Sec A

# Rafid Sir

[14-05-26]

- for River → Long shore sediment transport
  Cross shore sediment transport.

- River training structure → T, I আকৃতি

- Bolder.

[21-05-26]

## Lec-3 : Small Amplitude Wave Theory

- Source of waves:

  # Wind
  # Fog
  # Ship
  # Atmospheric process
  # Gravitation

Wave period $T$ is constant.

$$\omega = \frac{2\pi}{T}$$

$$k = \frac{2\pi}{L}$$

$$C = \frac{L}{T} = \frac{\omega}{k}$$

$$\varepsilon = \frac{H}{L}$$

Relative depth $= \frac{d}{L}$

Relative wave height $= \frac{H}{d}$

Swell: Propagating wave

Seiche: Standing wave.

Sea:

Swell:

Surf:

Deep water → particle moves almost circular.

Shallow water → particle moves elliptical.

Linear Wave Theory / Small amplitude wave theory

Assumption

[05-07-26]

Dispersion eq$^n$:

$$C = \frac{gT}{2\pi}\tanh\frac{2\pi d}{L}$$

$$L = \frac{gT^2}{2\pi}\tanh\frac{2\pi d}{L}$$

[Radian mode]

Wave classification:

# Deep water waves: $L_0 = \frac{gT^2}{2\pi}$; $C_0 = \frac{2\pi}{2\pi}$, $C_0 = \frac{L_0}{T}$; $C = \sqrt{\frac{gL_0}{2\pi}}$

# Shallow water waves: $C = \sqrt{gd}$, $L = \sqrt{gd}\,T$

# Intermediate / Transitional wave range: $\frac{C}{C_0} = \frac{L}{L_0} = \tanh\frac{2\pi d}{L}$ [Trial & E

[12-07-26]

## Pure Oscillatory waves & Finite amplitude waves:

* Eg 1:

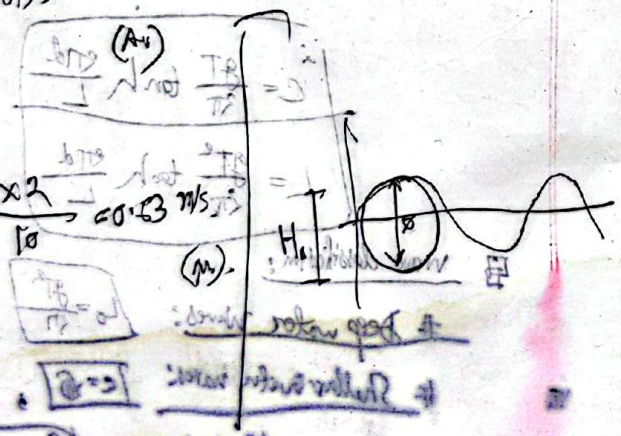
Length, $L_0 = \frac{gT^2}{2\pi} \Rightarrow \frac{9.81 \times 10^2}{2\pi} = 156.13$ m.

$\frac{d}{L_0} = \frac{100}{156.13} = 0.6$

Velocity, $C = \frac{L}{T} = \frac{gT}{2\pi} = 15.613$ m/s

Stiffness, $\frac{H_0}{L_0} = \frac{2}{156} = 0.013$.

Speed of crest, $u_c = \frac{\pi H_0}{T} = \frac{\pi \times 2}{10} = 0.63$ m/s




* Eg 2:

$\frac{C}{C_0} = \frac{L}{L_0} = \tanh \frac{2\pi d}{L}$

* Eg 3:

$\frac{C}{C_0} = \frac{L}{L_0} = \tanh \frac{2\pi d}{L}$

$L_0 = \frac{gT^2}{2\pi} = \frac{9.81 \times 10^2}{2\pi} = 156.13$ m.

$\frac{L}{156.13} = \tanh\left(\frac{2\pi \times 10}{L}\right) \Rightarrow L = 92.37$ m (Ans)

Lec-5

Memorization

* Velocity & Acceleration formulae will be given.
* Displacement formulae, Derivation, Figure. or will "not" be given.

[২৬-০৭-২৬]

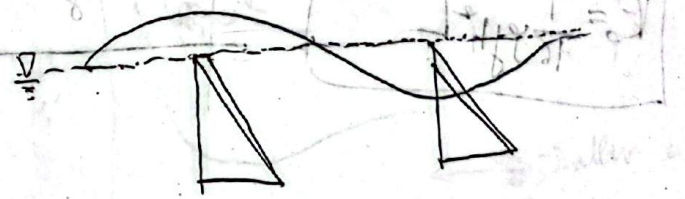
* Given: $T = 8$ Sec, $d = 15$ m, $H = 5.5$ m.

Find: The local hor & ver velocity u & w
Acceleration $\alpha_x$ & $\alpha_z$.
Displacement at an elevation $z = -5$ m below SWL when

$$\theta = \frac{2\pi x}{L} - \frac{2\pi t}{T} = \frac{\pi}{3} \text{ (or } 60^\circ\text{)}$$

## Wave pressure:

* Deep water vertical pressure distribution.



* $\eta = \frac{H}{2}$ [for linear wave, N=1]

$$k_z = \frac{\cosh\left(\frac{2\pi(z+d)}{L}\right)}{\cosh\left(\frac{2\pi d}{L}\right)}$$

$$\eta = \frac{N(\rho + \gamma z)}{\gamma k_z}$$

Lec 728 [09 of 25]

## Wave Energy:

$$\bar{E}_k = \frac{1}{16}\rho g H^2 L$$

$$\bar{E}_p = \frac{1}{16}\rho g H^2 L$$

Total wave energy in one wavelength per unit crest width,

$$\bar{E} = \frac{\rho g H^2 L}{8}$$

## Wave Power:

$$\bar{P} = \frac{n\bar{E}}{T}$$

$n = 0.5$ [Deep water]

$= 1$ [Shallow water]

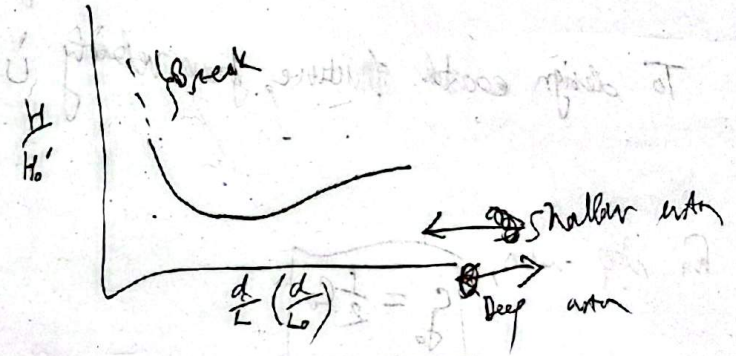
$$\frac{H_1}{H_2} = \sqrt{\frac{n_2 L_2}{n_1 L_1}}\sqrt{\frac{B_2}{B_1}}$$

$$\frac{H}{H_0} = \sqrt{\frac{L_0}{2nL}}\sqrt{\frac{B_0}{B}}$$ [$H_0 \rightarrow$ Deep water]

$$\frac{H}{H_0} = \frac{H}{H_0'}\sqrt{\frac{B_0}{B}}$$

Graph Explanation

## Dimensionless wave height versus Relative depth in 2D wave propagation transformation




## Specific energy/Energy density:

$$\bar{F} = \frac{\bar{E}}{L} = \frac{\rho g H^2}{8}$$

## Wave Energy flux:

$$\bar{P} = \bar{E} n C = \bar{E} C_g$$

16-08-26

Eg 6.1 (page 4)

$$n = \frac{1}{2}\left(1 + \frac{2kd}{\sinh(2kd)}\right)$$

[20-08-26]

$$k = \frac{2\pi}{L}$$

Group Velocity:

To design coastal structure, group velocity is required.

For deep water,

$$C_{g_{d_0}} = \frac{1}{2} C_0$$

For shallow water,

$$C_{g_s} = C = \sqrt{gd}$$

Normal Diagram

$$\text{हुई} = \text{अन्त} - \text{पूर्व}$$

Mid-78

*

$T = 10$ s

$d = 200$ m & 3 m.

$c_g = ?$

Lec-9 to: Wave Transformation [23-08-26]

## Wave Shoaling:

Derivation: Green's law: $H_0 L_0^{1/4} = \text{Constant}$

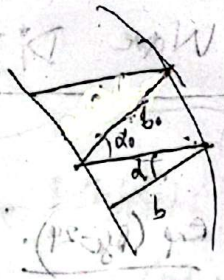
* $H_1 = 1\ m$
  $d_1 = 10\ m$
  $d_2 = 1\ m$
  $H_2 = ?$

Sol^n: $\frac{H_2}{H_1} = \left(\frac{d_1}{d_2}\right)^{\frac{1}{4}} \Rightarrow H_2 = 1.78\ m$ (Ans)

[23-08-26]

## Wave Refraction:

$$\frac{\sin\alpha}{\sin\alpha_0} = \frac{c}{c_0}$$ [Snell's law]




Refraction coeff, $K_r \equiv \frac{H}{H_0} = \sqrt{\frac{b_0}{b}} = \sqrt{\frac{\cos\alpha_0}{\cos\alpha}} < 1$ (always)

* Wave Refraction figures.

Imp

*Exp (Page-16):

$c_0 = 1.56\ T^2 = 25.6\ m/s$

$c = \sqrt{gd} = \sqrt{9.8 \times 3} = 4.75\ m/s$

[06-09-25]

## Wave Diffraction:



* Exp (Page-24).

[08-09-25]

## Bottom friction:

Short note

- Spilling
- Plunging
- Collapsing
- surging

} Wave Breaker Type

## Wave Breaking:

The stiffness ~~at which~~ wave breaks is called limiting stiffness.

will be given

* Surf similarity parameter range
* Breaker depth index.

[08-09-25]

Page-10

* Exp 1:



If wave shows "spilling breakers", then Breaking depth = 1.67 (Hb) (Breaking wave height)

(end graph is not needed)

* Exp 2:

* Exp 3:

[13-09-25]

## Radiation stress / Wave setup & Set-down :

Set down :

$$\eta_d = -\frac{H^2}{16d}$$

setup :

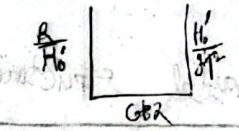
Page-35

* Exp :

## Wave swash / wave upsush :

wave set up + wave swash = wave run-up

## Wave Runup :




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* Exp :

## White capping :

## Wave overlapping :

## Wave reflection :

## wave diffraction, refraction, shoaling & reflection :

## Lec-16-17: Wave Forces on Coastal Structure [17-09-25]

### Forces on Coastal structures:

# Non-breaking waves forces
# Breaking waves forces
# Broken waves forces

### Non-breaking waves forces:

Page-11
* Pressure distribution for non-breaking waves — Fig.

Page-15
* Exp 1:

Critical condition: Crest on one side, Trough on another side.

Numerical
* Exp 2:

## Lec-17-18: Coastal Sediment Transport & Morphology

### Typical cross-shore beach profile

### Nearshore waves & current system - driving sediment transport.

def
### Estuary:

Fig
### Type based on "wave or tide dominance" & "Geomorphology":

Short note