

COASTAL ENGINEERING

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1. COASTAL ENGINEERING

It is the application of civil engineering, to combine the science of the ocean and engineering, in the regions of continental shelf, nearshore, coastal stretch and estuarine for the welfare of mankind.

2. MAJOR TOPICS IN COASTAL ENGINEERING

Wind

- .wave generation
- .Storm surge
- .wind set-up
- .wind induced current

Waves

- .hydrodynamics of waves
 - governing equations
 - particle velocity
 - acceleration
 - particle displacement
 - wave induced current
 - wave induced pressure
 - wave force
- .wave propagation
 - deep water
 - intermediate water
 - shallow water
- .Wave transformation
 - shoaling
 - refraction
 - bottom friction
 - reflection
 - diffraction

Tides

- .celestial bodies
- .earth rotation
- .governing equations
- .variation of tides
- .tidal currents

Coastal Morphology

- .wave breaking
- .surf zone
- .radiation stress
- .currents in surf zone
 - longshore current
 - onshore-offshore current
- .wave runup
- .sediment transport
 - longshore transport
 - onshore-offshore transport
 - bed load & suspended load
- .influence of littoral barriers
 - erosion
 - deposition

Coastal structures

- .coastal protection
- .coastal development
 - port & harbours
 - marinas
 - reclamation
- .seawalls
- .groins
- .breakwaters
- .vertical walls
- .floating breakwaters

Numerical models

- .wave and wave transformation models
- .current circulation models
- .morphological models

3. DEFINITIONS

Coast

A stretch of land of indefinite width that extends from the shoreline inland to the first major changes in terrain features (Fig.1).

Wave equation

When a wave propagates as shown in fig. 2, the velocity potential is given by,

$$\phi = \frac{Hg}{2\sigma} \frac{\cosh(k+d)}{\cosh kd} \cos(kx - \sigma t)$$

Where, H= wave height, g=accn. due to gravity, σ = wave frequency = $2\pi/T$, k=

wave number = $2\pi/L$, T = wave period and L = wave length, d = depth of water.

The relationship for the wave celerity (C), to the wave length and water depth is given by,

$$C = \frac{gT}{2\pi} \tanh\left(\frac{2\pi d}{L}\right)$$

In deep water, $\left(\frac{d}{L} > \frac{1}{2}\right)$, $C = \frac{gT}{2\pi}$

In shallow water, $\left(\frac{d}{L} < \frac{1}{20}\right)$, $C = \sqrt{gd}$

Shoaling and Refraction

When the wave propagates from deep water to shallow water, it undergoes change in height and length due to wave shoaling and refraction.

$$\text{Wave shoaling coefficient, } K_s = \sqrt{\frac{1}{2} \frac{1}{n} \frac{C_0}{C}}$$

$$\text{where, } n = \frac{1}{2} \left(1 + \frac{2kh}{\sinh 2kh}\right)$$

C_0 = wave celerity in deep water

C = wave celerity at place of consideration

$$\text{Wave refraction coefficient, } K_r = \left(\frac{\cos \alpha_0}{\cos \alpha}\right)^{0.5}$$

where, α_0 = wave direction in deep water and α = wave direction at point of consideration.

The wave height at any point, $H = H_0 \cdot K_s \cdot K_r$

where, H_o = wave height in deep water.

Sediment transport

When the waves break close to the coast, they set up current parallel to the coast called longshore current. The breaking waves also lift up sediment which will then be transported parallel to the coast by the longshore current. This transportation of sediment parallel to the coast is called longshore sediment transport.

The volume of sediment transport can be estimated by,

$$Q = 1290 \frac{\rho_g^2}{64\pi} T (H_o.Kr)^2 \sin 2\alpha b$$

where, Q = volume of sediment transport in m^3 /year, αb = wave breaking angle.

4. REFERENCES

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3. Wiegel, R.L., 1964, Oceanographical Engineering, Prentice-Hall, New Jersey.
4. Ippen, A.T., ed., 1966, Estuarine and Coastline Hydrodynamics, McGraw-Hill, Ny.