



University of Zagreb  
FACULTY OF MINING,  
GEOLOGY AND PETROLEUM  
ENGINEERING



# 100 Years of Soil Mechanics and Professor Nonveiller

- a flash review —

A Tribute to the Founders and Builders of  
Modern Geotechnics

by P. Kvasnička

# Soil mechanics before 1925

- **Early 20<sup>th</sup> century:**  
**No formal soil mechanics**
- **Major building projects coexisted with major failures**
- **Railway and road embankment collapses led to investigation committees**
- **No unified theory to explain soil behaviour**
- **Heuristic methods**

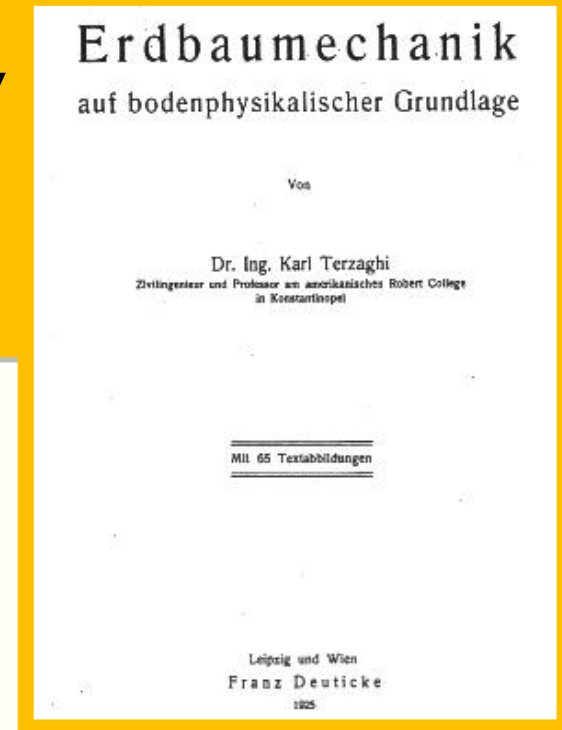
**Prije 1925 nije postojala „mehanika tla“, nego su nakon havarija osnovani odbori za istraživanje uzroka**

# Karl von Terzaghi (1883 – 1963)

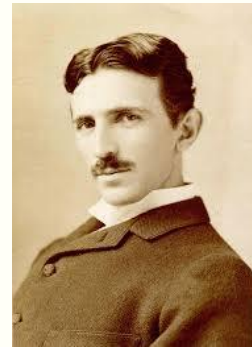
- Young Karl Terzaghi began to develop **his own approach**, based on physical and mathematical foundations.
- Found some common features in existing analytical procedures and integrated them into a **framework of effective stresses**.
- Stressed the importance of soil properties like **internal friction and cohesion**, and the significance of **water (permeability, capillary action)** on soil behaviour. **Consolidation theory**.
- Advocated for the **observational method** during construction and the use of the simplest possible apparatuses for testing soil properties.



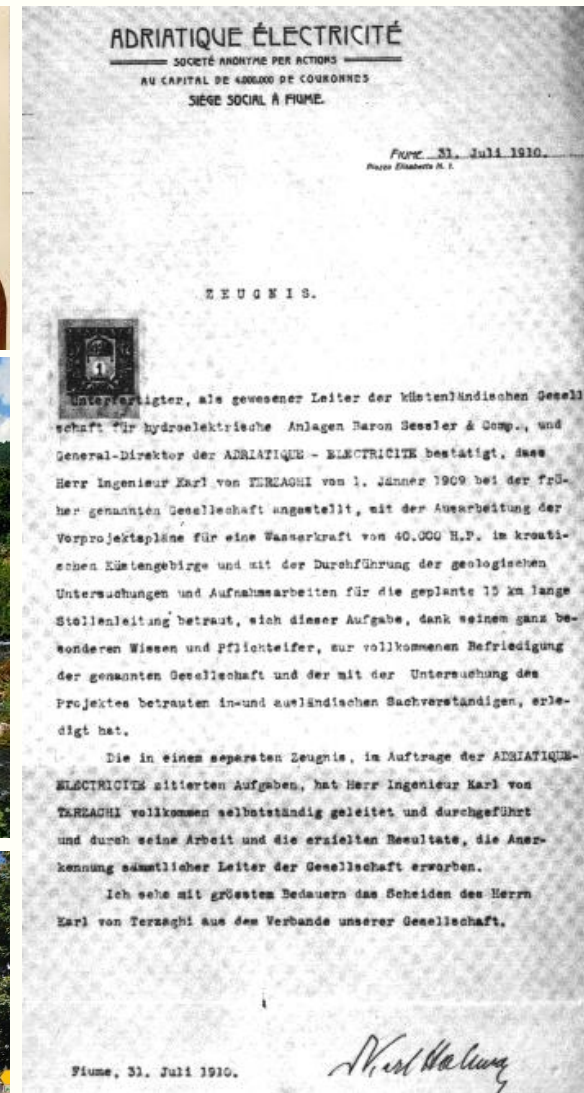
**in 1925, Terzaghi published his book  
'Erdbaumechanik auf  
Bodenphysikalischer Grundlage'  
and soil mechanics  
as a technical science was born!**



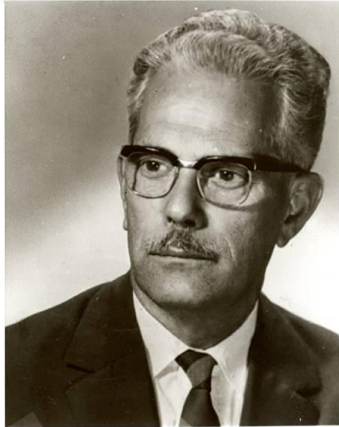
# Karl Terzaghi spent more than a year in Croatia, in Lika, where Nikola Tesla was born and grew up



- Assigned by Adriatique Électricité (1.1.1909.-31.7.1910.)
- Investigated the hydroelectric potential of the Gacka River
- Otočac, two weeks ago



# **Ervin Nonveiller (1910-1999)** **at TU Vienna, a student of K. Terzaghi**



**1910-1999**

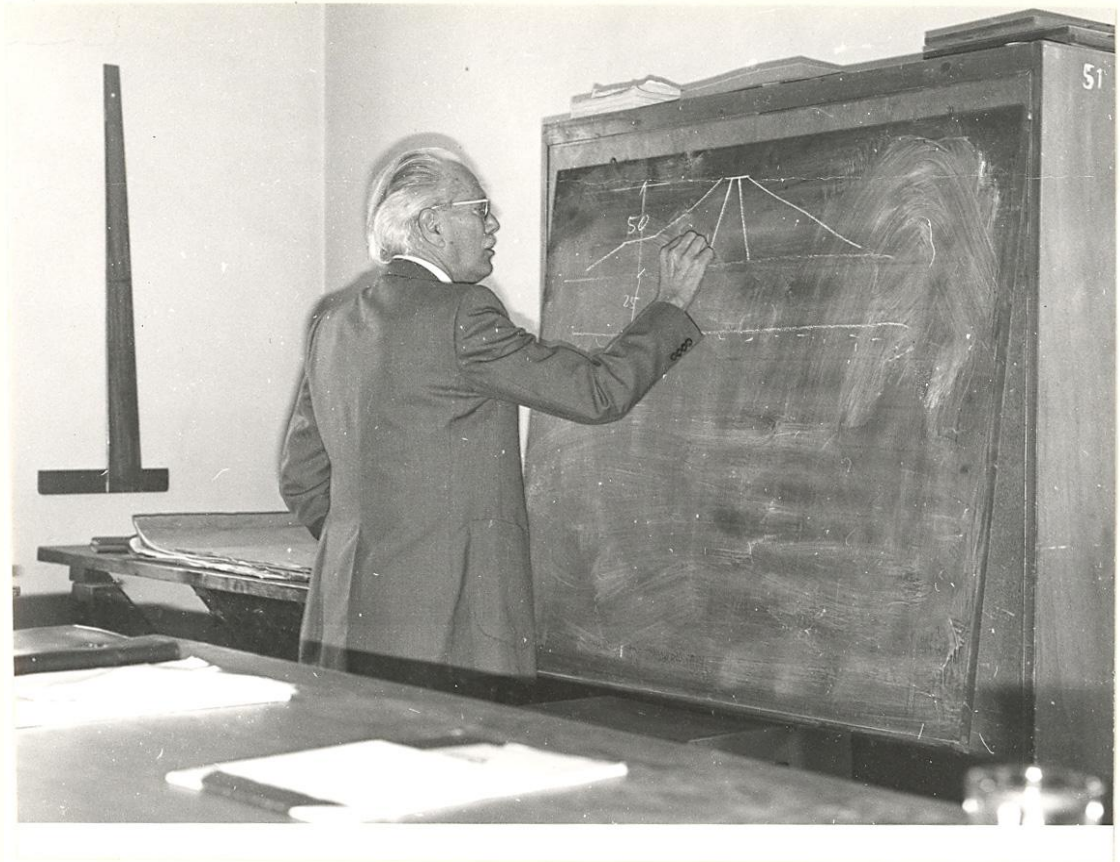


**1983-1963**

- **Graduated from TU Vienna in 1932**
- **Thesis supervised by Terzaghi**
- **Notes from Terzaghi's lectures preserved at the Norwegian Geotechnical Institute**

# Nonveiller's geotechnical work

- Turned to geotechnics during Lokvarka & Vinodol dams construction in 1948
- Organised rock deformation measurements
- Pioneered grouting porous rock at Bajer dam
- Received his doctorate in 1957
- Joined the Faculty of Civil Engineering in 1961 as an associate professor



Nicosia WDD 22.12.79

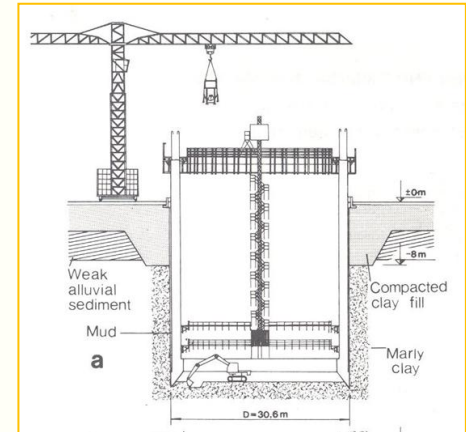
# Key engineering projects



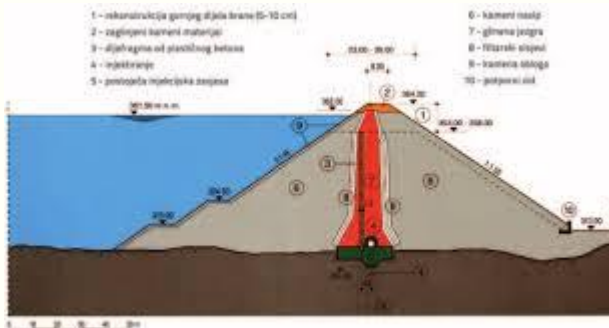
**Lokvarka dam**



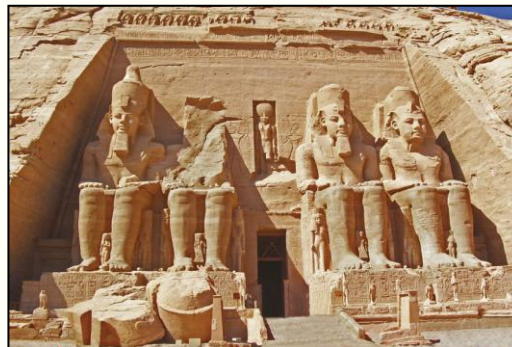
**Mahabad dam, Iran**



**Obrovac - controlled sinking of a caisson in a weak rock**



**Peruča dam**



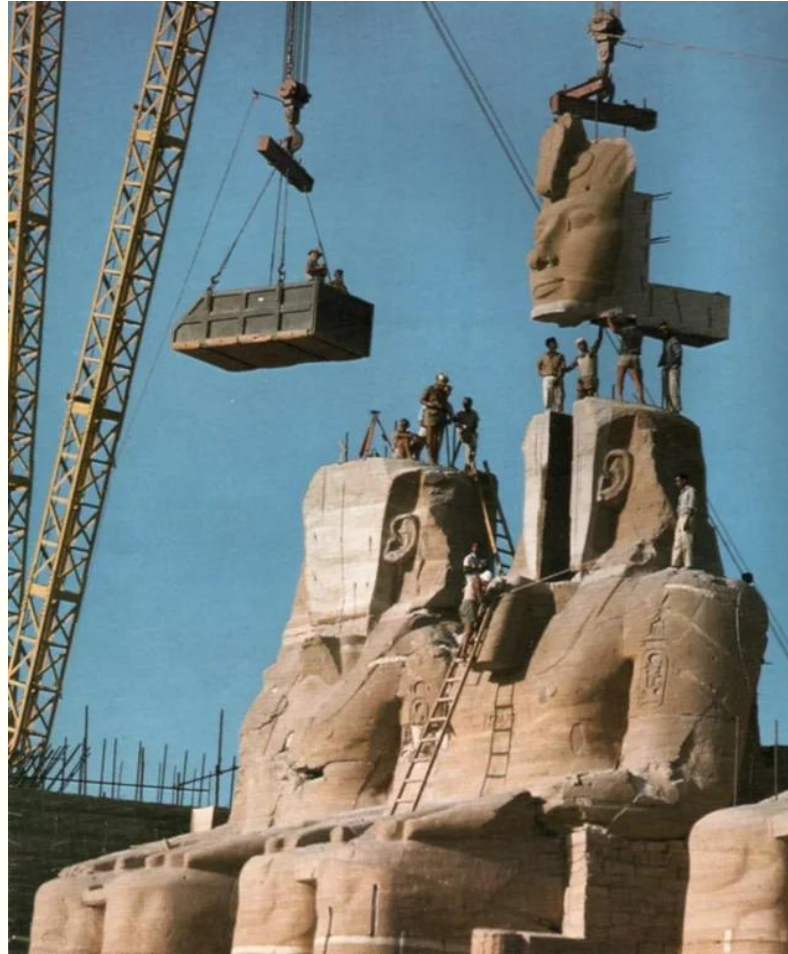
**Relocation of Abu Simbel Temples**



**Stabilisation of the Tower of Pisa**

# Relocation of Abu Simbel Temples – the UNESCO led project

- 1968: Saved from Lake Nasser flooding
- Cut into 1,000+ blocks, moved 65m higher
- Sandstone blocks grouted with resin
- Collaboration: Engineers, archaeologists, 3,000 workers



Hrvatski inženjeri  
ispitali su 23 hrama  
egipatskih faraona  
i opet ih sastavili

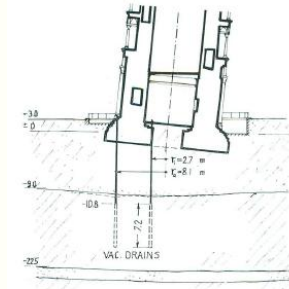
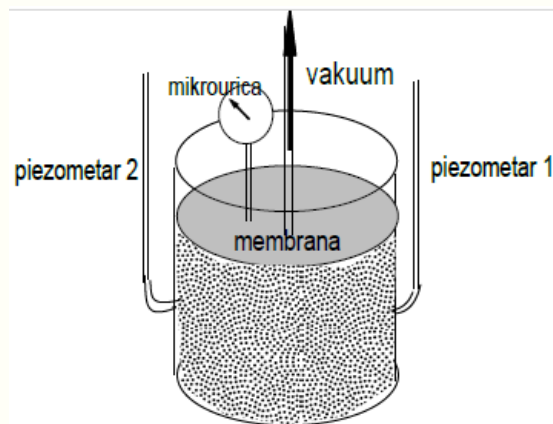


Foto: [www.observac](#)  
Gradnja Asuanske brane i gotemog Naserova akumulacijskog jezera uvjetovani su, iz današnje perspektive, kontroverznom relokacijom drevnih građevina iz doba starog Egipta

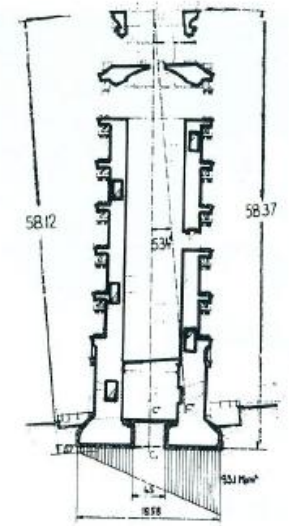
# Proposal for the stabilisation of the leaning Tower of Pisa

- 1970s: Member of the international committee
- Proposed **vacuum drainage to increase effective stresses**
- Analytically studied, lab tests started, although not finished
- Published in Belgium in 1976

From Nonveiller, E.:  
 „Consolidation of weak strata by drainage and preloading”, Extrait des Annales des travaux publics de Belgique, No. 6 – 1976.



25. — Disposition of drains below Tower foundation.



$$\sigma' = \sigma - u$$

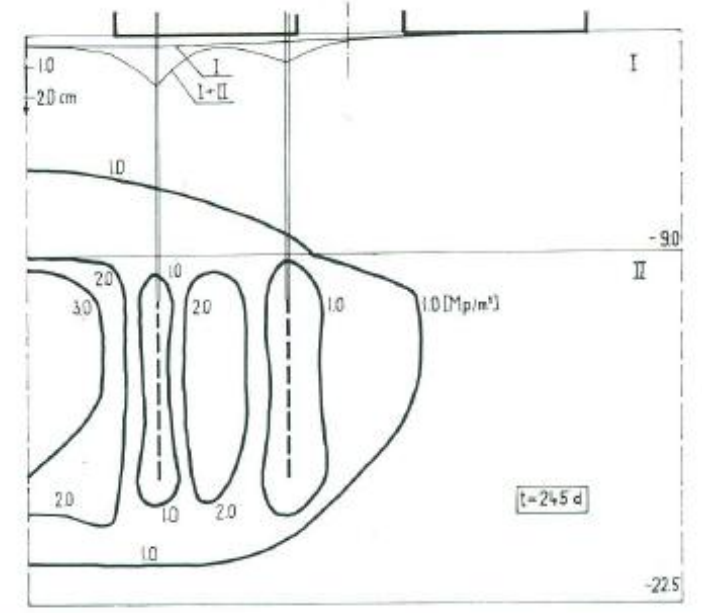


Fig. 27. — Pore pressure field after partial consolidation.



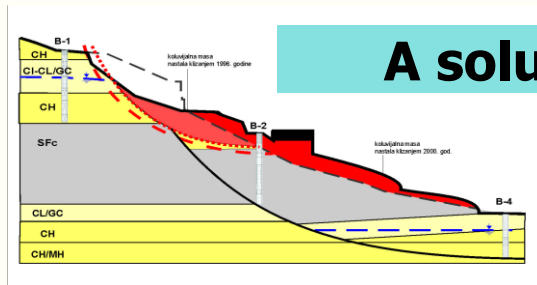
# Legacy of Professor Ervin Nonveiller

- An erudite professor who spoke English, German and Italian
- Member of international boards, panelist
- Solved real-world geotechnical problems
- Promoted quality field & lab investigations
- Early adopter of numerical analysis
- Educated generations of engineers
- Influenced both Croatian and global geotechnics



# Terzaghi and Nonveiller shaped modern geotechnics

- 100 years of progress rooted in their ideas
- Geotechnical Engineering: a combination of theory, observation, and courage

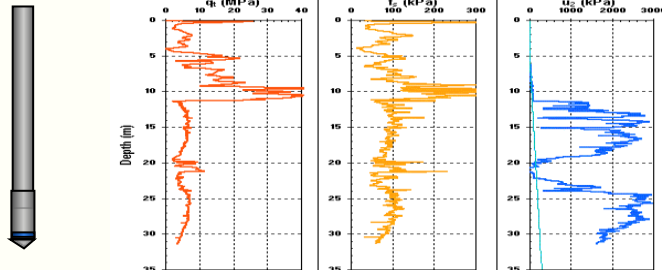


**A solution to a geotechnical problem**

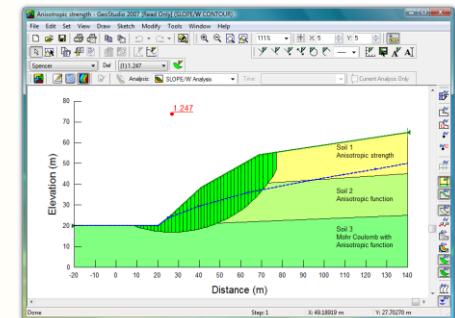


**Experience and courage**

**Observation and testing**



**Theory**



# Visit to the University of Tokyo and to Professor Čubrinovski in 2001



Dr Miško Čubrinovski with  
Dr Rolando Orense at the lab  
of the University of Tokyo



Dr Miško Čubrinovski and his  
family (left) in Yokohama

**Thank you!**

