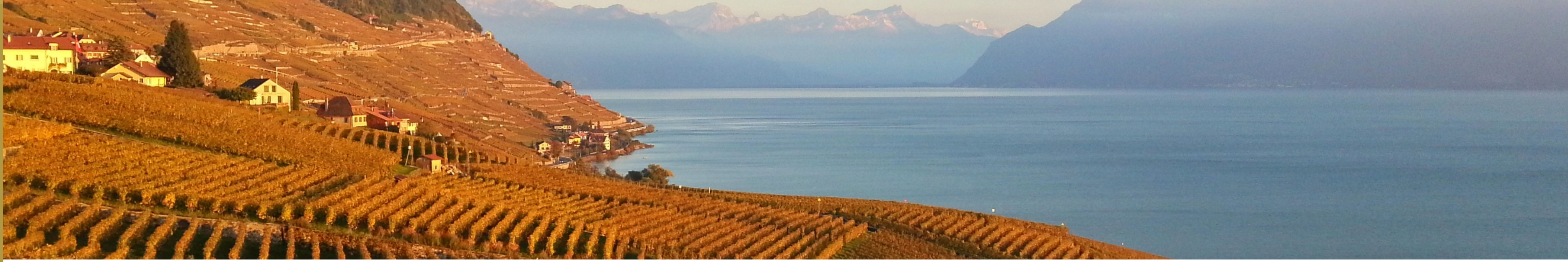


Excercise 1 | Anchorages

Objective

How much concrete (mass and volume) is needed for a proper anchorage of a right-curved pipe under pressure ?

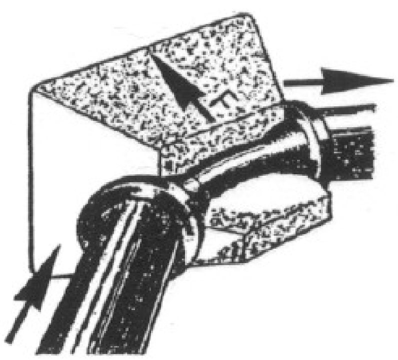
Procedure

1) The resulting (pushing) force :

$$F = K\,p\,S$$

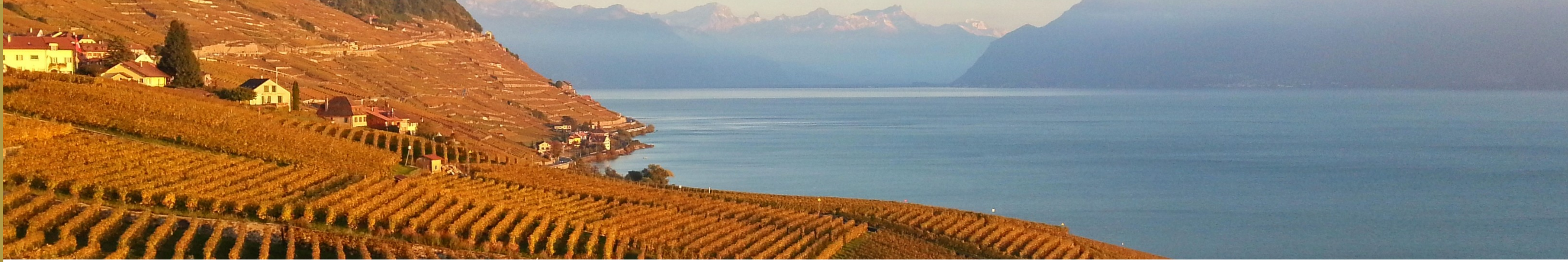
With :

$$K = 2\sin\frac{\alpha}{2}$$



2) Weight needed to avoid any slip :

$$\frac{F}{P} < 0.577$$



Excercise 2 | Drainage

Objective

Find the drains spacing under permanent and variable regime. Finally determine the granulometry of the drain coating to avoid clogging.

First step – Compute the effective rainfall

Consider :

1) A return period of 5 years

2) A slope of around 1-2 %

3) Medium to good hydraulic conditions (rather sandy soil)

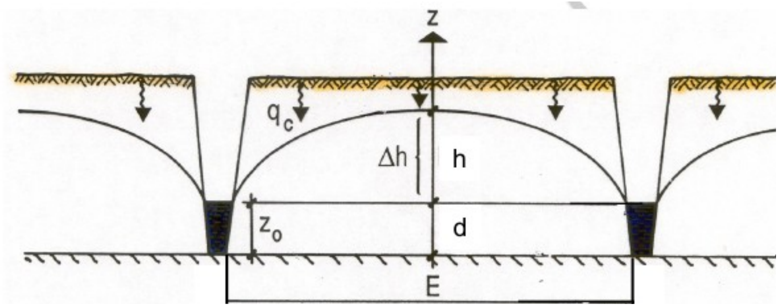
Second step – Compute the drain spacing under permanent regime

Hooghoudt's analogy

$$E^2 = \frac{8\,K\,h\,d}{q_c} + \frac{4\,K\,h^2}{q_c}$$

With :

$d = \dfrac{D}{\frac{8\,D}{\pi\,E}\ln\frac{D}{u} + 1}$ **If D < E/4** or $d = \dfrac{\pi\,E}{8\,\ln\frac{E}{u}}$ **If D > E/4**



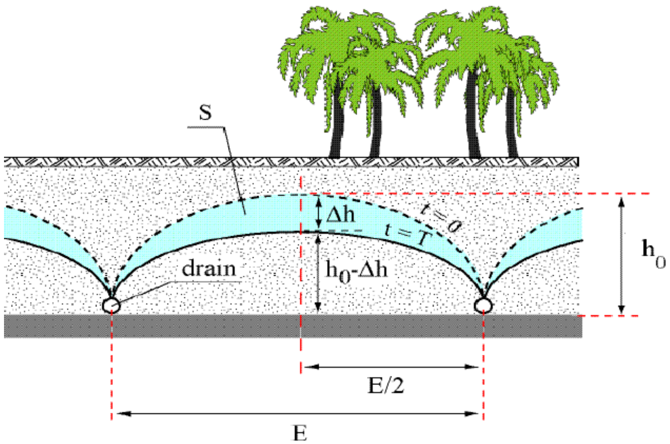
Compute d and E with one of the formulas and check if the condition is valid.

Hint : useful information in p. 13-21, Lecture 12 on moodle

Third step – Compute the drain spacing under drying up regime

Glover-Dumm's equation

$$E^2 = \frac{\pi^2 K T d}{\mu}\left[\ln\left(1.16\,\frac{h_0}{h_0 - \Delta}\right)\right]^{-1}$$

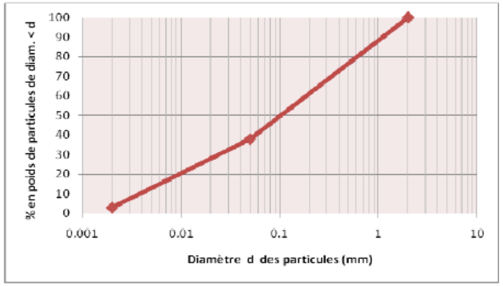


With :

$d = \frac{D}{\frac{8D}{\pi E}\ln\frac{D}{u}+1}$ **If D < E/4** or $d = \frac{\pi E}{8\ln\frac{E}{u}}$ **If D > E/4**

Forth step – Determine the granulometry of the coating

Plot the granulometry curve and determine the drain category



Hint : useful information in p. 13-21, Lecture 12 on moodle

Excercise 3 | Water table under a house

Objective

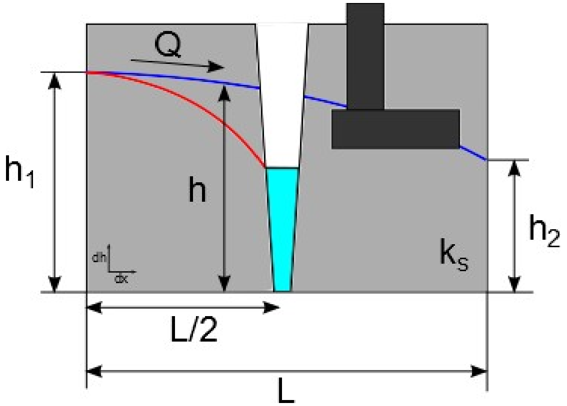
Compute the design flow rate of a draining trench in the case of an unconfined aquifer.

Procedure – From Darcy's formula

$$q = -k_s h \frac{dh}{dx}$$

Steps:

1. Integrate on dh and dx
2. Compute the flow rate q per unit width
3. Compute the flow rate Q over width b



h_1=10m
h_2=8m
L=1000m
b=500m
k_s=0.002 m/s

without trench
with trench

Assignment 5 | Hand-in

Deadline

December 31th, 23

You can hand-in...

- A scan of your hand written computations, results, discussion
- A **commented** code (Matlab/R)
- A **pdf** report with the computations, results, discussion