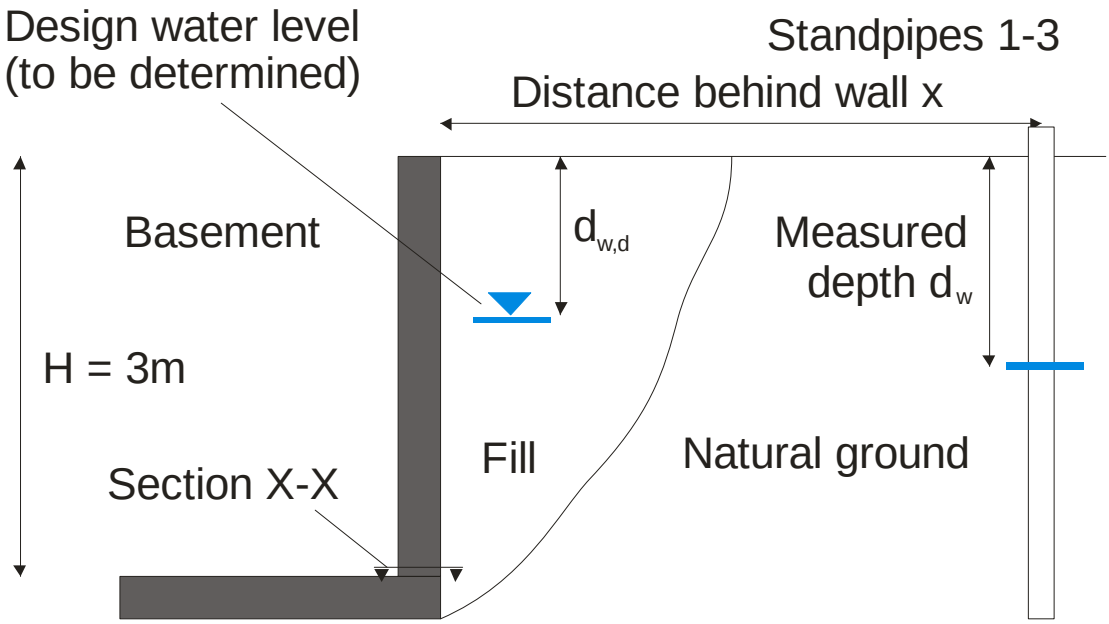
Example 2.4 Earth and pore water pressures on basement wall



This example is designed to compare engineers' assumptions about water pressures acting on the face of a basement wall. The wall will NOT be provided with a drainage system. Ground surface behind the wall is horizontal will be paved in the long term.

The natural water level has been measured in local standpipes as follows:

Standpipe 1, distance x = 10m behind the wall, depth to water d_w = 2.2 m
Standpipe 2, distance x = 25m behind the wall, depth to water d_w = 1.5 m
Standpipe 3, distance x = 50m behind the wall, depth to water d_w = 3.1 m

Three situations are envisaged (with different materials involved):

Situation A: natural ground = clay, fill = clay fill (from excavated natural ground)
Natural clay: γ_k = 22 kN/m^3, $c_{u,k}$ = 35 kPa, ϕ'_k = 25°, c'_k = 0 kPa

Situation B: natural ground = clay, fill = imported granular fill
Natural clay: as above
Imported granular fill: γ_k = 18 kN/m^3, ϕ'_k = 35°, c'_k = 0 kPa

Situation C: natural ground = gravel, fill = imported granular fill
Natural gravel: γ_k = 19 kN/m^3, ϕ'_k = 40°, c'_k = 0 kPa
Imported granular fill: as above

For each situation A-C above, please determine:

1) The characteristic depth of the water table $d_{w,k}$
2) The characteristic thrust on the wall (over height H) owing to water pressures alone
3) The characteristic thrust on the wall (over height H) owing to effective earth pressures alone
4) The characteristic bending moment at Section X-X owing to total pressures on the wall
5) The characteristic shear force at Section X-X owing to total pressures on the wall

Repeat 1-5 above using design values for the serviceability limit state (SLS)
Finally, repeat 1-5 above using design values for the ultimate limit state (ULS)