

Example: Calculate unbalanced dynamic head at A and B.

Take $q = 24 \text{ m}^3/\text{sec}/\text{m}$

USWL= 26 m

DSWL= 24.5 m

USTEL= 26.95 m

DSTEL= 24.7 m

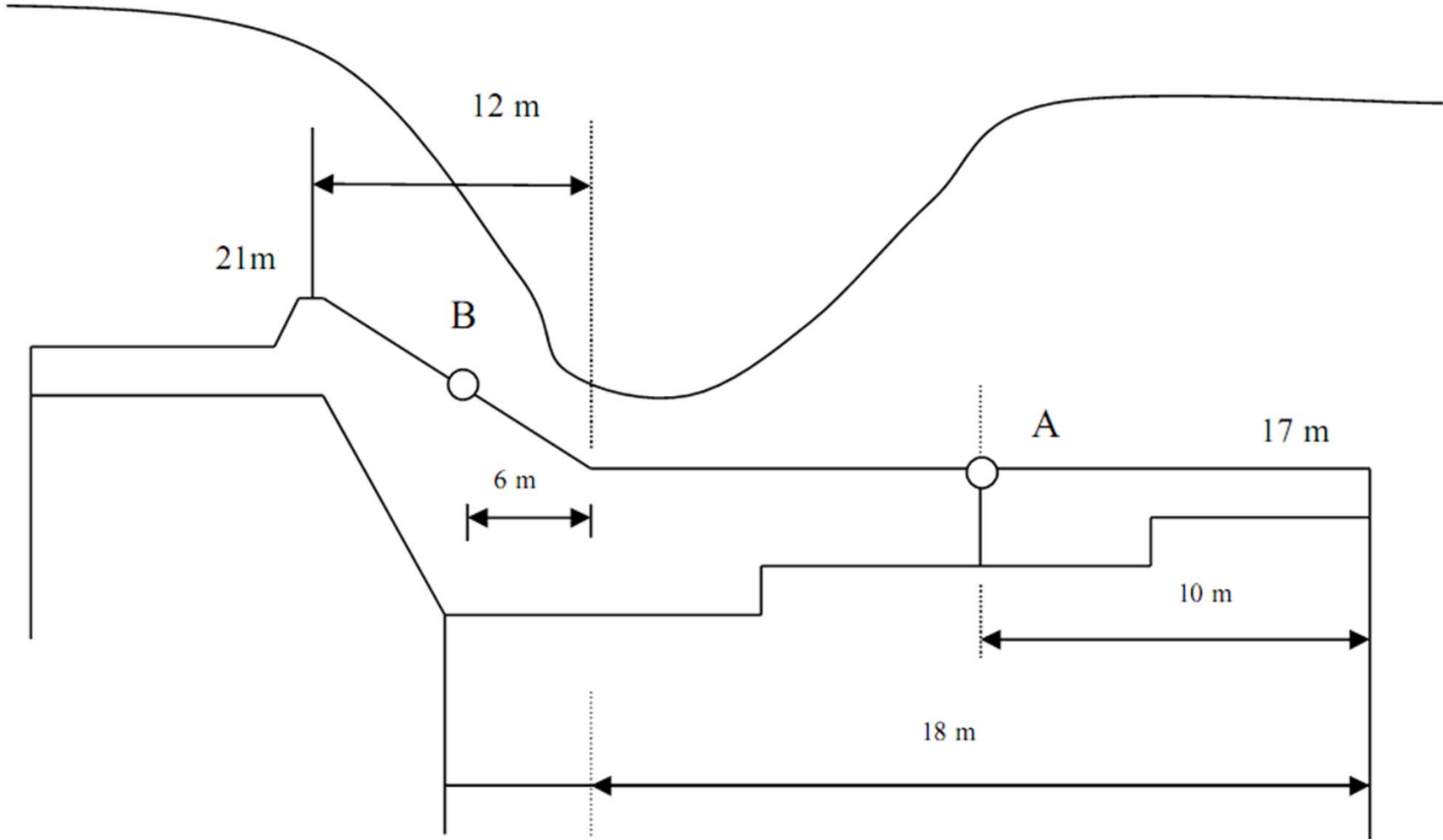
$\Phi_A = 0.388$

$\Phi_B = 0.484$

USTEL

HL= 2.25 m

DSTE



Solution:

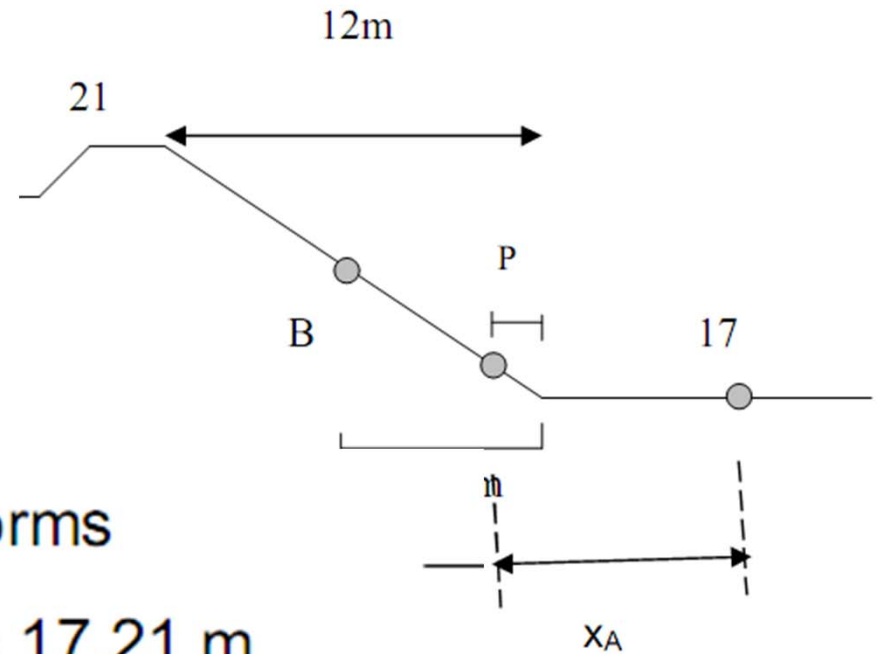
$$H_L = U_{STEL} - D_{STEL} \\ = 26.95 - 24.7 = 2.25 \text{ m}$$

From Blench curve or from tables

for $H_L = 2.25 \text{ m}$ and $q = 24 \text{ m}^3/\text{sec}/\text{m}$

then $E_{f2} = 7.49 \text{ m}$

$$E_{f1} = E_{f2} + H_L = 7.49 + 2.25 = 9.74 \text{ m}$$



Elevation of glaxis where jump forms

$$= D_{STEL} - E_{f_2} = 24.7 - 7.49 = 17.21 \text{ m}$$

Or $= U_{STEL} - E_{f_1} = 26.95 - 9.74 = 17.21 \text{ m}$

d/s floor level is $17.21 - 0.21 = 17 \text{ m}$

$$x/12 = (17.21 - 17) / (21 - 17)$$

$$x = 0.63 \text{ m}$$

Point A is at post jump side, water level at A = W_A

For $E_{f1} = 9.74$ m, $q = 24$ m³/sec/m, using energy curve $y_1 = 1.9$ (on supercritical side), this is first trial, check:

$$\begin{aligned} E_{f1} &= y_1 + \frac{q^2}{2gy_1^2} \\ &= 1.9 + \frac{(24)^2}{2g(1.9)^2} \\ &= 10.03 > 9.74 \end{aligned}$$

Take $y_1 = 1.92$

$E_{f1} = 9.88$ not O.K.

Take $y_1 = 1.94$

$E_{f1} = 9.74$ O.K.

Distance of A from point of jump (x)

$$x_A = (18-10) + 0.63 = 8.63 \text{ m}$$

$$x_A/y_1 = 8.63/1.94 = 4.448$$

$$(Fr_1)^2 = q^2/gy_1^3 = (24)^2/9.81(1.94)^3 = 8$$

Using special figure or from tables, $y_A/y_1 = 2.362$

$$y_A = 2.362 * 1.94 = 4.582 \text{ m}$$

Elevation of water at point A (W_A)

$$W_A = y_A + \text{elevation of glacis where jump forms.}$$
$$= 4.582 + 17.21 = 21.792 \text{ m}$$

Elevation of sub-soil pressure HGL of A (E_A)

$$\text{Max. Dynamic head} = \text{USWL} - \text{DSWL}$$
$$= 26 - 24.5 = 1.5 \text{ m.}$$

(max $H_{dynamic}$ = USTWL-DSWL)

$$H_A = \Phi_A * \max H_{dynamic} = 0.338 * 1.5 = 0.582 \text{ m}$$

$$\text{HGL A } (E_A) = H_A + \text{DSWL}$$

$$= 0.582 + 24.5 = 25.082 \text{ m}$$

$$\text{Unbalanced dynamic head at A} = E_A - W_A$$

$$= 25.082 - 21.792 = 3.29 \text{ m}$$

Point B: is at pre-jump side.

Level of glacis at B = 2+17 = 19 m

$$E_{fB} = USTEL - \text{elevation at B} \\ = 26.95 - 19 = 7.95 \text{ m}$$

From energy curve, for supercritical side

$$q = 24 \quad E_{fB} = 7.95 \quad y_B = 2.2 \text{ m this first trial.}$$

$$E_{fB} = y_B + \frac{q^2}{2gy_B^2} = 8.265 > 7.949 \text{ not O.K.}$$

$$\text{Finally } y_B = 2.276 \quad E_{fB} = 7.949 \text{ O.K.}$$

$$W_B = Y_B + \text{elevation at B} = 2.276 + 19 = 21.276 \text{ m}$$

Sub-soil elevation of water pressure (HGL) of B = E_B

$$H_B = \Phi_B * \max H_{\text{dynamic}} = 0.484 * 1.5 = 0.726 \text{ m}$$

$$E_B = H_B + \text{DSWL} = 0.726 + 24.5 = 25.226 \text{ m}$$

$$\begin{aligned} \text{Unbalanced Dynamic head at B} &= E_B - W_B \\ &= 25.226 - 21.276 = \\ &3.95 \text{ m} \end{aligned}$$