FIELD MEASUREMENTS
MESURES DE CHANTIER

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Returns to my questionnaire indicated that the majority of the participants attending the session expressed interest in field measurements related to embankments and slopes, excavations, and tunnels. At the beginning of the session these three topics were introduced in a general way by Prof. C.C. Ladd, Dr. Y. Lacroix, and Dr. W.H. Ward. The remainder of the session was devoted to discussion and questions from the floor.

EXCERPTS FROM THE CHAIRMAN'S OPENING REMARKS.

Our science of soil mechanics has evolved remarkedly well, during the past 50 years, not only on the basis of sound reasoning and application of appropiate theoretical concepts, but also to a large degree on the quantitative assesment of our ideas and theories that have been obtained by field measurements of the performance of soil structures. During the growth of our science, this philosophy of assessing the field behavior of our soil structures has been strongly advocated by most experts involved in the practice of soil engineering.

As a result our field measurements have proved to become a more and more important aspect of soil engineering. This trend was indicated by Terzaghi in 1954 when he stated that further progress depends chiefly on the improvement of our methods for measurement in the field. During the 15 years that have passed since Terzaghi made this statement, engineers and scientists throughout the world have indeed developed and improved instruments and techniques that when properly used have enabled us to obtain performance data that can be used to evaluate a great deal of our engineering projects. The principal difficulty, now 15 years later, is not primarily in the instrumentation but in the almost impossible task of sorting out, analyzing, and making practical use of the tons and tons of field data that are collected yearly throughout the world. Unfortunately, many of us often embark on expansive field measurement programs simply because it is now considered "fashionable" to measure or, on the other hand, we start our measurements only after we get into serious trouble on a job. All to often we do not devote sufficient manpower and time to either the planning of instrumentation programs nor to the analysis of the results and the incorporation of new findings based on field measurements into current engineering practice. This certainly does not mean that the speaker is advocating that we cease to make field measurements; the point to be made is that we must give more attention to both the details of the planning and execution of our field measurement programs and to the interpretation and use of the data.

Introduction by Prof. Ladd (M.I.T.)

"In conclusion, as Dr. Di Biagio mentioned even if you have reliable instrumentation, there is a problem, a measure's problem, one of this mentions is the collection in practice in which also how are you going to interpret the data you want to get it."

Introduction by Dr. Lacroix

The topic of his discussion was field observations and measurements in bottom excavations.

"I paid attention according that I have to measure with instruments, that many jobs requires no instruments, or a minimum of instruments, it depends about the accuracy of measurements, so it is variable. Field observatior and measurements in the construction on bottom excavations may have two purposes: one, to obtain data we could improve future designs; and two, obtain data to be immediately used to improve the state and economic of bottom excavation".

Introduction by Dr. Ward

"The constructions of tunnels gives origin to movements in the ground which particularly affects the structures along sides of the tunnels, and it is convenient to make appropriated instrumentations".

Prepared discussion from the Floor.

In order to be able to have sufficient time for questions and free discussion from the floor, the chairman, prior to the session did not encourage prepared discussions from the floor. Nine participants, however, requested and were granted permission to made prepared contributions. Each person was requested to limit his remarks to 10 minutes or less. Unfortunately this time limit was often exceeded, consequently, there was too little time for free discussion and questions from the floor. The chairman apologizes to the participants for allowing the time schedule to get out of hand.

Mr. F. Rosset gave two contributions in French. The first of these consisted of a description of the instrumentation used to measure displacements in the barrage Du Montcenis. Summary results of measurements were presented. A vibrating-wire inclinometer was used for measurements in inclined or vertical holes and a travelling hydraulic sensor was used in horizontal holes.

The second contribution described a nuclear device for insitu measurements of water content and density.

Dr. L. A. Wolfskill gave a summary of total earth pressure measurements at three points in a horizontal plane beneath an embankment of granular material. Each measurement point consisted of a cluster of three vibrating wire pressure cells mounted at different distances from the center of a circular steel plate. For a typical cell, calibration characteristics were compared for simple fluid pressure calibration and for calibration by embedding the cell in a tank of granular material and applying a distributed load to the top of the tank. Results of field measurements were summarized for various stages of embankment construction; these confirmed remarkedly well with computed values.

Dr. L. G. Bromwell described briefly a prototype inclinometer currently under development at M. I. T. A sample set of field measurements was included. The sensing component of this device is essentially a two component accelerometer and a servocoil; the reported sensitivity of the inclinometer is 10^{-5} radians. If suitable signal conditioning and recording equipment are used, observations can be made by one man nearly as fast as the inclinometer can be withdrawn from a hole. Further details can be obtained directly from Prof. Bromwell.

Mr. C. M. Vinel presented in French a description of an extensive measurement program connected with the construction of a tunnel in sand beneath the city of Bruxelles. The tunnel is 9m, in diameter and was constructed with the aid of a shield.

Measurements of earth pressure on the lining, stresses in the concrete liner plates, deformations of the tunnel and surrounding material, cone penetration data, and measurements with total pressure cells placed in boreholes adjacent to the tunnel were rapidly illustrated orssummarized in a series of 23 slides.

Mr. Gerrard described investigations that have been carried out in Australia to determine the cell action factor for total pressure cells. Results of calibration tests were presented as well as techniques for placing cells in a sand mass.

Mr. Vaughan followed up the preceding presentation with an illustration of the manner in which total stress was measured, using vibrating wire pressure cells, in the core of a dam, in Great Britain The importance of proper placement and compaction around the cells was stressed. The procedure used was described and summary data presented indicated that the instruments are indeed giving reliable measurements.

Mr. K. Szalay described the proposed instrumentation of Tarbela Dam. Unfortunately, the Session was running late at this time and only a very brief survey of the measurement program was attempted.

Mr. Vormeringer gave an account of a commercial device which enables pore pressure measurements to be made at any depth in a borehole. The borehole must first be lined with a tubular rubber membrane. After the instrument is lowered inside the membrane to the desired depth, expanding packers at the top and bottom of the instrument seal it off the remainder of the boring.

Mr. M. Bozozuk described briefly an instrument for measuring settlements.

The sensing element is a pressure transducer which measures changes in elevation of a fluid filled tube.

Settlement profiles beneath a highway fill were measured by pulling the device through a tube that had been placed under the embankment.