Keynote Address: Case Histories in Early Soil Mechanics

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Keynote

That case histories today play an important role in soil mechanics is attested by the attendance at this conference and by the long series of such gatherings. Yet, the nature and purpose of case histories have changed over the years. The change has been gradual and almost unnoticed, but it reflects the maturing of our discipline.

Let me take you back 65 years to when I just met the subject as a student of Arthur Casagrande at Harvard. We students had come to learn about a new branch of civil engineering, first introduced to the United States by Terzaghi at MIT in 1925. To be such a student was itself something of an act of faith, because soil mechanics was by no means an accepted discipline, let alone a recognized element in civil engineering. The small group of engineers who attended the first international conference on the subject became its missionaries, but there was skepticism among educators, and particularly among practitioners, that the subject would find a respected place in either civil engineering practice or civil engineering education.

Indeed, the basic question in those days was, simply, did soil mechanics work? Could the behavior of such a heterogeneous and complex material as soil ever be predicted on the basis of theory and material-property tests? Many, probably most, engineers, including many of the foremost practitioners, thought not. Some expressed strong feeling about the matter.

Consider the following quotation from a discussion in the Transactions of the American Society of Civil Engineers in 1938. The discussion, presented by Mr. A. Streiff, Vice-President of the Ambursen Engineering Corporation, a company that designed and built many reinforced-concrete dams in all parts of the world; “Soil mechanics, at least for the present (1938) has not visibly enriched the “tool box” of the practicing engineer. Nevertheless, continued research remains of the greatest importance in spite of the paucity of practical results…..” Mr. Streiff was a vocal, but by no means the only, critic of the new subject, in spite of the enthusiasm generated by Terzaghi and Casagrande at the 1936 conference.

Consequently, many of the case histories in the 1940’s and 1950’s were devoted to observations that showed that soil mechanics actually worked. Skempton, for example, wrote an often-quoted, very short paper demonstrating that the bearing-capacity of a single rectangular footing 8x9 ft in plan, which had been loaded to failure on a soft clay, was given with reasonable accuracy by the simple equation $q_d = 5c = 2.5q_u$. Similarly the Raymond Concrete Pile Company made borings like those on the Chicago subway and obtained 2-inch Shelby-tube samples that we tested in unconfined compression at Illinois and demonstrated that the historic failure of the Transcona Elevator in Winnipeg was also in agreement with the simple expression $q_d = 2.5q_u$. Altogether, perhaps a half-dozen accounts appeared in the technical literature during the 40’s and 50’s comparing actual and calculated failure loads on saturated plastic clays. These exercises, seemingly somewhat naïve and crude today, were nevertheless influential in establishing the utility and reliability of simple applications of the new soil mechanics. They, together with hindcasts of the long-term settlements of buildings on compressible clays in cities such as Chicago, and analyses of slope failures at various places in the world, gradually convinced the skeptics that soil mechanics was a useful and reliable tool.

The importance of these often crude but realistic case histories can hardly be overestimated in demonstrating the practical utility and reliability of soil mechanics. Today, no reputable engineer would dismiss the subject as irrelevant. However, today’s applications are often far more complex. They make use of much more sophisticated field and laboratory investigations, and predictions often involve extensive computer modeling in which approximations must be made about the behavior of both the soils and the affected structures. Many assumptions are embodied in such forecasts, whether the designed realizes it or not, and the consequences of error may be severe. Hence, in the complex problems of today, the need for observations and documentation in case histories is no less than it was a half century ago. Indeed, the complexity of many modern projects demands some form of the use of the observational method, and the results deserve being included in authoritative case histories.

Possibly the weakest aspect of our modern-day accumulation of case histories is the characterization of the soils involved, including the geological implications. Anyone who has read Goodman's biography of Terzaghi cannot help being impressed with the quantity and quality of inference that Terzaghi habitually drew from the physiography and geomorphology of a site even before any borings were made. This sort of information and how it was used should be incorporated in any geotechnical case history. The failure to think and act in geological fashion is an undesired by-product of our computer age. It must be remedied, or the benefits of applied soil mechanics will be lost. As expressed by Don Deere, we mush keep the geo in geotechnics and in the data preserved in our case histories.

So today's case histories must not be allowed to settle into routine descriptions of boring logs, soil tests, and computational procedures. It is my hope that this conference and those to follow will increasingly describe interactions among geology, soil properties adequately described, construction procedures, and performance.

References:

Skempton, A.W., (1942). An Investigation of the Bearing Capacity of a Soft Clay Soil, Journ. Inst. C.E. 18, p. 307.

Skempton, A.W., (1951). The Bearing Capacity of Clays. Building Research Congress I: pp. 180-189.

Peck, R.B. and F.G. Bryant (1953). The Bearing Capacity Failure of the Transcona Elevator. Geotechnique, March 1953, pp. 208-210