VIDEO-LESSON DEVELOPING
THE BIG IDEA OF SOIL MECHANICS "EFFECTIVE STRESS"
IN THREE PARTS + SUMMARY
BY ADDRESSING THE ESSENTIAL QUESTION
"WHAT HAPPENS WHEN SOIL COMPRESSES"

SUMMARY

1 Introduction

We have reached the summary.

2 Goal of the video-lesson – summary of the SUMMARY

On one slide, we will see: WHAT WE LEARNED ABOUT HOW SOIL COMPRESSES

And on two more slides we will see: MORE GENERAL THINGS WE LEARNED WHILE LEARNING ABOUT HOW SOIL COMPRESSES

I suggest we keep three things from the long story of this video-lesson.

3 The engineer's answer to our initial question: when soil compresses, effective stress increases

The first thing to keep is the answer we gave to the question about the topic we said it is worth teaching to everyone. We started by asking what happens when soil compresses. Then we narrowed down the question and focused on what happens to saturated soils, below the groundwater level. We saw that as the soil skeleton compresses, the soil grains come closer together and some water leaves, the water that cannot fit in this tighter packing of grains. The quantity that determines how much soil compresses is the effective stress, the stress felt by the soil skeleton. Effective stress increases – compression increases. We saw that effective stress increases when the total stress increases (when we build a building) or when the water pressure *decreases* (when we pump groundwater). Finally, we saw that in order for soil to compress, some water must escape. So compression is completed when the escape of the excess water is completed. In soils through which water flows slowly, like in clay soils, this delay in settlement completion may be unacceptable. In such a case, the geotechnical engineer will address the problem by selecting alternative methods to design and construct the foundations of the building.

4 Impacts from engineering projects: prediction

The second thing I suggest we remember is general. It has to do with the possible impacts of engineering projects on natural processes. After the fact, and provided we understand the phenomena, some things seem reasonable. In this video-lesson, we followed this order of presentation: soil compresses – soil expels water. We pump water from soil – water leaves the soil. It makes sense that soil compresses. But, when we want to pump water, our attention is on water. It is not obvious to think what will happen to soil. People in Venice and Mexico City did not think about the soil, until they saw the settlements. That something makes sense after the fact does not guarantee

that we will think of it in advance. In the engineering profession, we must think in advance of everything that might go wrong, all the undesired possibilities. We must quantify all the impacts and go ahead with our project when all the negative impacts have been identified and quantified, and their magnitude is acceptable. If something is not acceptable, we change the project design.

5 How do the applied engineering sciences work?

The third thing I suggest we keep from this video-lesson has to do with the general method of the applied engineering sciences. Like in basic science, we try to discover the concepts and the laws that can explain many phenomena with some common characteristics. An example of such a concept is effective stress, which explains the loading of soil and the pumping of water.

After we have explained the phenomenon to ourselves, we can describe it with a mathematical expression. The mathematical expression will allow us to calculate the quantity of interest with precision. The calculation of settlement due to loading of the soil and due to pumping water is an example of this process.