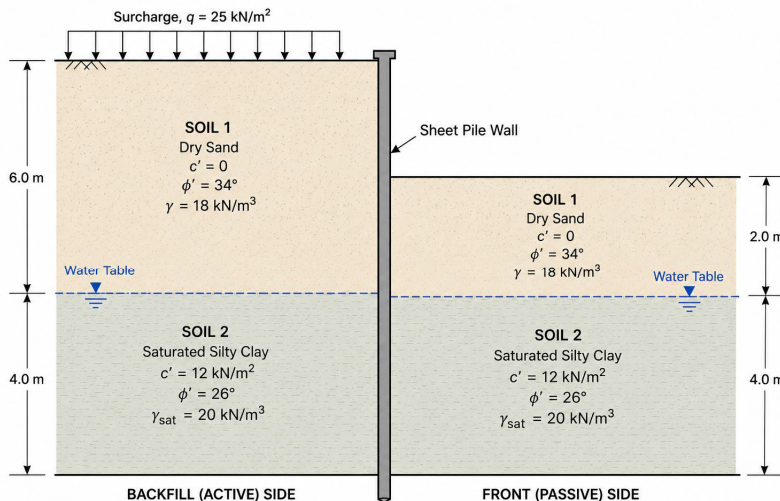


## Retaining Walls Pressure Distribution



For Soil 1

$$k_a = \frac{1 - \sin 34}{1 + \sin 34} = 0.28$$

$$k_p = \frac{1}{k_a} = \frac{1}{0.28} = 3.54$$

For Soil 2

$$k_a = \frac{1 - \sin 26}{1 + \sin 26} = 0.39$$

$$k_p = \frac{1}{k_a} = \frac{1}{0.39} = 2.56$$

Active Pressure

| Soil | Depth (m) | Pressure (kN/m <sup>2</sup> )                                                                                                                                       |
|------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | 0         | $p_{sw} = q k_a = 25 \times 0.28 = \underline{7.0}$                                                                                                                 |
| 1    | 6         | $p_{sw} + p_a = q k_a + k_a \gamma z$ $= (25 \times 0.28) + (0.28 \times 18 \times 6.0)$ $= \underline{37.24}$                                                      |
| 2    | 6         | $p_a = k_a (q + \gamma z) - 2c\sqrt{k_a}$ $= 0.39 \times (25 + (18 \times 6.0)) - 2 \times 12 \times \sqrt{0.39}$ $= \underline{34.54}$                             |
| 2    | 10        | $p_a = k_a (q + \gamma z) - 2c\sqrt{k_a} + k_a \gamma z$ $= 0.39 \times (25 + (18 \times 6.0)) - 2 \times 12 \times \sqrt{0.39} + 0.39 \times (20 - 9.81) \times 4$ |

$$= 0.39 \times (25 + (18 \times 6.0)) - 2 \times 12 \times \sqrt{0.39} + 0.39 \times (20 - 9.81) \times 4$$

$$= \underline{50.44}$$

Passive Pressure

Soil Depth(m) Pressure (kN/m<sup>2</sup>)

1 0 0

1 2  $P_p = k_p \gamma z = 3.54 \times 18 \times 2.0 = \underline{127.44}$

2 2  $P_p = k_p \gamma z - 2c \sqrt{k_p}$

$$= 2.56 \times 18 \times 2.0 - 2 \times 12 \times \sqrt{2.56}$$

$$= \underline{130.56}$$

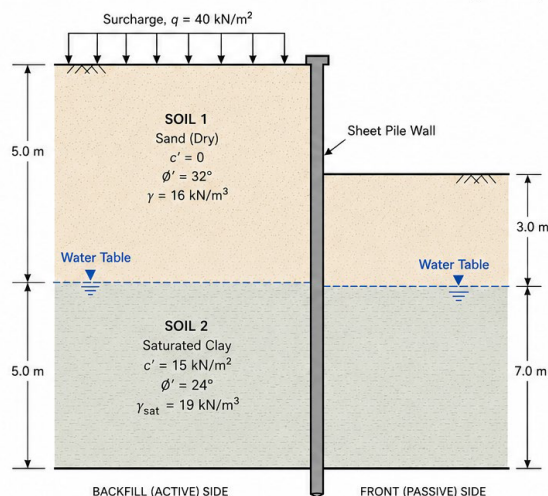
2 6  $P_p = k_p \gamma z - 2c \sqrt{k_p} + k_p \gamma z$

$$= 2.56 \times 18 \times 2.0 - 2 \times 12 \times \sqrt{2.56} + 2.56 \times (20 - 9.81) \times 4$$

$$= \underline{234.91}$$

Plot the distributions of active pressure behind the wall and passive pressure in front of the wall. Indicate the key values on the diagrams.

[20 Marks]



For Soil 1

$$k_a = \underline{1 - \sin 32} = 0.31$$

For Soil 2

$$k_a = \underline{1 - \sin 24} = 0.42$$

For Soil 1

$$k_a = \frac{1 - \sin 32}{1 + \sin 32} = 0.31$$

$$k_p = \frac{1}{k_a} = \frac{1}{0.31} = 3.25$$

For Soil 2

$$k_a = \frac{1 - \sin 24}{1 + \sin 24} = 0.42$$

$$k_p = \frac{1}{k_a} = \frac{1}{0.42} = 2.37$$

### Active Pressure

| Soil | Depth (m) | Pressure (kN/m <sup>2</sup> )                                                                                                                                                                                                |
|------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | 0         | $p_{sw} = q k_a = 40 \times 0.31 = \underline{12.4}$                                                                                                                                                                         |
| 1    | 5         | $\begin{aligned} p_{sw} + p_a &= q k_a + k_a \gamma z \\ &= (40 \times 0.31) + (0.31 \times 16 \times 5.0) \\ &= \underline{37.20} \end{aligned}$                                                                            |
| 2    | 5         | $\begin{aligned} p_a &= k_a (q + \gamma z) - 2c\sqrt{k_a} \\ &= 0.42 \times (40 + (16 \times 5.0)) - 2 \times 15 \times \sqrt{0.42} \\ &= \underline{1.80} \end{aligned}$                                                    |
| 2    | 10        | $\begin{aligned} p_a &= k_a (q + \gamma z) - 2c\sqrt{k_a} + k_a \gamma z \\ &= 0.42 \times (40 + (16 \times 5.0)) - 2 \times 15 \times \sqrt{0.42} + 0.42 \times (16 - 9.81) \times 5 \\ &= \underline{21.10} \end{aligned}$ |

### Passive Pressure

| Soil | Depth (m) | Pressure (kN/m <sup>2</sup> )                                                                                                       |
|------|-----------|-------------------------------------------------------------------------------------------------------------------------------------|
| 1    | 0         | <u>0</u>                                                                                                                            |
| 1    | 3         | $p_p = k_p \gamma z = 3.25 \times 16 \times 3.0 = \underline{156.0}$                                                                |
| 2    | 3         | $\begin{aligned} p_p &= k_p \gamma z - 2c\sqrt{k_p} \\ &= 2.37 \times 16 \times 3.0 - 2 \times 15 \times \sqrt{2.37} \end{aligned}$ |

$$= 2.37 \times 16 \times 3.0 - 2 \times 15 \times \sqrt{2.37}$$

$$= \underline{67.58}$$

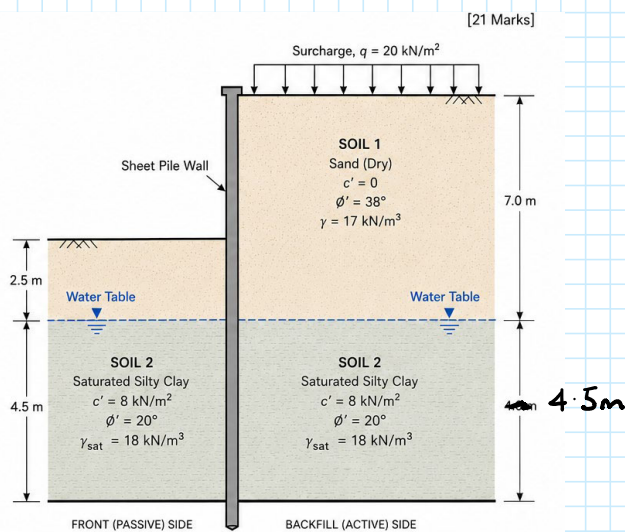
2

8

$$p_p = k_p \gamma z - 2c\sqrt{k_p} + k_p \gamma z$$

$$= 2.37 \times 16 \times 3.0 - 2 \times 15 \times \sqrt{2.37} + 2.37 \times (19 - 9.81) \times 5$$

$$= \underline{176.48}$$



For Soil 1.

$$k_a = \frac{1 - \sin 38}{1 + \sin 38} = 0.24$$

$$k_p = \frac{1}{k_a} = \frac{1}{0.24} = 4.20$$

For Soil 2

$$k_a = \frac{1 - \sin 20}{1 + \sin 20} = 0.49$$

$$k_p = \frac{1}{k_a} = \frac{1}{0.49} = 2.04$$

Active Pressure

| Soil | Depth (m) | Pressure (kN/m <sup>2</sup> )                                                                                        |
|------|-----------|----------------------------------------------------------------------------------------------------------------------|
| 1    | 0         | $p_{sw} = q k_a = 20 \times 0.24 = \underline{4.8}$                                                                  |
| 1    | 7         | $p_{sw} + p_a = q k_a + k_a \gamma z$<br>$= (20 \times 0.24) + (0.24 \times 17 \times 7.0)$<br>$= \underline{33.36}$ |

$$= \underline{55.56}$$

2

7

$$\begin{aligned} p_a &= k_a (q + \gamma z) - 2c\sqrt{k_a} \\ &= 0.49 \times (20 + (17 \times 7)) - 2 \times 8.0 \sqrt{0.49} \\ &= \underline{56.91} \end{aligned}$$

2

11.5

$$\begin{aligned} p_a &= k_a (q + \gamma z) - 2c\sqrt{k_a} + k_a \gamma z \\ &= 0.49 \times (20 + (17 \times 7)) - 2 \times 8 \sqrt{0.49} + 0.49 \times (18 - 9.81) \times 4.5 \\ &= \underline{74.97} \end{aligned}$$

Passive Pressure

Soil

Depth(m)

Pressure (kN/m<sup>2</sup>)

1

0

0

1

2.5

$$p_p = k_p \gamma z = 4.2 \times 17 \times 2.5 = \underline{178.5}$$

2

2.5

$$\begin{aligned} p_p &= k_p \gamma z - 2c\sqrt{k_p} \\ &= 2.04 \times 17 \times 2.5 - 2 \times 8.0 \times \sqrt{2.04} \\ &= \underline{63.85} \end{aligned}$$

2

7.0

$$\begin{aligned} p_p &= k_p \gamma z - 2c\sqrt{k_p} + k_p \gamma z \\ &= 2.04 \times 17 \times 2.5 - 2 \times 8 \times \sqrt{2.04} + 2.04 \times (18 - 9.81) \times 4.5 \\ &= \underline{139.03} \end{aligned}$$