels are much less maneuverable than smaller ships, and need much more depth.
4. Smaller ships can thus easily take courses that are nearer to the shore. Unlike with road traffic, there is no exact road a ship must follow, so this can easily be done.
5. Shipping lanes are the busiest parts of the sea, thus being a usef u.1 place for stranded boaters whose boats are sinking or people on a life raft.

B. **Disadvantages:** Following are the disadvantages of shipping lane :

1. Small boats also do best to avoid the lanes, in risk of conflicts with bigger ships.
2. As the shipping lanes are very large, sections of the lane exist which can be shallow or have some kind of obstruction (e.g. sand bank). This threat is greatest when passing some narrows, such as between islands in the Indian Ocean (e.g. in Indonesia) as well as between islands in the Pacific {e.g. near the Marquesas Islands, Tahiti).
3. Some shipping lanes, such as the Straits of Malacca of Indonesia and Malaysia, and the waters of Somalia, are frequented by pirates operating independently or as privateers (for companies and countries). Passing ships run the risk of being attacked and held for ransom.

**Que 9. What is anchoring ? Explain the points should be considered in anchoring.**

**Answer**

**A Anchoring**:

1. Anchoring is not only a normal part of boating, it is also an important safety measure in an emergency.

2. Anchoring may keep the vessel safely positioned head on to heavy conditions and it can also allow you to retain your position and not be swept away or on shore.

**B. Considerable Points**: Five things to remember in anchoring are *:*

1. Choose your anchor, chain and/or line carefully to suit your vessel requirements, the depth of water, and the bottom type you are likely to operate in.
2. Always lower the anchor rather than hurling the anchor and chain overboard, this may lead to tangling.
3. As a rule of thumb, the line paid out should be at least three times the depth of water. This distance should be increased to five to one in rougher seas.

4. Regularly check the anchor is not dragging by inspecting the rope tension and monitoring your position.
5. Never drop anchor from the stern or midship, you may risk swamping the vessel.

**Que 10. Write a short note on location of harbour.**

**Answer**

**Location of Harbour** :

1. The main function of a harbor is to provide a sheltered area where vessels can moor.
2. An easy accessibility of a harbor implies a wide and straight approach the direction of which coincides with the direction of the currents and of the highest waves.
3. Wide entrance is desirable for maneuvering.
4. Optional layout of harbor navigation does not exist in reality.
5. It is because of the fact that a harbor on an open coast with a wide entrance, facing the highest waves, cannot entirely be a sheltered area.
6. A strong wave action in harbor not only hinders mooring and cargo handling but it also enhances the design criteria for harbor structure.
7. The other factors affecting the harbor site area are

i. Cost of construction and maintenance for marine structures.

ii. The required initial dredging.

iii. The recurrent dredging for the maintenance of design depths.

**Que 11. Write a short note on littoral transport with erosion** and deposition of sediments.

**Answer**

**Littoral Transport with Erosion and Deposition** :

1. Longshore drift is a geographical process that consists of the transportation of sediments (clay, silt, sand and shingle) along a coast at an angle to the shoreline, which is dependent on prevailing wind direction, swash and backwash.
2. This process occurs in the littoral zone, and in or close to the surf zone. The process is also known as littoral drift, longshore current or longshore transport.
3. Longshore drift is influenced by numerous aspects of the coastal system, with processes that occur within the surf zone largely influencing the deposition and erosion of sediments.
4. Longshore currents can generate oblique breaking waves result in longshore transports.
5. Longshore drift can generally be defined in terms of the systems within the surf zone.
6. Longshore drift affects numerous sediment sizes as it works depending on the sediment (e.g. the difference in long shore drift of sediments from sandy beach to that of sediments from s shingle beach).
7. Sand is largely affected by the oscillatory force of breaking waves, the motion of sediment due to the impact of breaking waves and bed shear from long shore current.
8. Because shingle beaches are much steeper that sandy ones, plunging breakers are more likely to form, causing the majority oflong shore transport to occur in the swash zone, due to a lack of an extended surf zone.

**Que 12. What is sounding? Explain the methods for taking**

**sounding on a ship in brief.**

**Answer**

**A Sounding:** It is the process for calculating the total quantity of fluid (oil, sludge, or water) inside a ship's tank. First the depth of the fluid from the surface to the bottom of the tank is derived corresponding to which volumetric quantity is calculated using the sounding table.

**B. Methods for taking Sounding on a Ship** :

**1. Manual Sounding** :

i. In this method, a sounding tape is used with a heavy weight bob attached to one end of the tap using hook. It is the most commonly used methods for calculation of tank capacity.

ii. Uthe capacity inside a tank is more, free space of the tank is measured to calculate total capacity of the tank. *This* method is called ullage measurement.

**2. Electronic Sounding** :

i. In electronic sounding, a sensor is used which senses the pressure inside the sounding pipe or by sensing the tank pressure and sends a signal to the receiver.

ii. Here the signal is translated to the tanks content value with the help of a PLC circuit.

iii. The value is displayed using electrical operated servo gauge or electrical capacitance gauge.

**3. Mechanical Sounding** :

i. Mechanical provisions are made inside the tank so that the quantity of tank can directly be read through a level marker or an indicator or a float level sensor.

ii. In the tank a float can be attached to a pointer through a pulley.

iii. *As* the level varies pointer reading will change accordingly.

iv. A level gauge glass is also attached to the tank to read the quantity of the fluid inside the tank. The gauge may also be a pneumatic/hydraulic operated gauge or differential pressure gauge.

**Que 13. What is dock? Also give the classification of docks. Answer**

**A Docks:**

1. Docks are enclosed areas for berthing the ships to keeps them afloat at a uniform level to facilitate loading and unloading cargo.
2. A dock is a marine structure for berthing of vessels for loading and unloading cargo and passengers.
3. Docks are necessary for discharging of the cargo. A ship requires number of days for discharging cargo, during which period they need a uniform water level.
4. If ship is subjected to a vertical movement by the tides, great inconvenience will be felt in lifting the cargo from the ship and special arrangement will be needed for lifting the cargo.

**B. Classification of Docks** : Following are the two types of docks :

1. **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 harbour docks.
2. **Dry Docks** : The docks used for repairs of ship are known as dry docks.

**Que 14. What is dry dock *1* Explain the construction and uses of dry dock.**

**Answer**

**Dry Docks:**

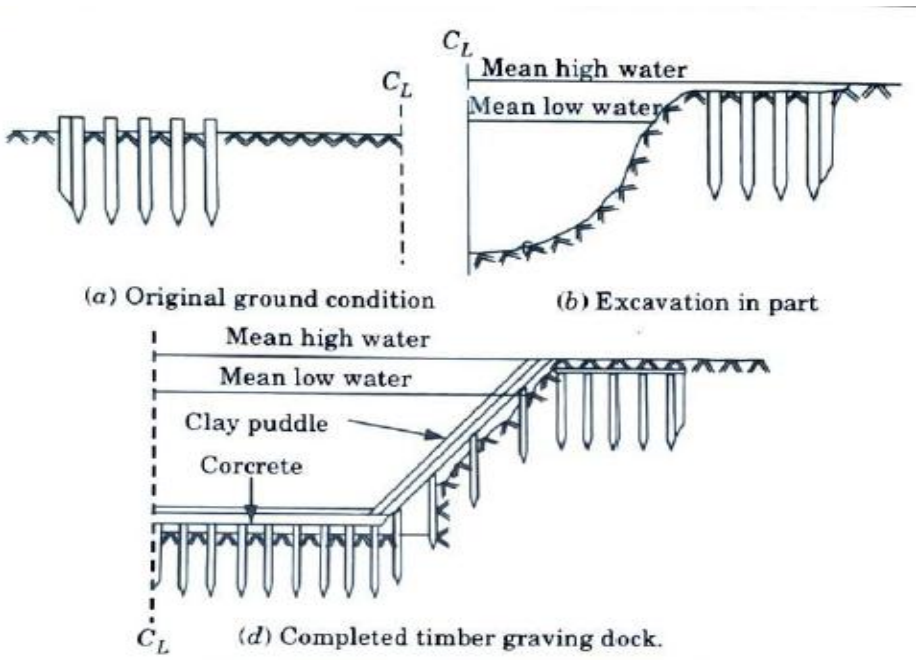
1. They are compartments into wltich asltip can he floated and supported on blocks for repair work after the dock has been drained.
2. The size of the dock shouJdhe commensurate with the size of the ship. Larger dock size requires additional water to he pumped out and the longer shoring to brace the sltip against the dock walls.
3. The main components of a dry dock are : the floor, the walls and the entrance.
4. *As* soon as the ship is ta.ken afloat, the caisson or gate is then shut, the water is pumped out and the sltip is left dry, being supported on the docking block with or without raking shores strutting on to her from the dock walls.
5. The dock design must meet the user requirements in respect of depths, lengths and breadths, crane facilities, general services, water, compressed air, steam, oil fuel and electricity.
6. In some docks advantage is ta.ken of the fall of tide to reduce pumping or eliminate it completely.

**Uses:**

1. The dry docks are generally used only for carrying out minor repairs, inspections and painting.
2. It can also be needed for heavy repairs or complete refitting.

**Construction of Dry Dock** :

1. For construction of graving docks located on the foreshore of harbour the site is unwatered.
2. The various methods of construction depending upon site condition have been employed.
3. For the construction of timber graving dock theentire site is surrounded by a wall of sheet piling.
4. Prior to excavation a portion of the round piling is driven.
5. The different stages of construction are shown in Fig. 5.13.1.
6. The dry dock constructions on ledge rock covered with a blanket of soil under water.
7. Sometimes ¡t is difficult to unwater th area for construction in dry condition. Under these conditions, it is desirable to place concrete under water by use of bottom dump buckets or tremies.




**Fig, 5.14.1.** Stages in timber graving dock.

8. In order to protect the cement from being washed away the concrete is

confined within form and depositing it within the form in one continuous operation.

9. ln tremies the concreting operation is started by inserting a plug inside the tremie pipe resting on the bottom. It rises slowly as the concrete flows out.
10. Precautions should be taken to exclude the outside water from entering or breaking through the flowing concrete.
11. Generally the tremie pipes are spaced at about 6 m apart. This allows a 3 m radius for the flow of the concrete.

**Que 15. Explain the term which are related to the tidal phenomenon.**

**Answer**

Following are the various terms which are related to tidal phenomenon :

1. **Lunar Day** : It is the time taken by moon to make a complete revolution around the earth. It is about 24 hrs 50 min *i.e.*, 50 minutes longer then solar day.
2. **Semi-diurnal Tides** : These are the tides which occur twice each lunar day.
3. **Diurnal Tides:** These are the high tides which occur only one time a day. These tides occur in places like Pensacola.
4. **Mixed Diurnal Tides:** If one of the two tides a day does not reach the height of the previous tides. Such tides are called as mixed diurnal tides. These tides occur at San Francisco.
5. **Tidal Bores** : These are high crested waves caused by the rush of flood tide up a river.They have a regular occurrence at certain locations as in the Bay of Fundy.
6. **Spring Tides or Moon Tide or Tides at Full Moon** : These are highest tides which occur at intervals of half a lunar month. TI-,c)"" occur when the generating forces of the moon and sun are additives. This happens when sun, moon and earth fall in line.
7. **Neap Tides** : This is the lowest tide of the month. It occurs when the lines connecting the earth with the sun and the moon form right angle. This happens when the moon is in its quarters. In this case the actions of the moon and sun are subtractive.
8. **Age of Tide:** Tidal waves are retarded by frictional forces as the earth revolves daily around its axis. The tides tend to follow the direction of the moon. This interval of time can be as high as 2½days and is known as age of tide.
9. **High Water:** High water is maximum height reach by each rising tide.
10. **Low Water:** Low water is the maximum depression of the falling tide.
11. **Mean High Water:** This is the average of the high water over a 19 year period.
12. **Mean Low Water:**This is the avera ge of the low water in a 19 year period.
13. **Tidal Range:** This is the difference in height between high water and low water at a tidal station. This can be graphically shown in 5.15.1.
14. **Mean Range:**This is the average of the differences between all high water and all low waters.
15. **Spring Range** : This is the difference between mean high water and mean low water of spring tides.
16. **Neap Range** : This is the difference between mean high water and mean low water of spring tides.

17. **Higher High Water:** This is the higher of the two high waters of any two diurnal tidal days.
18. **Mean Higher High Water:** This is the average height of the higher high water over a 19 year period.

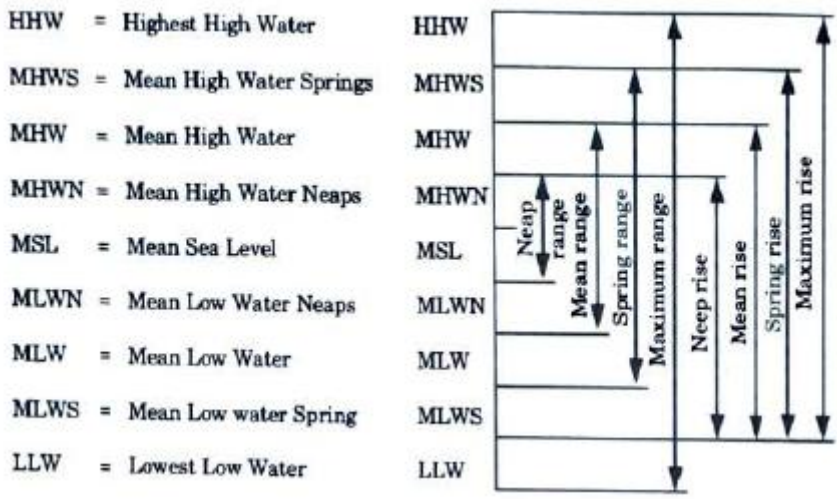



Fig. 5.15.1.

19. **Lower Low Water** : This is the lower of the two low waters of any diurnal tidal days.
20. **Mean Lower Low Water:** This is the average height of the lower low waters over a 19 year period.
21. **Highest High Water:** This is the highest spring tide on record.
22. **Lowest Low Water:** This is the lowest spring tide on record.
23. **Mean Range** : This is the height of mean high water above mean low water.
24. **Mean Sea Level** : This is mean of the height between mean high water and mean low water. This is the standard datum to which elevations on land are referred.
25. **Diurnal Range** : This is the difference in height between the mean higher high water and mean lower low water.
26. **High Water Interval:** This is the average time interval from a lunar transit to the next succeeding high water at a given place. This is expressed in solar hours and minutes.
27. **Low Water Interval:** This is the average time from a lunar transit to the next succeeding low water.

**Que 16 Discuss briefly inland water transport.**

**Answer**

**Inland Water Transport:**

1. The development of a nation can be judged from the extent of advancement in the field of transportation.
2. Amongst the various modes of transportation the inland water transport, one of the oldest modes of transportation, occupies a unique position.
3. In the past, riverways played a very important communication link all over the world. It is for this reason that almost all the world capitals and trade centres were generally located on water points.
4. In India also river transport was developed much ahead of other modes of transportation.

5. Rivers and lakes follow a natural course and do not required major human efforts to stabilize the banks and beds and to keep the channel free of soil build up and natural hazards.
6. Channelized rivers required major work to make them navigable. The type of improvements needed include construction oflocks and dams to increase water depth and channel width.
7. Artificial channels are manmade waterways and should be such that are most easily and economically constructed and maintained.

**Que 17. What are the advantages and disadvantages of inland waterways?**

**Answer**

**A Advantages:** Following are the advantages of inland waterways:

1. Easiest and cheapest mode of communication by utilization of natural surfaces of canals, rivers and oceans, as the element of friction during traction and maintenance are less than road transport.
2. Require cheap manual, wind the steam motive power.
3. Higher load carrying capacity for bulky and heavy commodities.
4. Development of commerce and expansion of trades.
5. Development of natural resources and their effective use.
6. Development of economic progress and international contact.
7. Provides enhanced mobility and promotes social and political unity.

**B. Disadvantages**: Following are the disadvantages of inland waterways:

1. It requires more time due to slow speed and circuitous routers. Final docking stages require greater skill.
2. Mountainous rivers, shoals, rapids and waterfalls hinder water transportation require better position fixing and obstruction detecting systems to avoid surface collision.
3. Frequent storms and hurricanes result in great loss of life and material.
4. Vessels oil spillage, noise, smoke and fumes cause pollution and endanger marine lives.

**Que 18. Explain the waterways in India. Also discuss the development of inland waterways in India.**

**Answer**

**1.** Five waterways in India have been declared as National Waterways (NWs) so far. These include:

**i.** Ganga-Bhagirathi-Hooghly river system (Allahabad-Haldia-1620 km) as NW-1.

**ii.** River Brahmaputra (Dbubri-Sadiya-891 km) as NW-2.

**iii.** West Coast Canal (Kottapuram-Kollam)along with Udyogmandal and Champakara Canals - (205 km) as NW-3.

**iv.** Kakinada-Puducherry canals along with Godavari and Krishna rivers (1078 km) as NW-4.

**v.** East Coast Canal integrated with Brahmani river and Mahanadi delta rivers (588 km) as NW-5.

**2.** NW-1, 2, and 3 are operational in certain stretches and vessels are moving on them. They have developed fairway of targeted depth and width, terminals with cargo handJing facilities and navigational aids.

**3.** NW-4 and 5 are yet to be made operational. Various studies for development of these waterways are under way. Dredging of fairway and con truction of temporary terminal has started recently in **NW-5.**

**4.** The draft National Perspective Plan (NPP), prepared under the

Sagarmala Programme, proposes priority development of National Waterways- I 2, 4 and 5 to enhance port connectivity to the hinterland and to enable faster and cheaper movement of key cargo types such as coal, iron ore, food grains etc.

5. To develop inland water transport in the country, The National Waterways Bill, 2015, for declaration of 106 addition.<l waterways as National Waterways has been passed by the Lok Sabha during winter session, 2015.
6. The process for preparation of Techno-Economic Feasibility Studies/ Detailed Project Reports for identified new waterways has been initiated.
7. The extend and scope for developing these waterways will be known after completion of above studies.

**Que 19. What is dredging? Classify different types of dredging work. Also give the classification of dredgers.**

**Answer**

**A. Dredging:**

1. Dredging is the technique and operation of removing material from the sea bed, a river bed, or a lake and disposal in stream or onto the shore.
2. This is generally carried out for the purpose of depending bed under water.
3. In navigation canals and harbours, increased water depth provides sufficient draft for ships.

**B. Types of Dredgers:** Following are the types of dredgers :

1. Dredgers used for excavating under water may be classified as :

i. Clamshell dredger.

ii. Suction dredger.

iii. Bucket dredger.

iv. Grapple dredger.

v. Dipper dredger.

2. Dredgers can also be divided into following two broad categories :

i. Mechanical dredger.

ii. Hydraulic dredger.

**C. Classification** : Following are the classification of dredging works :

1. **Maintenance Dredging:** It is carried out to remove siltation which may occur more or less continuously or periodically in the port as well as in the four ways to the port.
2. **Improvement Dredging:** It is carried out to improve the existing depths to allow to access of larger ships.
3. **Sundry Dredging:** It is carried out to serve different purposes like realization of new works, the extraction of materials *for* reclamation and sanitation purposes.

**Que 20. Give the advantages and disadvantages of direct labour method and contract dredging system.**

**Answer**

**A Direct Labour Method** :

**1. Advantages:** Following are the advantages of direct labour method :

i. It is possible to prepare a coordinated plan on a large scale for all parts of the country.

ii. It is possible to optimize the use of the available plant. This method aJso helps in meeting urgent needs at any moment.

iii. This system avoids the possible disputes which normally arise when the completed dredging works are measured and checked.

iv. This sydem also avoids the general costs of contractors due to longer depreciation terms.

2. **Disadvantages** : Following are the disadvantages of direct labour method:

i. ltlacks flexibility.

ii. It needs important administrative direction.

iii. It is difficult to pay the personnel in accordance with the work. Hence working personnel exhibit lack of interest.

iv. It is experienced to frequent negligence of maintenance.

**B. Contract Dredging System** :

**1. Advantages** : Following are the advantages of contract dredging system:

i. It is more flexible than direct labour system.

ii. It utilizes the maximum productivity of personnel.

iii. This system results in possibility of obtaining the most suitable plant to carry out the dredging in a desired way.

iv. This system is found to be more economical because of competition.

v. In this system it is possible to have real knowledge of costs by the enterprises.

**2. Disadvantages:** Following are the disadvantages of contract dredging system:

i. It is difficult to measure and check the works carried out in the cases of continuous siltation or with certain execution methods.

ii. The system may result in monopoly or enterprises which may unduly influence the prices and conditions.

iii. Periods of idleness may result in important expenses.

iv. The contractor may neglect the execution of work in which he is not interested.

**Que 21. Give a brief account of any four coastal structures with neat sketches and state their location and functions.**

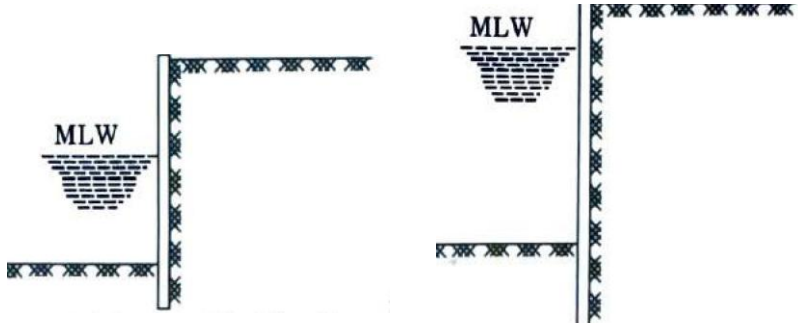
**Answer**

**Coastal Structures** : Following are the four coastal structures :

1. **Bulkheads** :

i. Bulkheads can be constructed by concrete, steel, or timber.

ii. There are two major types which are gravity structures and anchored sheet pile walls.




*(a)* Anchored bulkhead (b) Cantilevered bulkhead

**Fig. 5.21.1.**

iii. The bulkheads might not have exposed to substantially strong wave actions and its *main* purpose is to retain earth but scouring at the base of the structure should be considered by the designer.

iv. Cellular sheet pile bulkheads are employed for situations where rock is close to the surface and enough penetration cannot be achieved for the anchored bulkhead type.

v. Moreover sheet pile should be sufficiently reinforced for bending moment, soil conditions, hydrostatic pressures, and support points.

## 2. Groins:

i. Groins are shore protection structures that decrease erosion affect to the shoreline by changing offshore current and wave patterns.

ii. Groins can be built by materials such as concrete, stone, steel, or timber and are categorized depend on length, height and permeability.

iii. Further more groins are commonly constructed vertically to the shoreline and it can either impermeable or permeable.

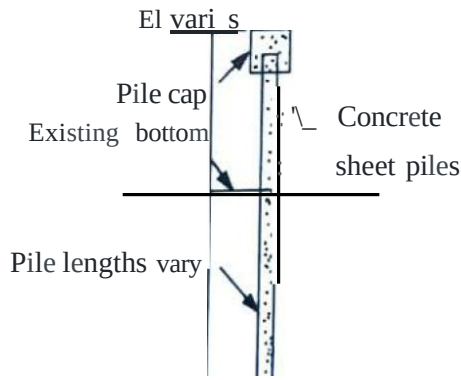
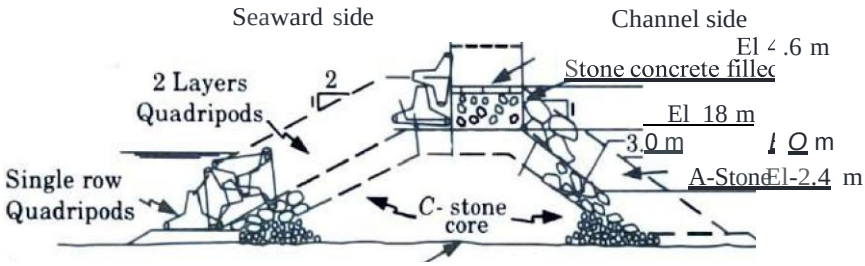



**Fig. 5.21.2.** Prestressed concrete sheet pile groin.

## 3. Jetties:

i. Jetties are usually built of materials such as concrete, steel, stone, timber, and occasionally asphalt used as binder.

ii. This structure is constructed at river estuary or harbour entrance and extended into deeper water to oppose forming of sandbars and limit currents.



A-Stone Avg 92-mt Min 61-mt
*B*- Stone 50 % > 2.8-rnt, Min 81-mt
*C*- Stone 18 mt-to 0 1 m 50 % > 224-kg

**Fig. 5.21.3.** Quadripod and rubble mound jetty details.

**4. Breakwaters** :

i. There are three major types of breakwaters namely : offshore, shore-connected, and rubble mound.

ii. Not only are they used to protect shore area, anchorage, harbour from wave actions but also to create secure environment for mooring, operating, and handling ships.

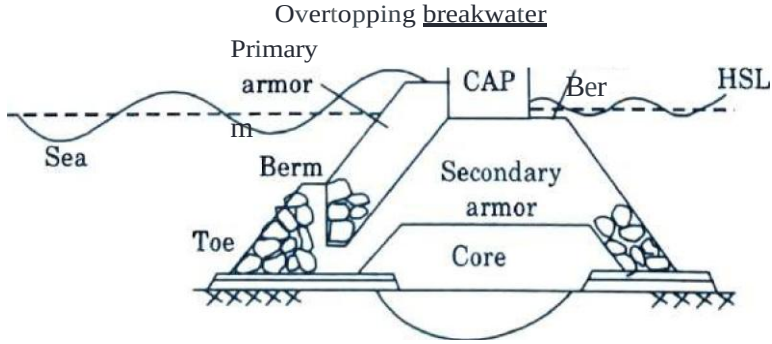



**Fig. 5.21.4.** Rubble mound breakwater.

**Que 22. Explain the following coastal protection works with neat sketches.**

**A Sea Walls.** **B. Riprap.**

**C. Groins.** **D. Dolphins.**

**Answer**

**A Sea Walls:**

1. These are the structures constructed parallel to shore line to develop a demarcating line between land area and water area.
2. Sea walls are used where land to be protected is a developed one and wave effects are severe.
3. These walls are very massive and expensive.

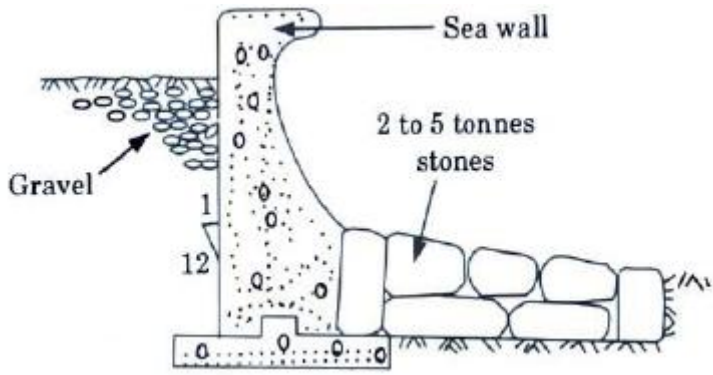



**Fig. 5.22.1.** Sea wall.

**B. Riprap:**

1. It is supported by an earth bank. It is constructed by unscreened crushed stones.
2. It is protects the land from wave erosion.
3. This can he achieved by isolating the coarse riprap from the natural earth bank by one or more courses of filter stone.
4. The filter stone blankets generally are kept 30 cm thick.
5. The stone in each layer must be graded to choke t,he openings between stones in the adjacent coarser layer.

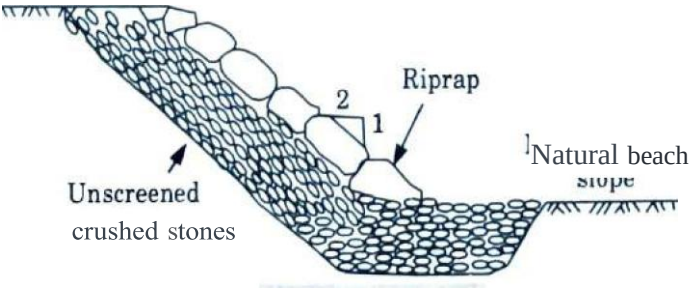



**Fig.** 5.22.2. Stone riprap.

C. Groins: Refer Q. 5.20, Page, Unit-5.

**B. Dolphins** :

1. The construction in the form of a cluster of closely spaced piles is known as dolphins. The piles are pulled together at the top and tied by a cable.
2. They are marine structures for mooring vessels.
3. Dolphins are used for tying up ships and also for transferring cargo from one ship to another when moored along both of their sides.
4. Dolphins are mainly designed for resisting horizontal impact force, wind force and water current forces from a vessel when docking.

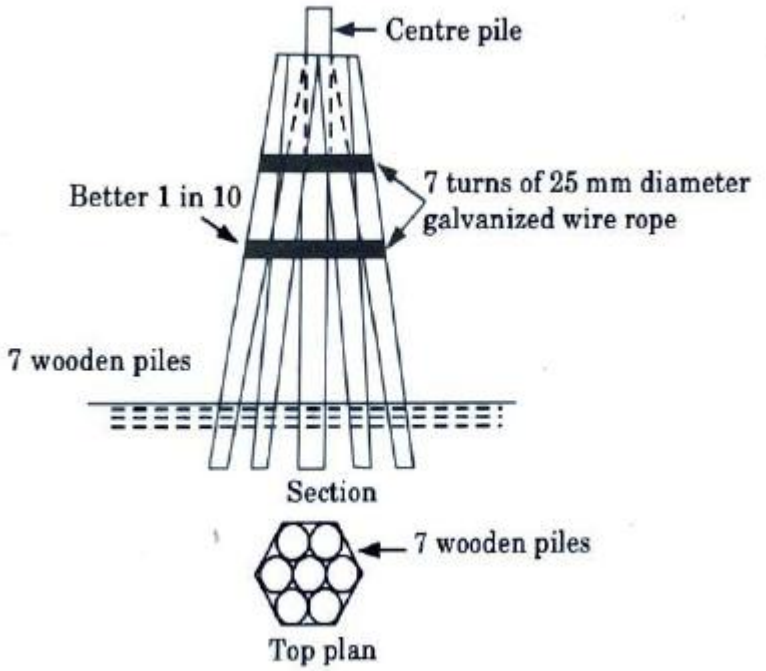



**Fig. 5.22.3.** Dolphin.