

Question: what is worth teaching to everyone from Soil Mechanics?
(civil engineering subject)

Answer:

What happens when soil compresses¹

Part 1

¹ **compress:** to press or squeeze together, to undergo compression (Webster)

Goals of lesson in 3 parts + summary

- describe what happens when soil compresses
- link the description of soil settlement to the quantitative prediction of settlement (this is what civil engineers need to know)

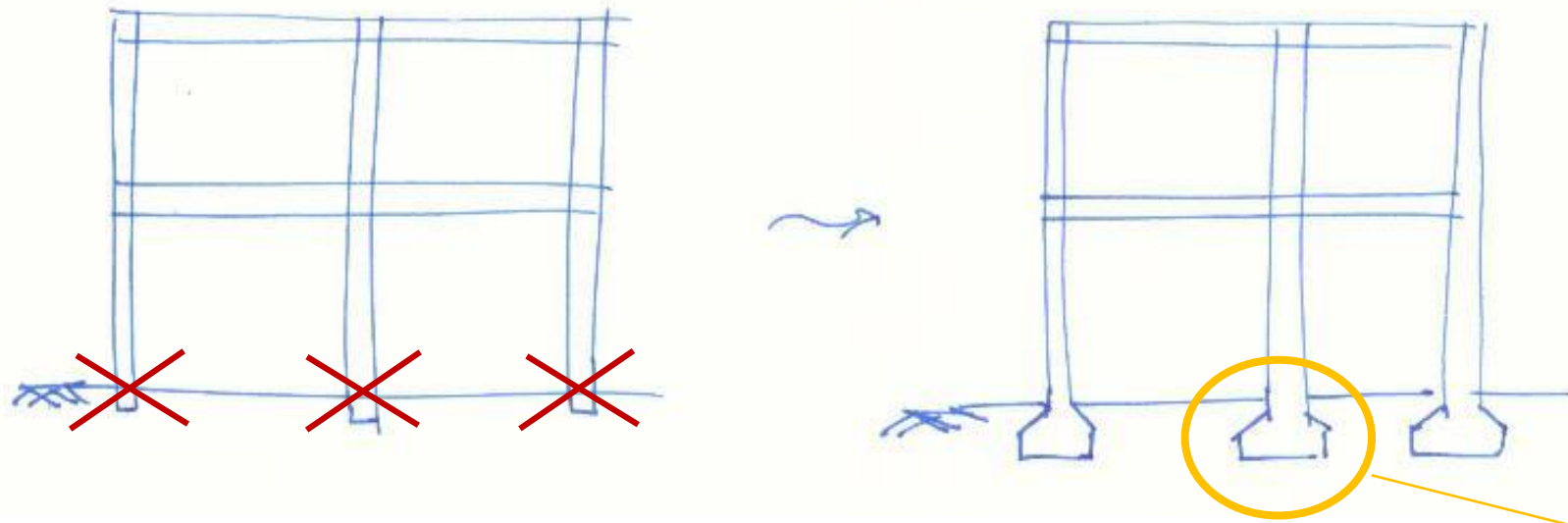
Part 1

- BUILDINGS COMPRESS SOIL – SOIL SETTLES AS AIR (DRY SOIL) OR WATER (SOIL SATURATED WITH WATER) ESCAPES
- SATURATED CLAY SOILS MAY COMPRESS FOR YEARS BEFORE SETTLEMENT IS COMPLETE (DOES IT MATTER?)

Weight, pressure (stress), compression (settlement)



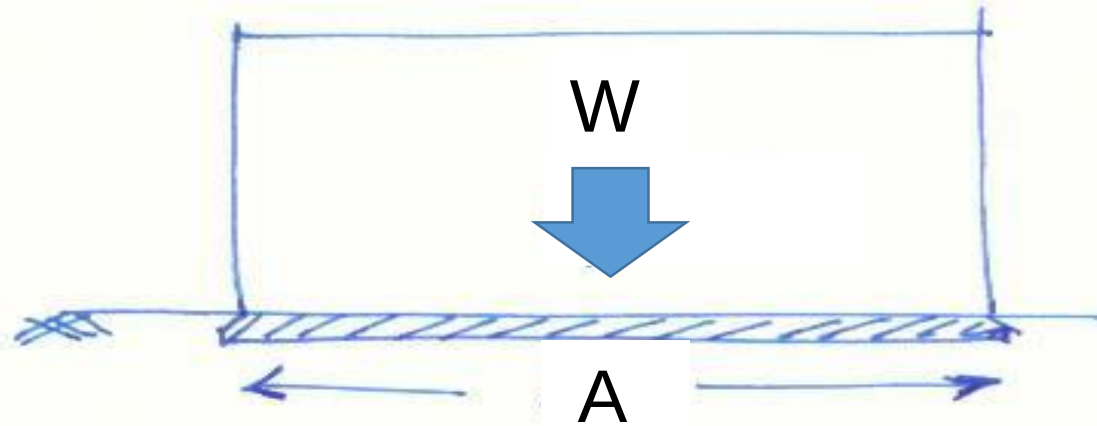
Transferring to soil loads from columns of building...



... to a wider area (“footing”)



Building load W – soil stress σ

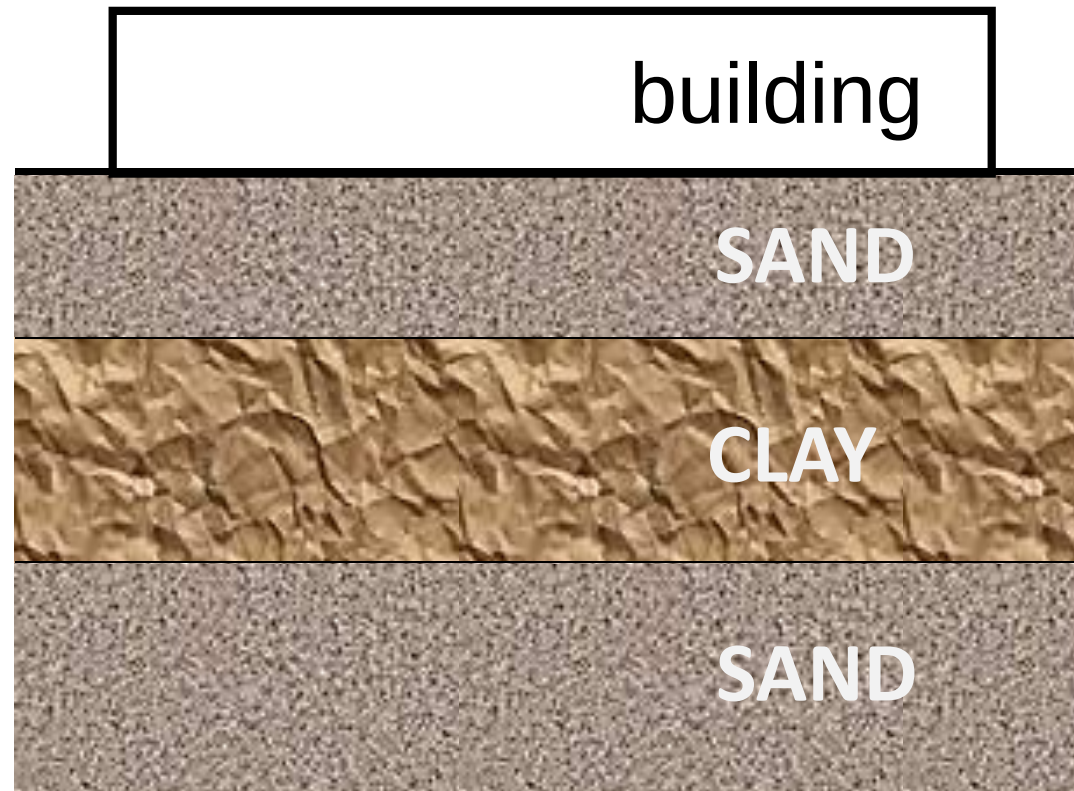


W = weight of building

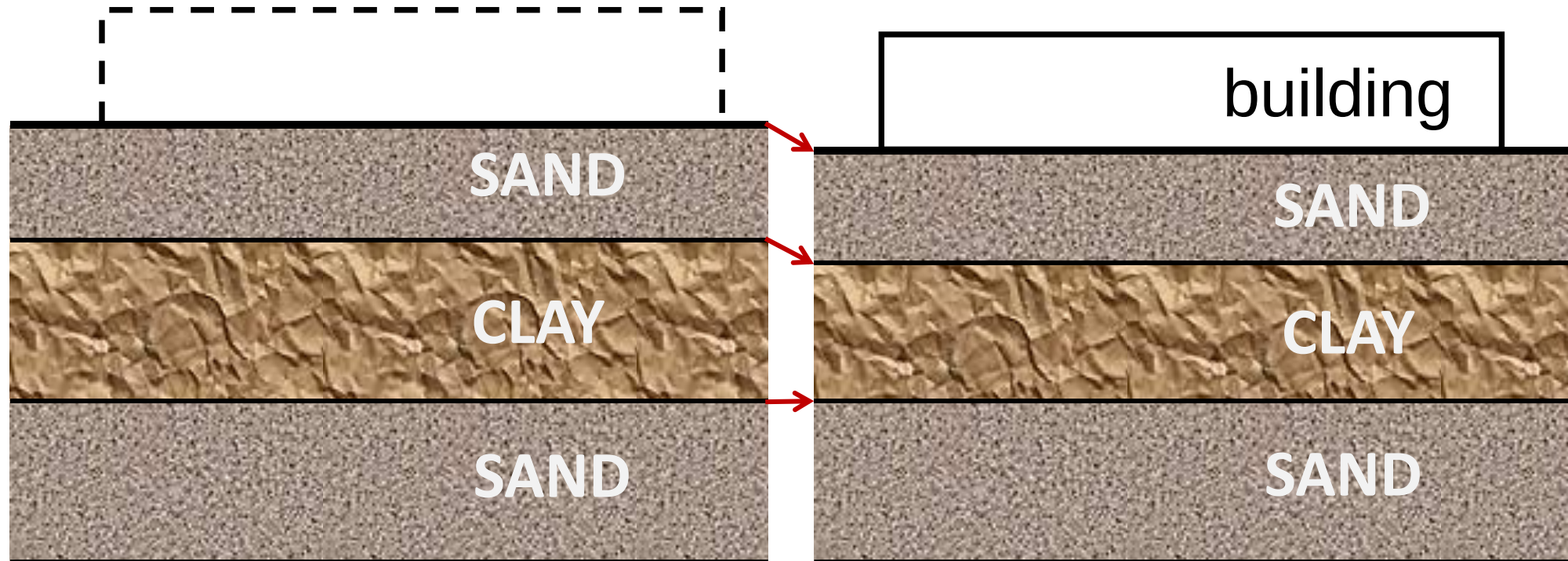
foundation area A = building footprint (see transcript)

$$\text{Stress } \sigma = \frac{W}{A} = \frac{\text{Building load}}{\text{Foundation area}}$$

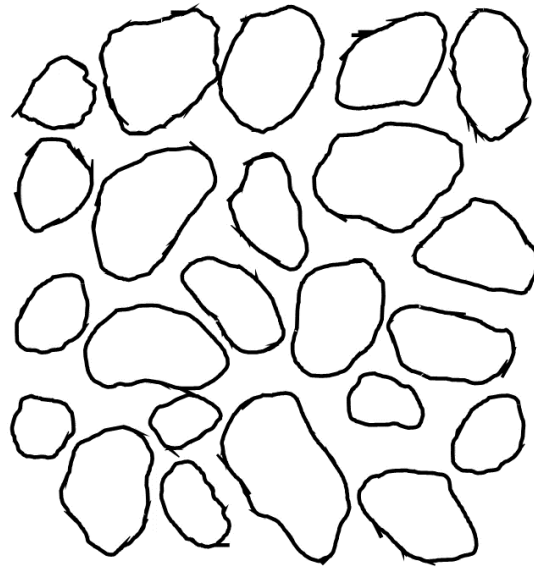
Soil cross section or soil profile: soil layers underneath soil surface



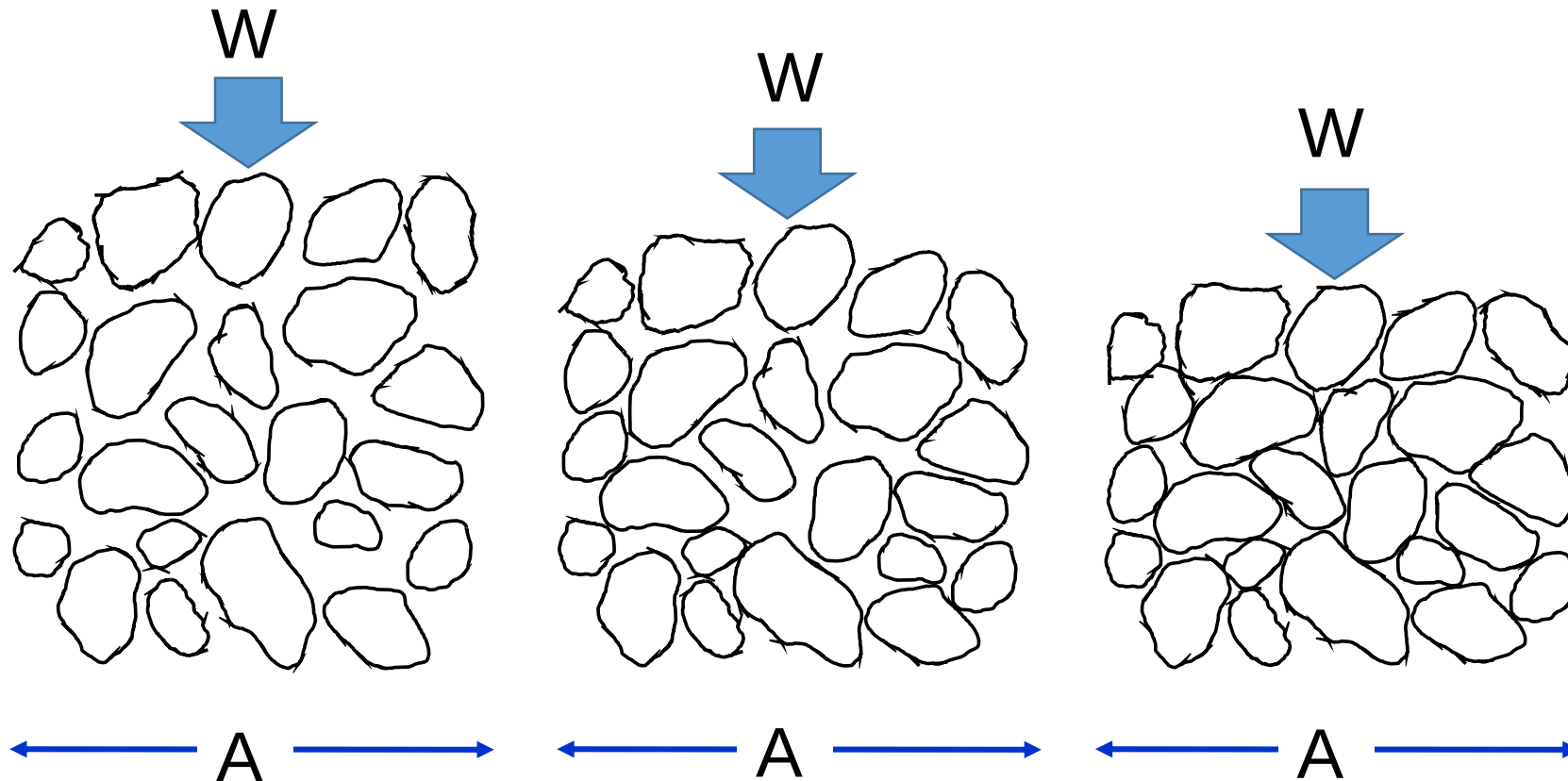
Settlement of soil surface = compression of soil layers



Soil compresses = soil grains move



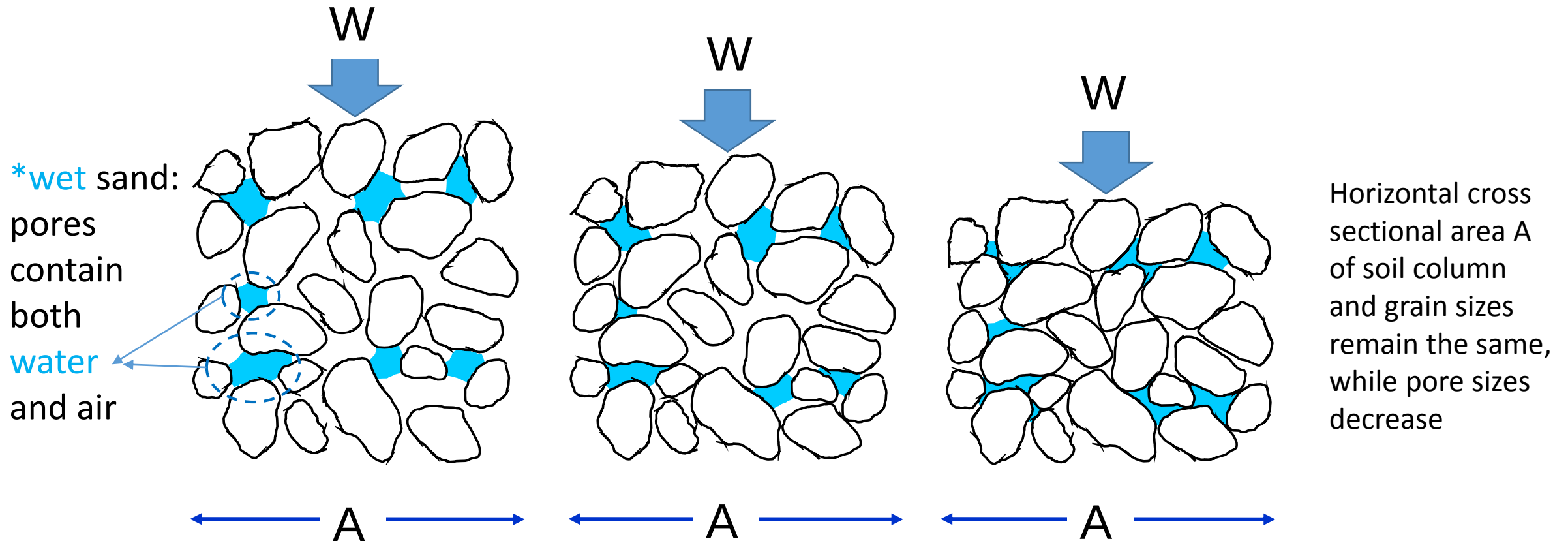
Compression of dry sand = air escapes, pores get smaller, grains come closer together



Same three frames we saw animated on previous slide.

Horizontal cross sectional area A of soil column and grain sizes remain the same, while pore sizes decrease

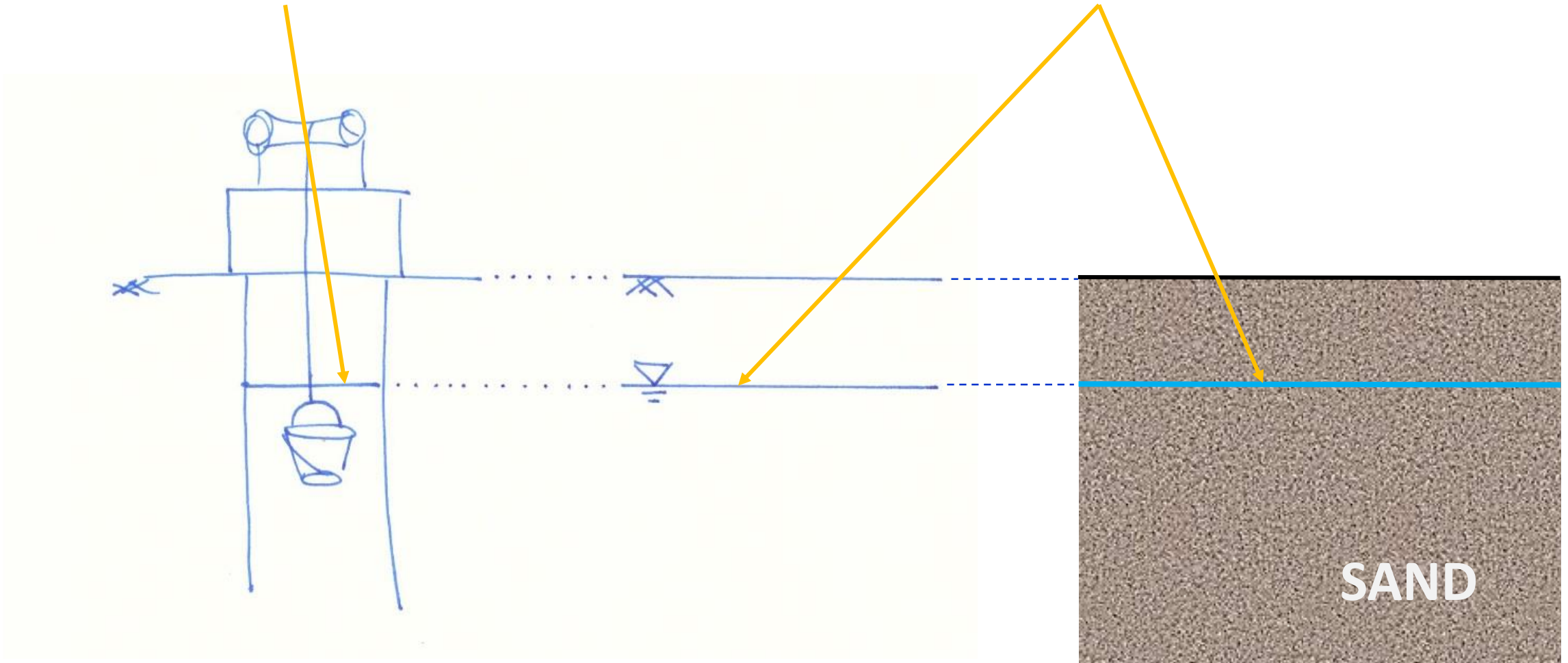
Compression of wet* sand = mainly air escapes, pores get smaller, grains come closer together



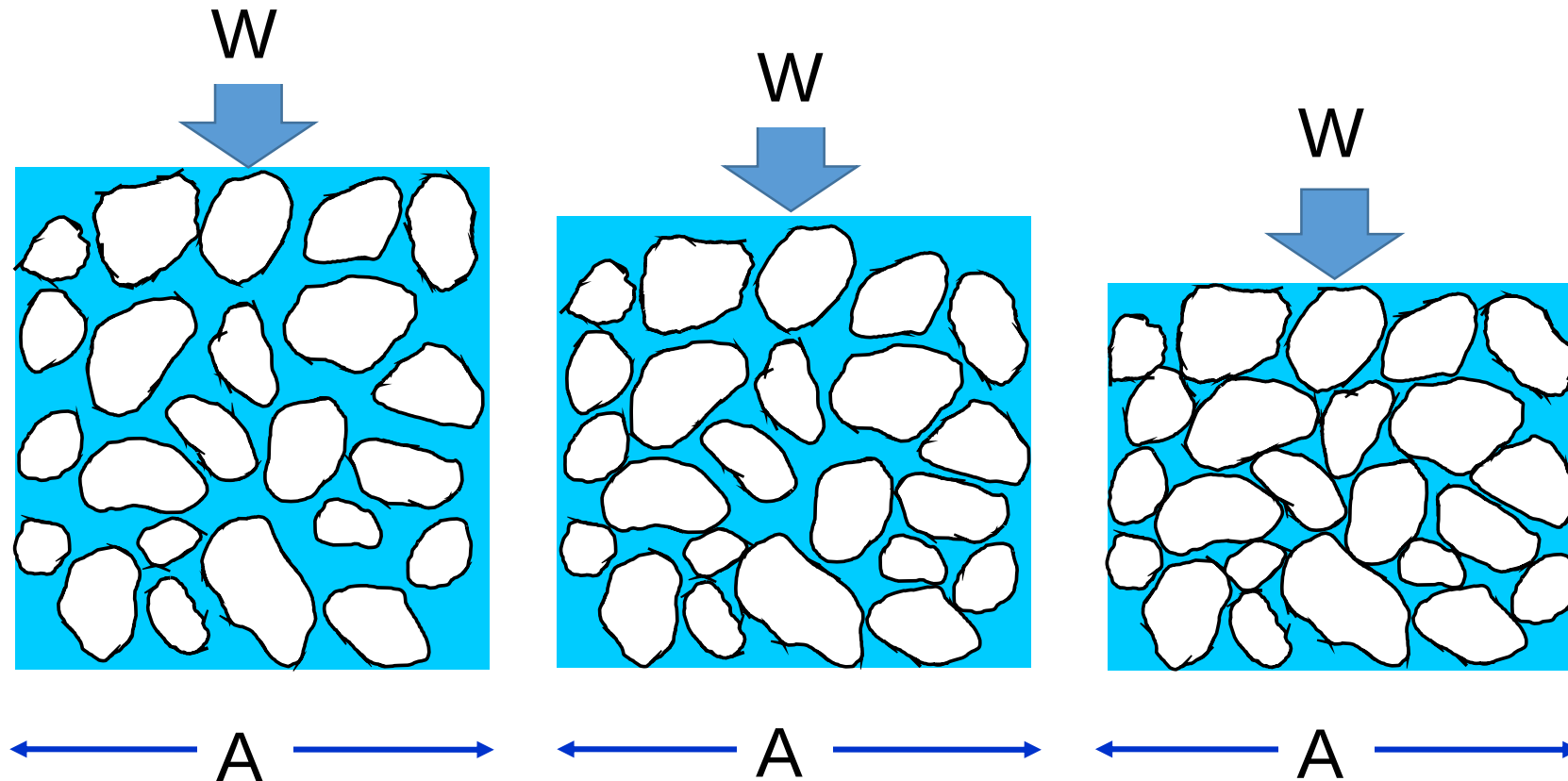
Water in wells



Water surface in wells = Groundwater level



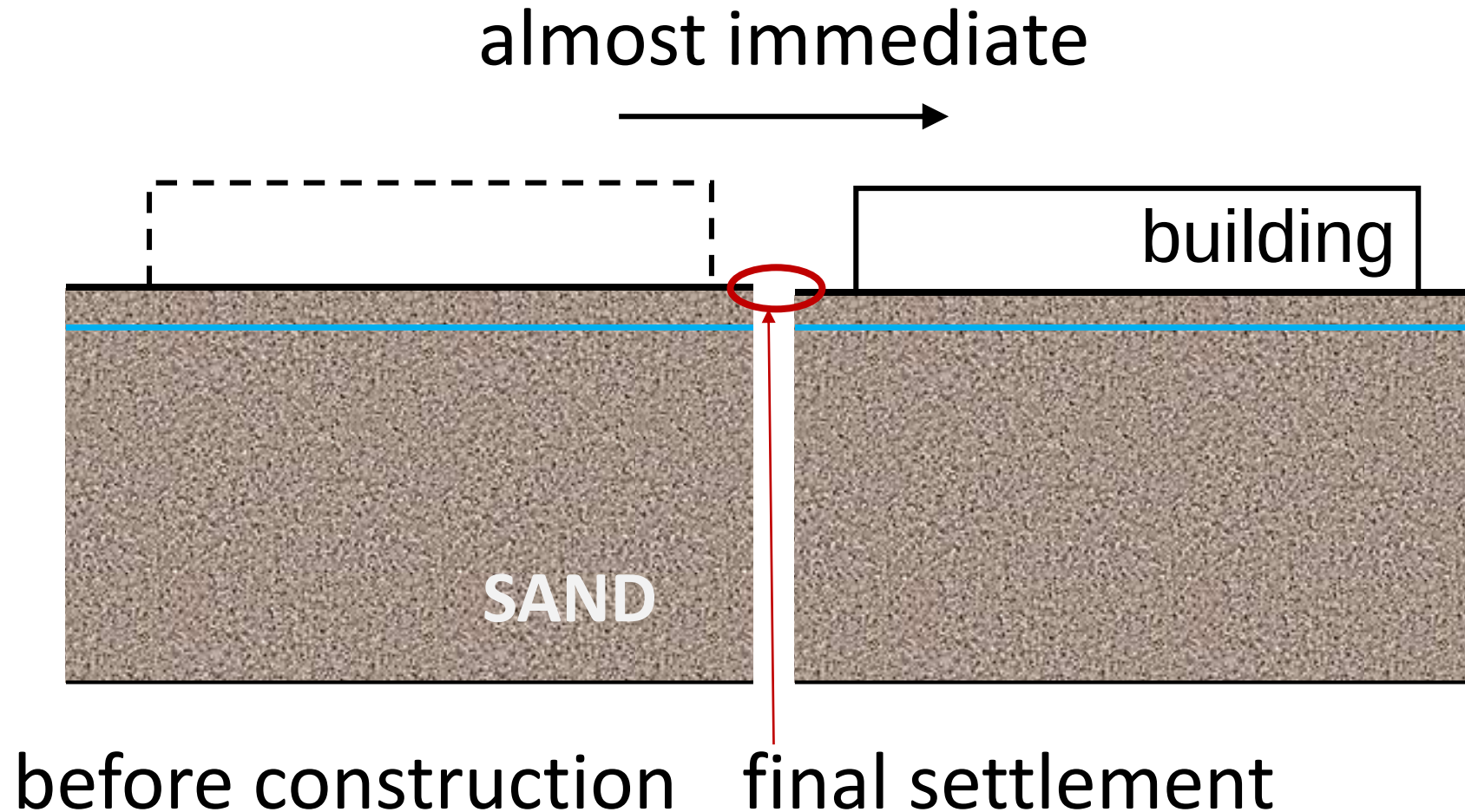
Compression of saturated sand = water* escapes**,
pores get smaller, grains come closer together



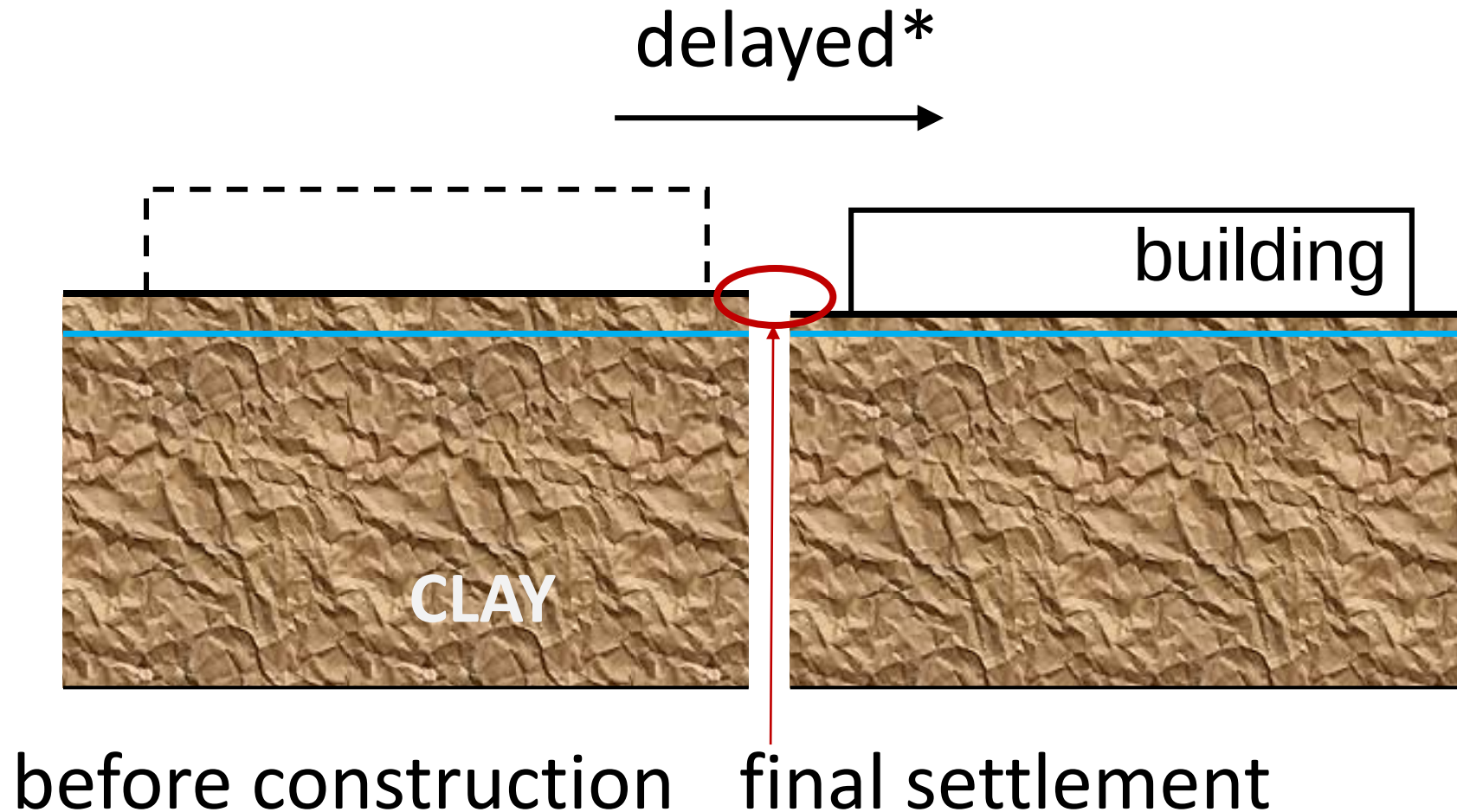
* without air entering

** escaping water not shown

Building construction → Sand settlement



Building construction → Clay settlement



*because water flows slowly through clay

Soil compression – main ideas

- Buildings cause soil to compress: the technical term is “settle”
- The volume of soil reduces when the volume of the pores between the grains decreases
 - air escapes from dry soils or partly dry – partly wet soils
 - water escapes from soils with pores filled only with water (saturated soils)
- The above has been more or less known or could be anticipated
- The new information is that in clay soils (that is, soils through which water moves slowly), soil settles slowly before it stops
 - How slowly? It may take a few to many years.

Soil settlement - impacts

- Evolution of soil settlement in time: we want the settlement to be practically complete before we start using our structures (for example, before we connect our buildings to the utility lines)
 - There are foundation design methods that reduce the amount of settlement and speed up its completion (taught to civil engineering students)
 - Settlements not anticipated during the design stage of a building can cause serious problems (see Part 2)
- 

Attribution of sources

- Picture (to the right) in Slide 11 from Creative Commons:
<https://www.flickr.com/creativecommons/>