Universitatea Politehnica Timişoara
Facultatea de Construcţii
Departamentul de Căi de Comunicație Terestre, Fundații și Cadastru

FOUNDATIONS

- CURS 7 -

Lateral Earth Pressure and
Retaining Walls

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CHAPTER V – LATERAL EARTH PRESSURE AND RETAINING WALLS

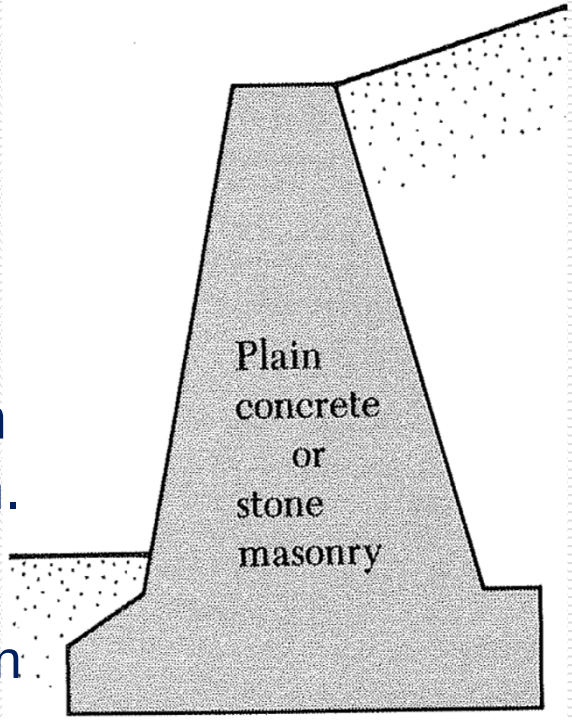
§ 5.4 Design of retaining walls
Structural design of retaining walls

- In stability analyses the retaining walls are considered as rigid bodies. In order to accomplish this requirement, the vertical retaining element, together with their footing (sole) must be designed accordingly.

- Structural checking of the retaining walls must be performed in function of the component material:
  - Gravity retaining walls (plain concrete, masonry, different soils)
  - Reinforced concrete retaining walls

§ 5.4 Design of retaining walls
Structural design of **gravity** retaining walls

- The Gravity Retaining Walls are constructed from plain concrete or stone masonry.
- The checking conditions should assure compression in all sections of the wall.
- The structural check is performed in different horizontal cross-sections under axial compression and bending moment characteristic to that section.
- The checking conditions:
  - assuring the entire cross-section in compression
  - check of compression resistance of materials



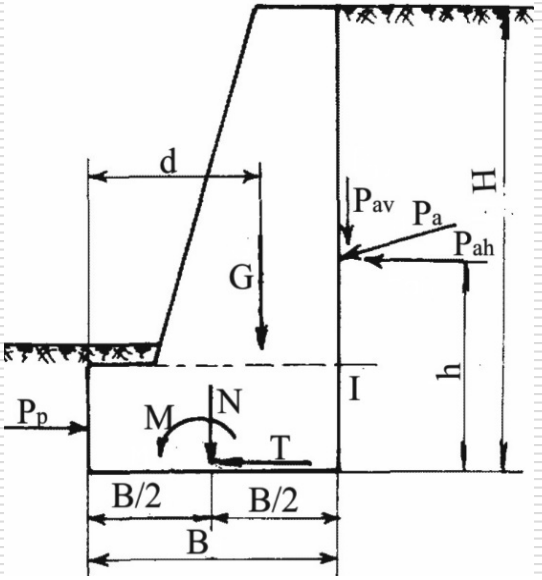
- Generally, the check to shear force is not necessary

The horizontal cross-section at the interface between the wall and the sole should always be checked.

§ 5.4 Design of retaining walls

Structural design of **gravity** retaining walls

- For plain gravity retaining walls and in the conditions in which the fulfilment of the compression condition would lead to big sole dimensions, the concrete could be lightly reinforced.
- This would lead also to a more economical solution.

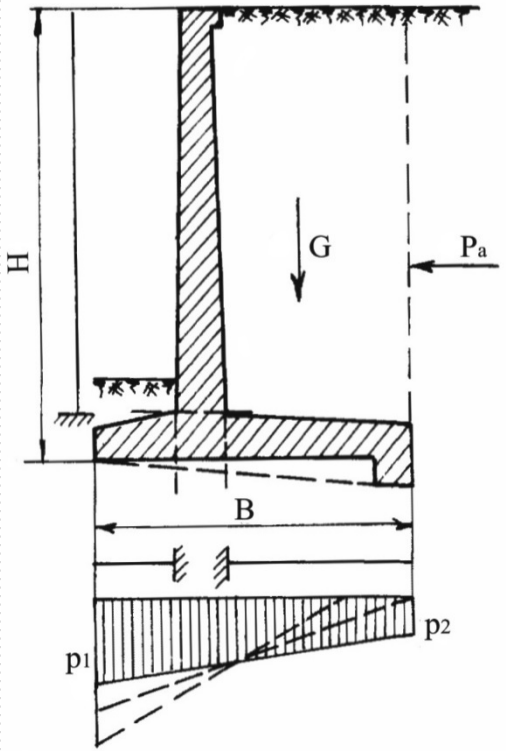


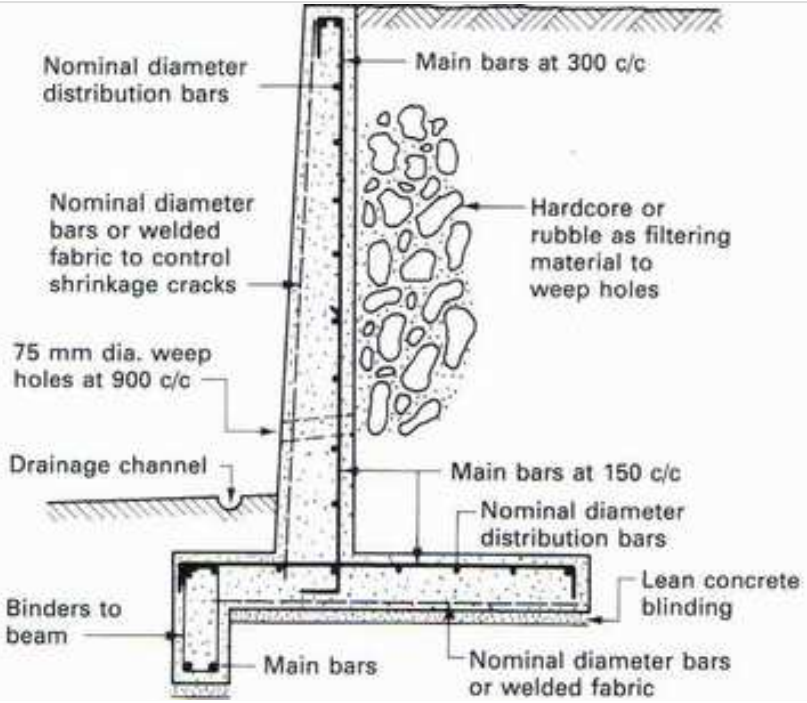
Structural design of **reinforced concrete** retaining walls

- For reinforced concrete retaining walls, the soil weight located above the heel and the toe is considered as acting together with the retaining wall (design hypothesis).
- The structural design is based on structural analysis of the unitary elements, isolated on one meter length.
- The reinforcing is then computed according to the shear forces and moment distributions.

§ 5.4 Design of retaining walls
Structural design of **reinforced concrete** retaining walls

- In a static analysis, in case of simple reinforcing walls, the stem is considered as a cantilever fixed into the base, loaded laterally by the active pressure.
- The toe and the heel are also considered as cantilevers, fixed into the stem and loaded by the:
  - geotechnical pressure
  - soil weights located above the elements.



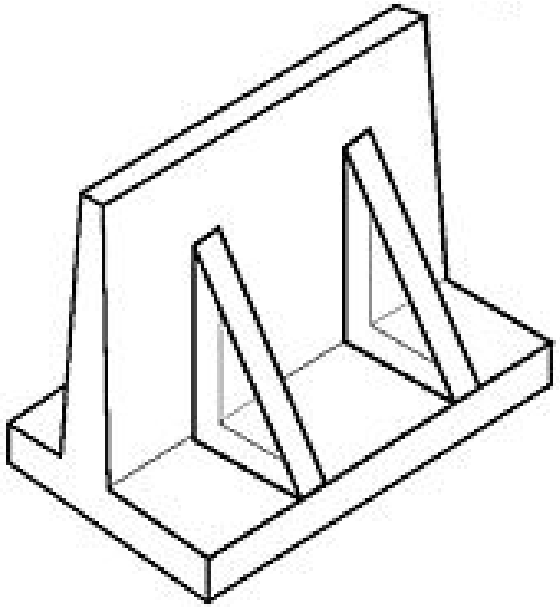


- Different design hypothesis are made in function of these loads.

Reinforcing of concrete retaining walls

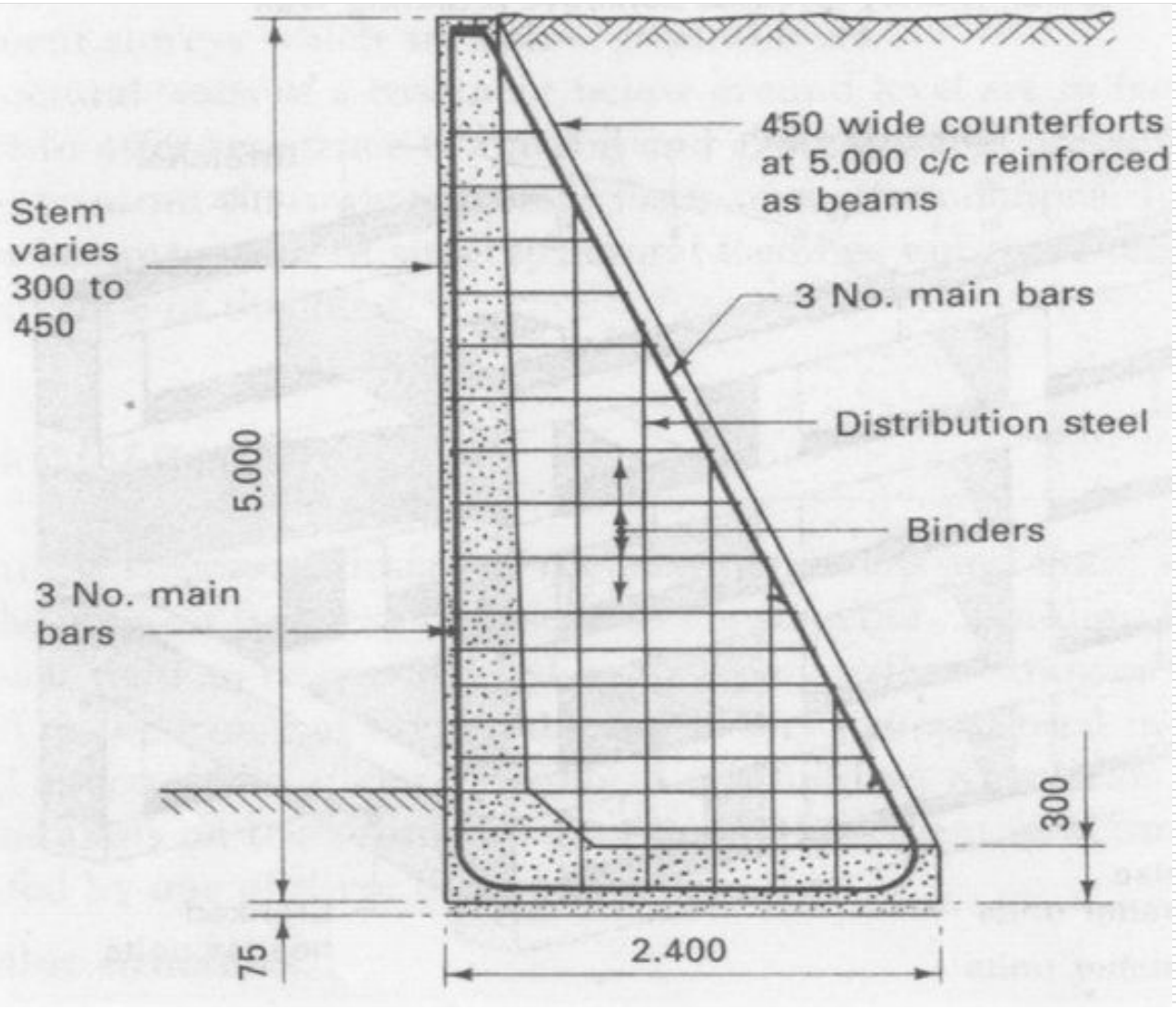
§ 5.4 Design of retaining walls
Structural design of **reinforced concrete** retaining walls

- In case of counterfort retaining walls, the static design considers a continuous beam supported by the counterforts.
- If the panel dimensions are similar, then the design can be made on the assumption of a plate fixed on three sides.



- The counterfort is considered fixed in the foundation base and loaded by the resultant of the active pressure computed on the tributary area between two counterforts.
- Its reinforcement is made accordingly, as for an tensioned element.

§ 5.4 Design of retaining walls
Structural design of **reinforced concrete** retaining walls

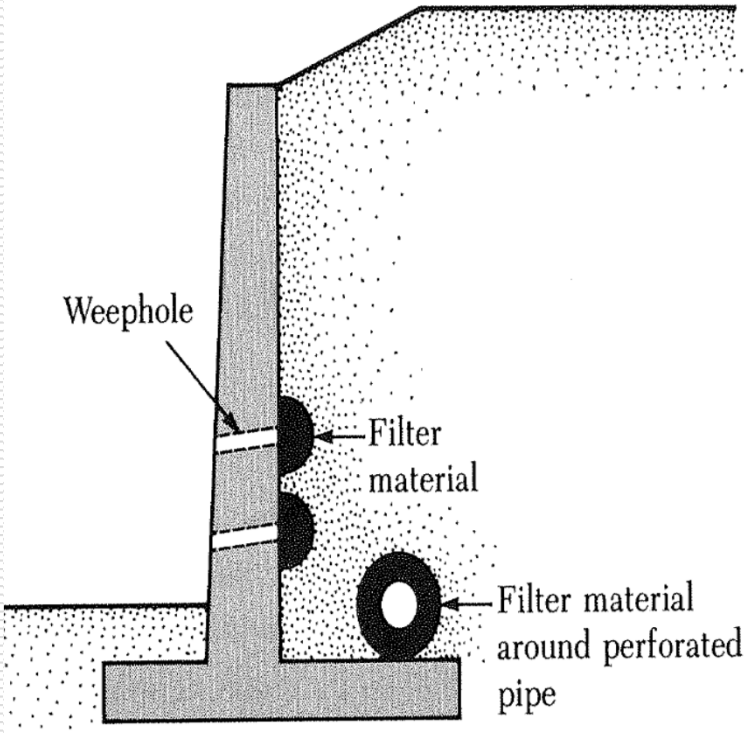


Reinforcing of counterforts

§ 5.5 Drainage and technological considerations for retaining walls

1. Drainage

- As the result of rainfall or other wet conditions, the backfill material for a retaining wall may become saturated.
- The saturation will increase the pressure on the wall and create unstable condition.
- For this reason, adequate drainage must be provided by means of weep holes and/or drainage pipes.

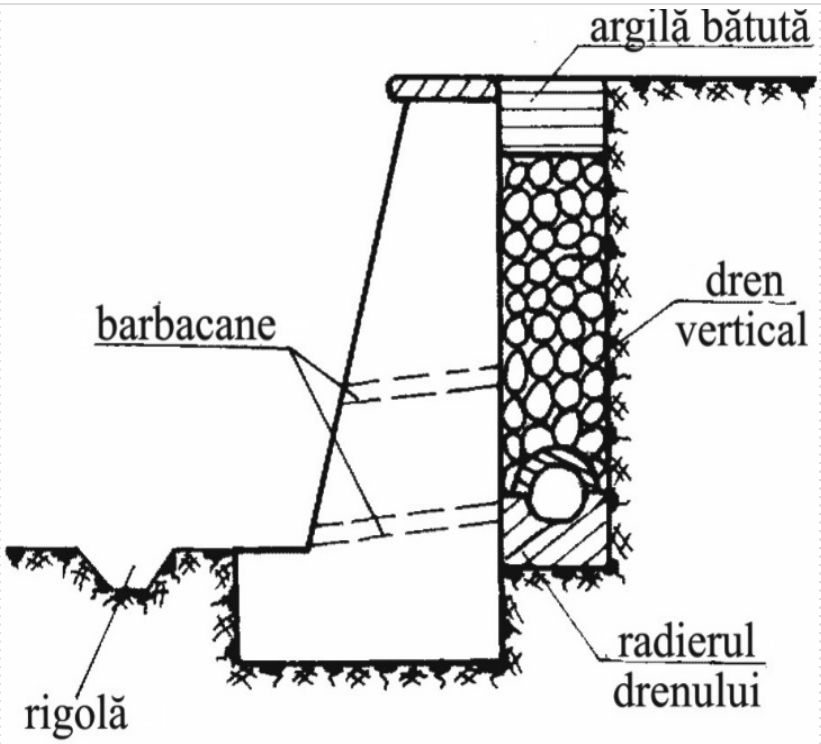


- weepholes: d_{min} = 0.1m, adequately spaced (0.5….1m)
- Filters as granular soils or geotextiles should assure the clear drainage of waters

§ 5.5 Drainage and technological considerations for retaining walls

2. Crest protection

- The crest represents the most exposed part of a retaining wall to external factors.
- For this reason, the crest should be protected by:
  - Pavement with natural stone
  - Special concrete paving
- The same finishing could be applied to the external face of the stem



- The top of the backfill material is usually compacted clay. Its purpose is to stop the infiltration of waters into the backfill soil

§ 5.5 Drainage and technological considerations for retaining walls

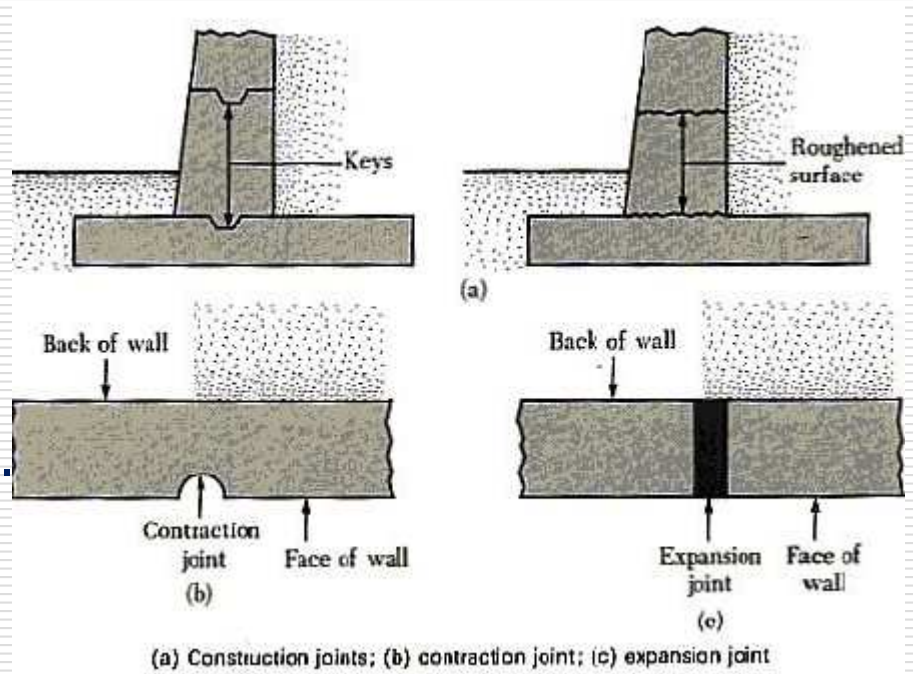
3. Joints

☐ A retaining wall may be constructed with one or all of the following joints:

☐ **Construction joints (a):**

Horizontal or vertical joints used between successive pours of concrete.

In order to increase the shear at the joints, keys may be used. If not, the surface should be cleaned and roughed.



(a) Construction joints; (b) contraction joint; (c) expansion joint

☐ **Contraction joints (b):**

Are conceived as vertical grooves (joints)placed in front of the wall and allows concrete to shrink without noticeable harm. Grooves are 6-8mm wide and 12-16 mm deep.

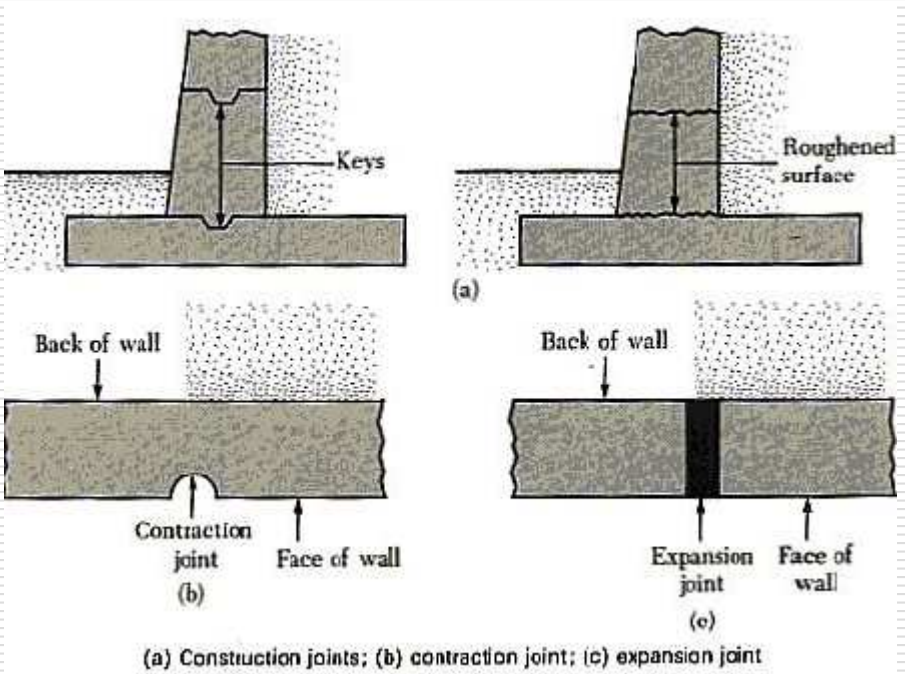
§ 5.5 Drainage and technological considerations for retaining walls

3. Joints

☐ **Expansion joints (c):**

Are provided to take into account the expansion of concrete caused by temperature changes.

Usually are filled with flexible joint fillers.



(a) Construction joints; (b) contraction joint; (c) expansion joint

In most of the cases, reinforcing steel bars are running across the stem, including the expansion joints.

The steel is greased for allowing concrete expansion.