7. HARBOURS AND PORTS

CLASSIFICATION OF HARBOUR DEPENDING UPON THE PROTECTION NEEDED

Depending upon the protection needed, harbours are broadly classified as:

(i) Natural Harbours or Natural roadsteads
(ii) Semi-natural harbours
(iii) Artificial harbours or artificial roadsteads

CLASSIFICATION OF HARBOUR DEPENDING UPON THE UTILITY

From their utility, harbours are further classified into five major types

(i) Harbours of refuge
(ii) Commercial harbours
(iii) Fishery harbours
(iv) Military harbours
(v) Marine harbours.

CLASSIFICATION OF HARBOUR BASED UPON THE LOCATION

The layout of a harbour is greatly influenced by its location and based on the location, harbours are further classified into the following four major types:

(i) Canal harbour
(ii) Lake harbour
(iii) River or estuary harbour
(iv) Sea or ocean harbour

HARBOUR DEPTH

The channel depth is generally determined by the following formula:

$$D = D_1 + \frac{H}{3} + D_2$$

where, D_1 = draft of the largest ship to be accommodated
D_2 = allowance for squat of the moving ship
H = height of storm waves.

The max. harbour depth below lowest low water is achieved as follows:
Max. harbour depth = loaded draft + 1.2 m when bottom is soft
Max. harbour depth = loaded draft + 1.8 m when bottom is rock.
The depths of sea bottom are obtained by use of fathometer or echo sounder.

WAVE PARAMETERS

- **Height and length of waves:** Waves being generated by wind, their development depends upon the surface area of sea exposed to wind action. Such a surface giving rise to a wave is called a Fetch and is usually measured in km, denoting the length across which the wave action is generated and is active.
- **The height of the wave in metres** $= 0.34\sqrt{F}$ **, where F is the fetch in km.**
- This is an empirical formula given by Thomas.
- The length could be defined as the distance between adjacent crests of a wave. The length influences the force of the wave.
- **Bertin's formula,**

$$L = \frac{t^2}{2\pi}.g \text{ or } L = 1.56t^2$$

where, L = length in metres and t is the period in seconds for two successive waves to pass the same section.

DYNAMIC EFFECT OF WAVE ACTION

1. **In deep water:** When the depth of water is great compared to the length of wave, **Velocity** $v = \sqrt{2g\frac{l}{4\pi}} = 1.25\sqrt{l}$

   - Considering the wave as a cycloidal curve, the height h of the wave $= 1/\pi$, where l is the length of the wave.

   $v = \sqrt{5h}$ and pressure on unit surface

   $$p = 5\frac{wv}{g} = \frac{wh}{2} \text{ nearly.}$$

2. **In shallow water:** In shallow water, if depth of water is d, it has been found that the velocity $v = 3.16\sqrt{d}$ approximately.

   $$p = \frac{w}{g} \times 10 \times d \text{ or } wd \text{ approximately.}$$

   - **Height of wave:** $hp = h\left\{\sqrt{b/B} - 0.027\sqrt[4]{D}\left(1 + \sqrt{b/B}\right)\right\}$

where, h_p = height of wave at the point under consideration
h = height of wave at the entrance of the harbour.
b = width of entrance
B = width of basin at point under consideration
D = distance of point of consideration from entrance.