State of the art vs. engineering practice vs. what we teach

An example: Compressibility

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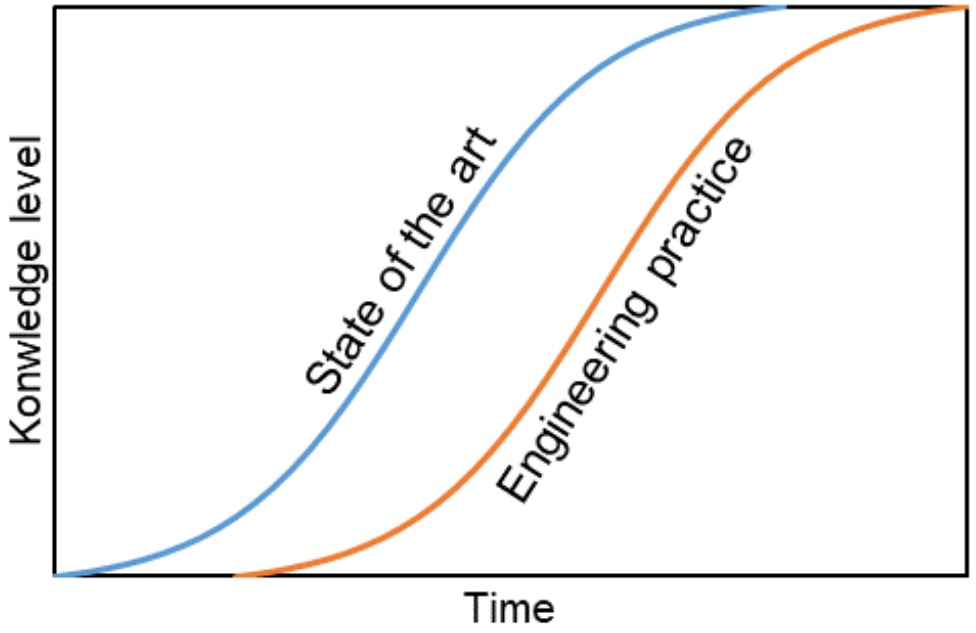
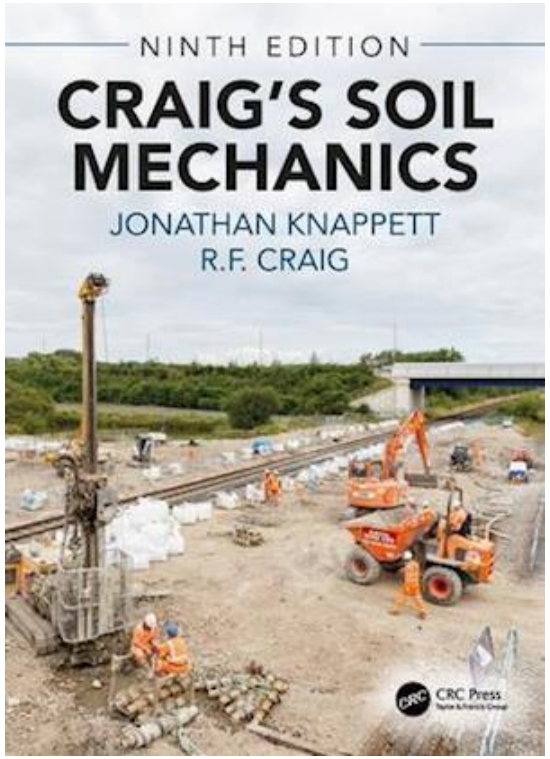
State of the art vs. engineering practice vs. what we teach

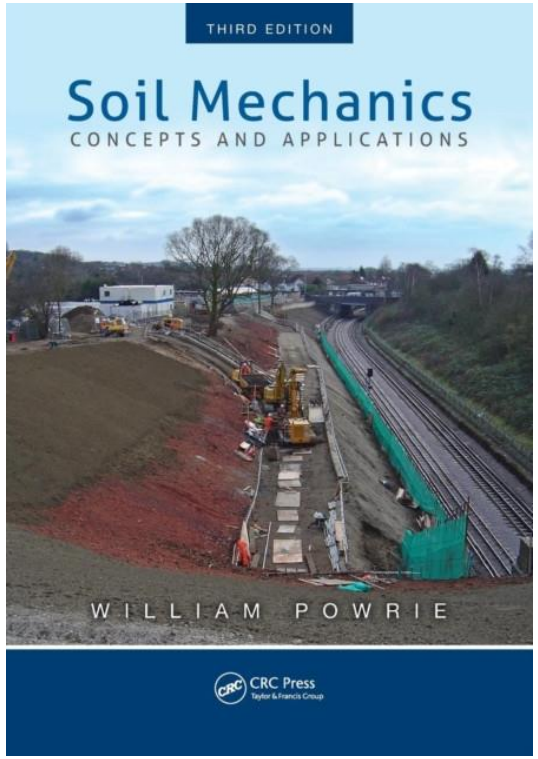
- The state of the art constantly develops and often contain disputes
- Engineering practice and teaching is chasing the state of the art
- Since teaching impacts engineering practice, how far can we afford it to be behind the state of the art?
- **All of the above in the context of an example close to my heart: Compressibility**

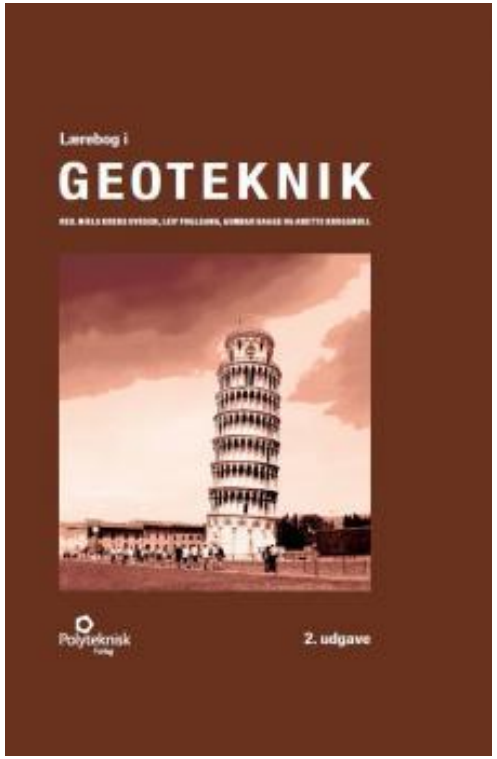


Based on the figure presented by Harry Poulos (2022) at the Time capsule session of the 20th ICSMGE

Settlement-time prediction in textbooks

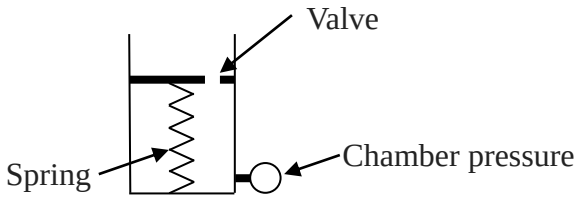


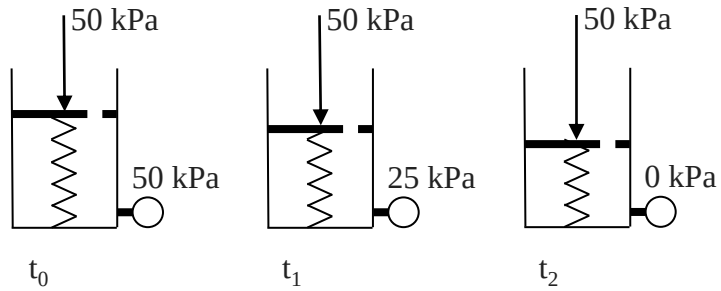


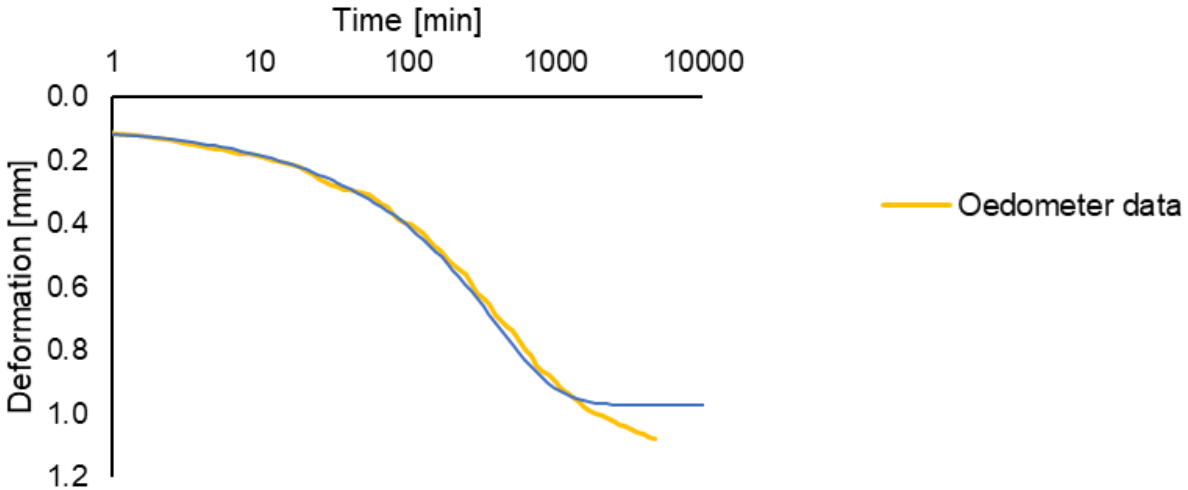


Consolidation theory

- All three textbooks introduce consolidation in a similar way:
  - Terzaghi's 1D consolidation theory, hence: $\frac{\partial u}{\partial t} = c_v \frac{\partial^2 u}{\partial z^2}$ and its solution.
  - The oedometer test and how to derive c_v (Casagrande and Taylor constructions)

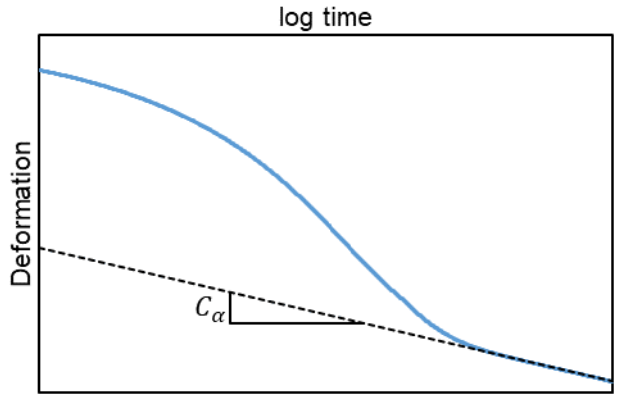






In one textbook this is the end of the story. We are now ready to predict settlements of actual geo-structures??

Secondary compression



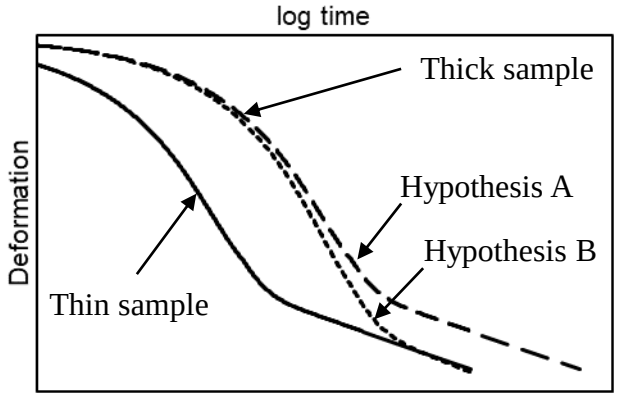
- Two of the textbooks introduce secondary compression and teach you that it can be described by C_α.
- One textbook then states: *"… Thus the secondary compression characteristics of an oedometer specimen cannot normally be extrapolated to the case of a full-scale foundation."*
- The other describes that secondary deformation is calculated as:

$$\varepsilon_{creep} = C_\alpha \cdot \log(t/t_{100})$$

- **Although there is consensus about the primary deformation (consolidation) we are left with three different recommendations on how to predict secondary compression**

What is the state of the art?

- TC306 “favorite figures” project – My contribution



Adapted from:

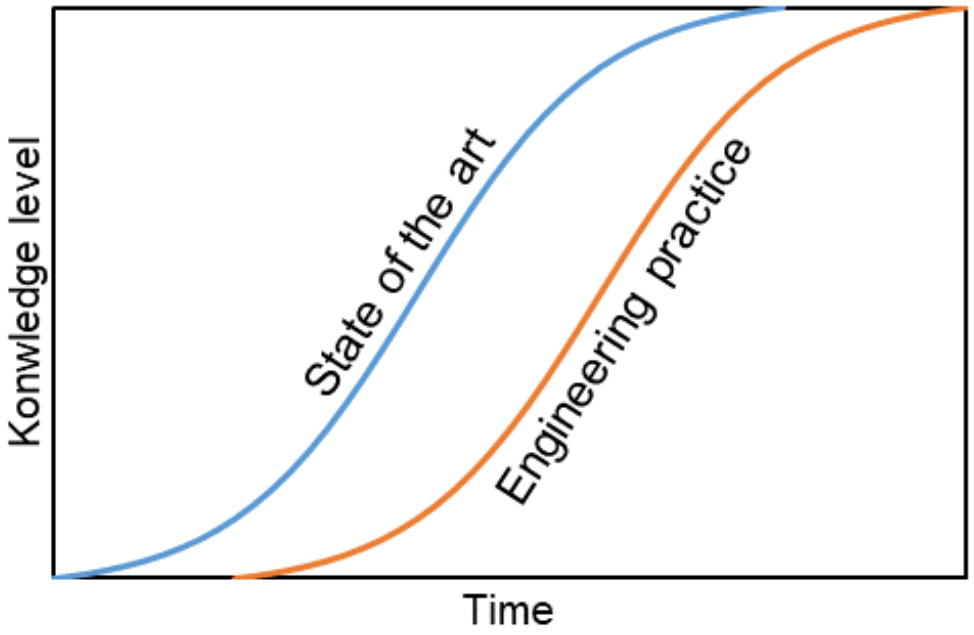
C. C. Ladd, R. Foott, K. Ishihara, F. Schlosser, H. G. Poulos, 1977, Stress-Deformation and Strength Characteristics, State-of-the-Art Report, Proceedings of the 9th ICSMFE, Tokyo (Figure 40, page 448)

S. A. Degago, G. Grimstad, H. P. Jostad, S. Nordal and M. Olsson, 2011, Use and misuse of the isotache concept with respect to creep hypotheses A and B, Géotechnique (Figure 1, page 898)

- Leroueil, S. 2017. Compressibility and consolidation of clays: From lab to field conditions. ISSMGE webinar (url in references)

State of the art vs. Engineering practice vs. What we teach

- What we teach impacts engineering practice.
- Where is teaching on this graph? Where should it be?
- How do we adjust teaching to an ever evolving state of the art?
- What should we skip to be able to reach further in what we teach?
- In what other topics do we see similar differences between state of the art and what we teach?



Based on the figure presented by Harry Poulos (2022) at the Time capsule session of the 20th ICSMGE.

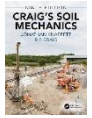
Ledesma, A. (2024): The difficult task of teaching shear strength of soils

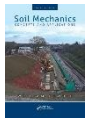
"It is not appropriate to present concepts without a supporting theoretical framework that is nowadays available, so we are committed to adapt those theories to the undergraduate level."

References

TEXTBOOKS

- Knappett, J. and Craig, R. F. 2019. Craig's soil mechanics. CRC Press, Taylor and Francis Group, 9th edition.
- Powrie, W. 2014. Soil mechanics concepts and applications. CRC Press, Taylor and Francis Group, 3rd edition.
- Ovesen, N. K., Fuglsang, L. and Bagge, G. 2009. Lærebog i geoteknik. Polyteknisk forlag, 1st edition.





OTHER REFERENCES

- Degago, S. A., Grimstad, G., Jostad, H. P., Nordal, S. and Olsson, M. 2011. Use and misuse of the isotache concept with respect to creep hypotheses A and B, Géotechnique, 61(10):897-908 (Figure 1, page 898)
- Ladd, C. C., Foott, R., Ishihara, K., Schlosser, F. and Poulos, H. G. 1977. Stress-Deformation and Strength Characteristics, State-of-the-Art Report, Proceedings of the 9th ICSMFE, Tokyo (Figure 40, page 448)
- Ledesma, A. 2024. The difficult task of teaching shear strength of soils, Soils and Rocks, 47(2), Special Issue on Geo-education, ahead-of-print article.
- Leroueil, S. 2017. Compressibility and consolidation of clays: From lab to field conditions. ISSMGE webinar. https://www.issmge.org/education/recorded-webinars/compressibility-and-consolidation-of-clays-from-lab-to-field-conditions