

6. Analysis and Proportioning of Retaining walls

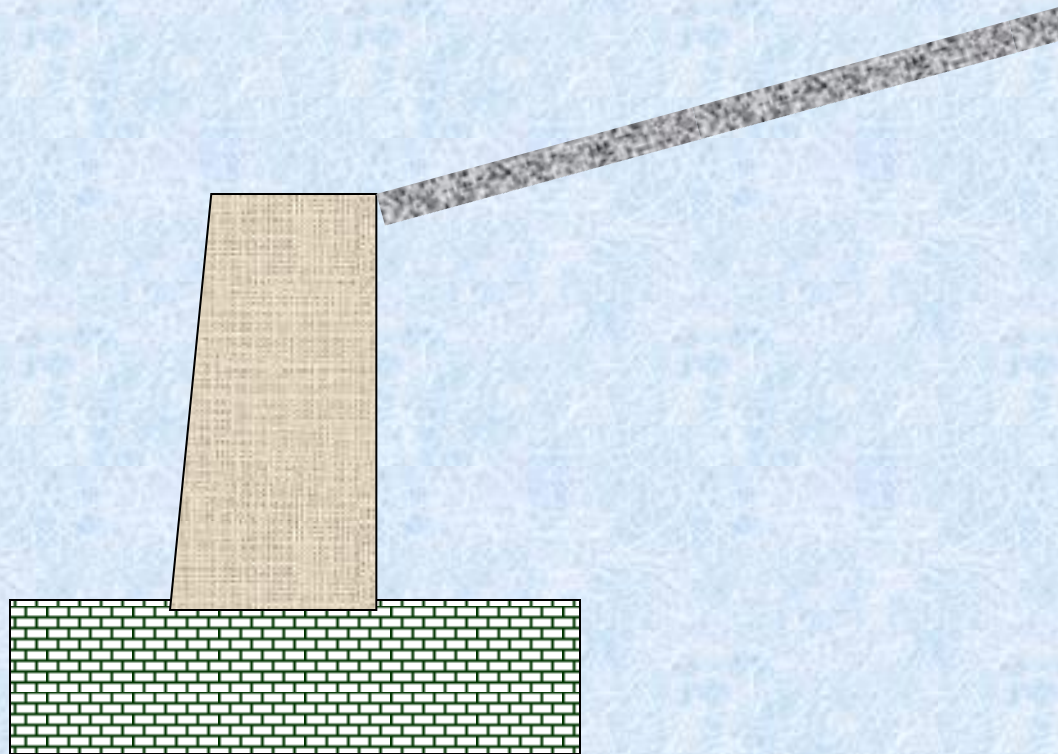
Retaining walls: are structures used to provide lateral stability of earth or other material where conditions disallow the mass to assume its natural slope.

6.1. Common Types of retaining walls

1.Gravity walls:

- Made of plain concrete or stone masonry.
- Depends upon its weight for stability.
- Trapezoidal in section with the base projecting beyond the face and back of the wall.
- No tensile stress in any portion of the wall.
- Economically used for walls less than 6m high.

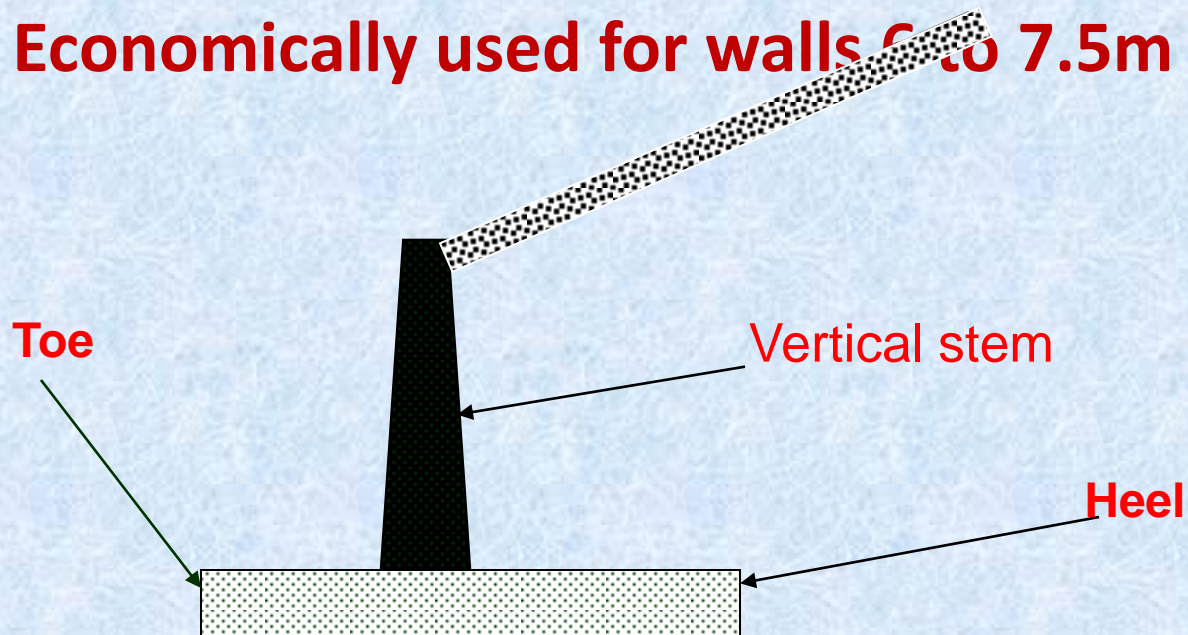
G.r.w



Gravity Walls

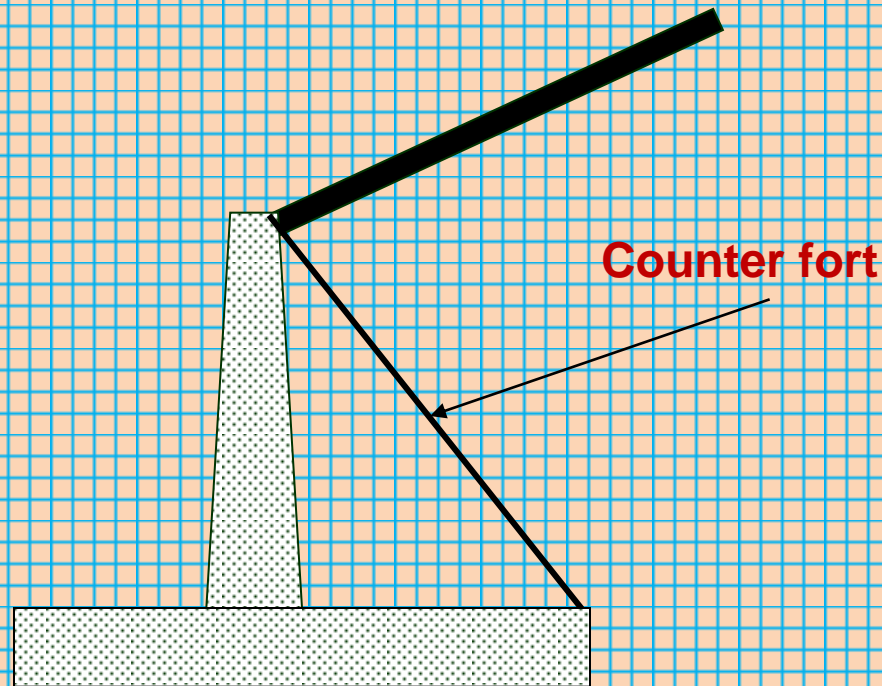
2. Cantilever walls

- Made of reinforced concrete material.
- Inverted T-shaped in section with each projecting acts as a cantilever.
- Economically used for walls 6 to 7.5m high.



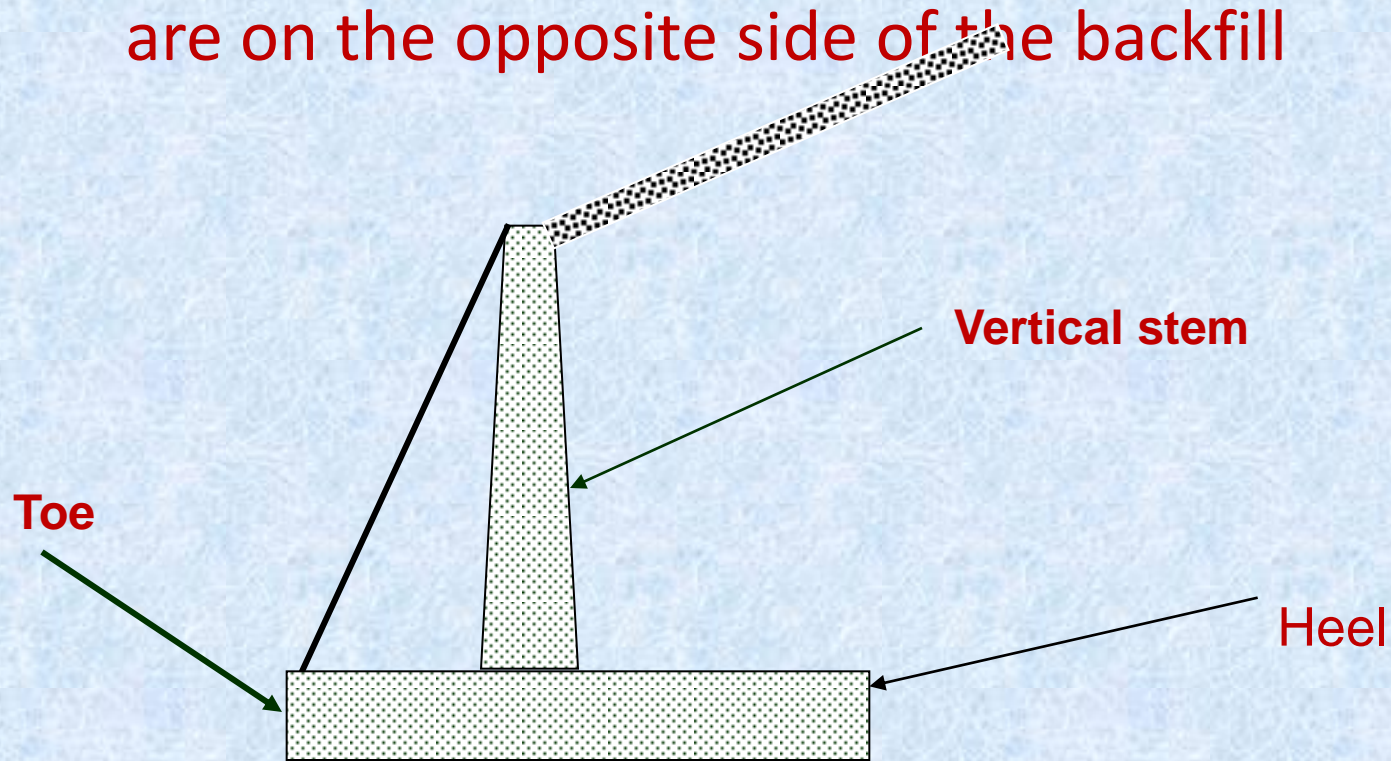
3. Counter fort walls

- Made of reinforced concrete materials
- Consists of cantilever wall with vertical brackets known as counter fort placed behind face of wall
- Ordinarily used for walls height greater than 6.0m

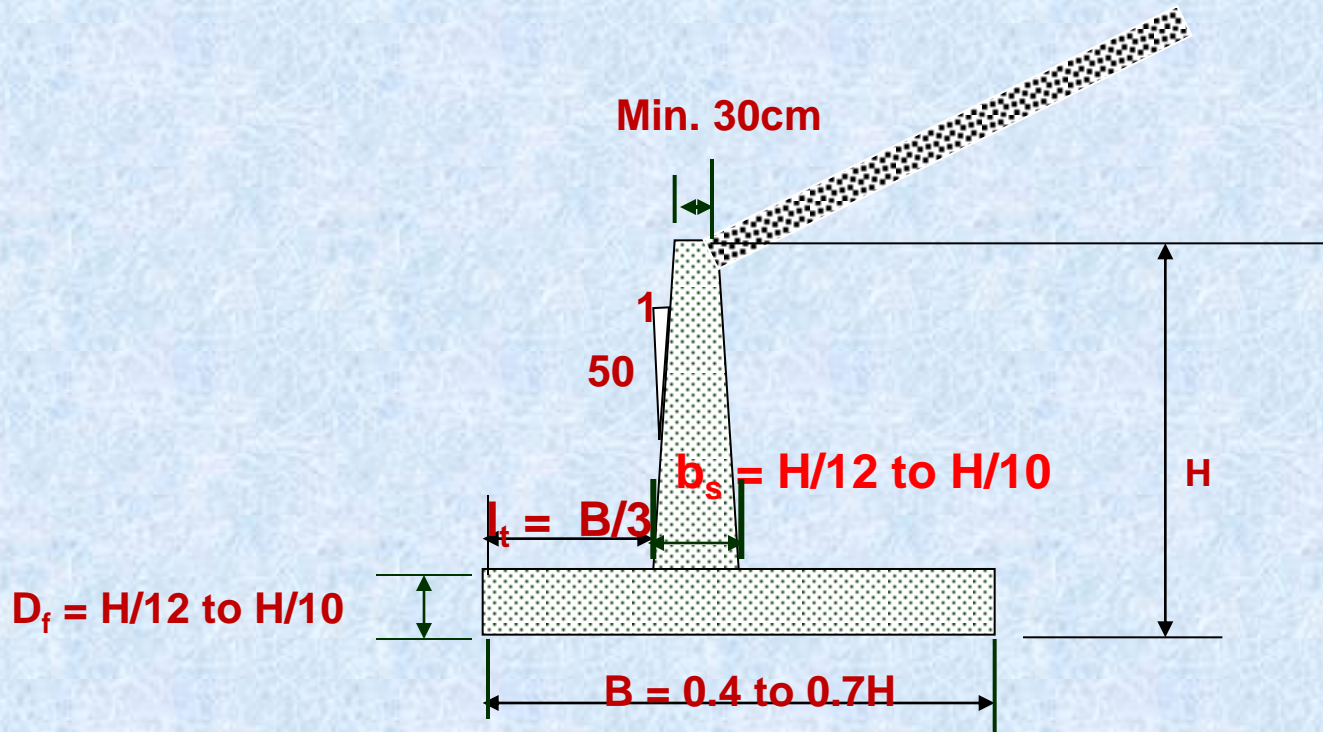


4. *Buttress walls*

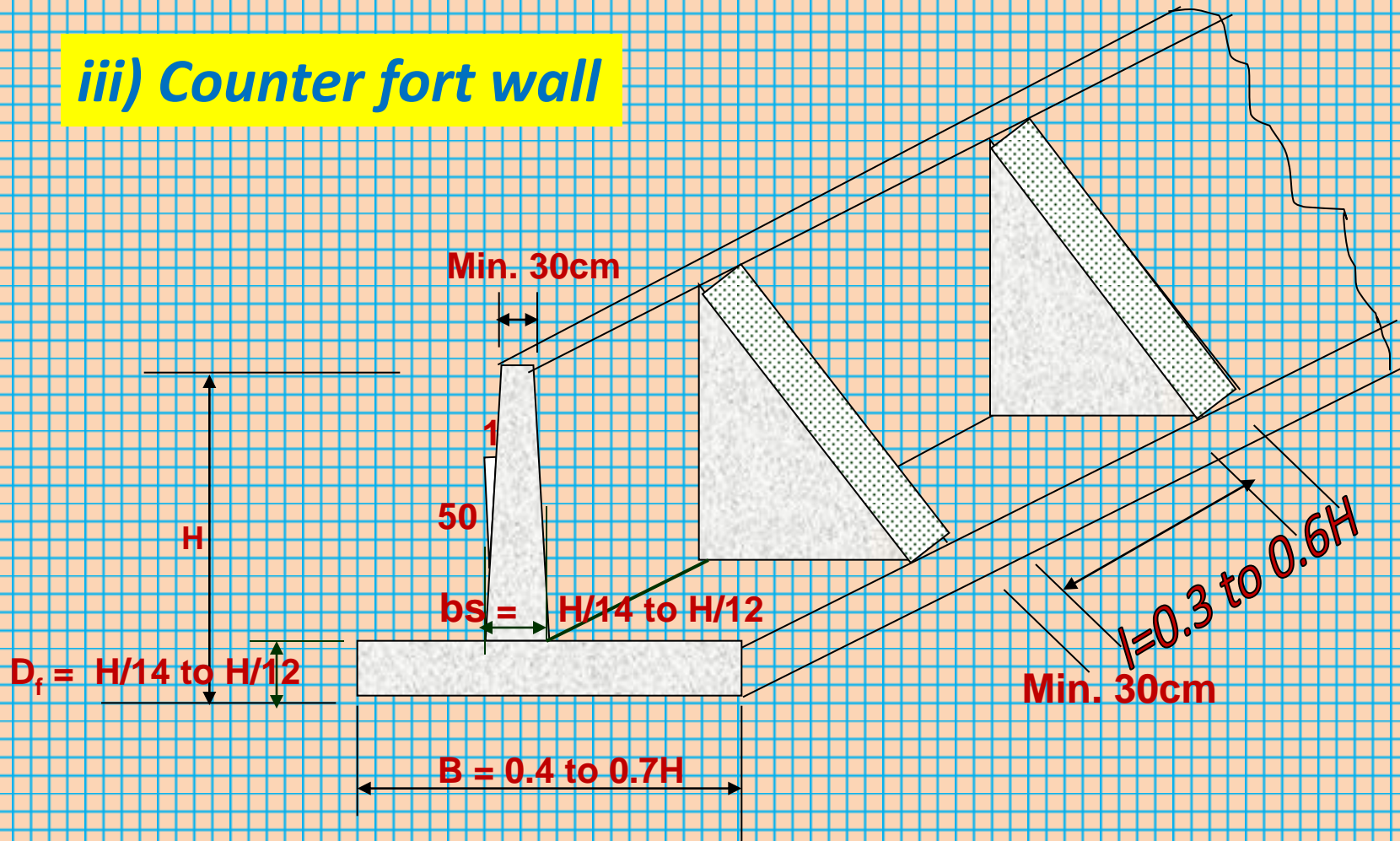
Same as counter fort except that the vertical brackets are on the opposite side of the backfill



ii) Cantilever wall



iii) Counter fort wall



6.3. Forces on Retaining Walls

The forces that should be considered in the design of retaining walls include

- **Active and passive** earth pressures
- **Dead weight** including the weight of the wall and portion of soil mass that is considered to act on the retaining structure
- **Surcharge** including live loads, if any
- **Water pressure**, if any
- **Contact pressure** under the base of the structure

6.4. Stability of Retaining Walls

Retaining walls should be designed to provide adequate stability against sliding, overturning, foundation bearing failure and overall or deep foundation failure.

1. Sliding stability

Factor of safety =

$$\frac{\text{Horizontal resisting force}}{\text{Horizontal sliding force}} = \frac{F_R}{P_{Ah}}$$

Factor of safety ≥ 1.5 for granular soils
Factor of safety ≥ 2.0 for cohesive soils

2. Overturning Stability

$$\text{Factor of safety} = \frac{\text{Sum of moments to resist overturning}}{\text{Sum of overturning moments}} = \frac{M_s}{M_o}$$

Factor of safety ≥ 1.5 for granular backfill
Factor of safety ≥ 2.0 for cohesive backfill

If the line of action of the resultant force on wall acts within the middle third width of the base, wall is safe against overturning

3. Foundation stability

$$q_t = \frac{R_v}{B} \left(1 \pm \frac{6e}{B} \right)$$

Where e = eccentricity of R_v

$$q_t \leq q_{\text{all}} \text{ , } q_{\text{all}} = q_{\text{ult}}/\text{F.S}$$

F.S = Factor of safety = 2 and 3 for granular and cohesive soils, respectively.

Deep foundation failure (Overall stability)

If layer of weak soil is located within a depth of about $1 \frac{1}{2}$ times the height of the retaining wall the overall stability of retaining wall should be investigated.

E.g. using Swedish circle method.