the traditional pore pressure coefficients A_1 and B_1 were calculated; with the same values of σ_3, but with a larger range of $\sigma_1 - \sigma_3$ (1 and 4 kg/cm^2), A_2 and B_2 were also calculated.

Fig.2 shows two straight-lines, for comparison with the observed data and with the values taken from the statistical surface of Fig.1: straight-line (1) shows the variation of u with $\sigma_1 - \sigma_3$, for σ_3= 6 kg/cm^2 (as the other two curves), and for A_1 and B_1; and curve (2) shows the same variation, for A_2 and B_2.

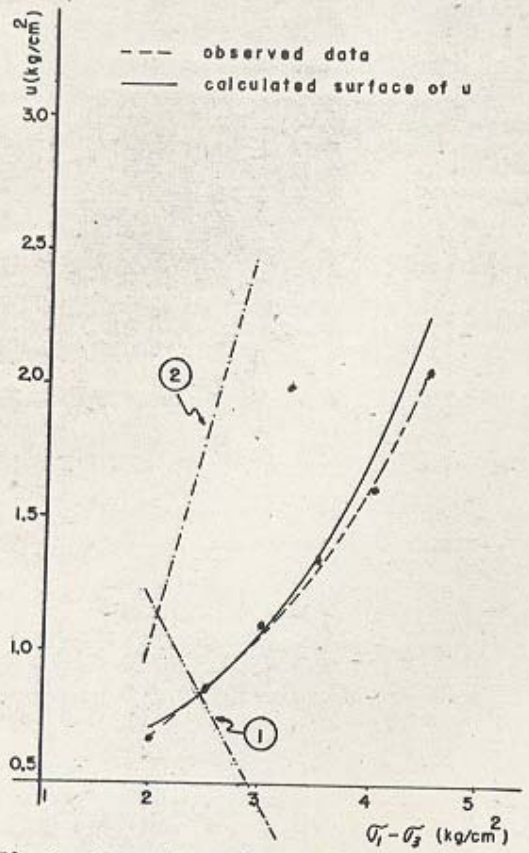


Fig.2- Comparison between observed and differently calculated values for σ_3 = 6 kg/cm^2

These straight-lines show that any computation based on a linearization of the function $u = f(\sigma_3, \sigma_1 - \sigma_3)$ only gives reliable values when the parameters for computation of the pressure coefficients A and B are very close to the values one wishes to calculate; they show therefore that the heavy responsibility of obtaining a reliable result lies on the choice of appropriate values for the determination of A and B, as mentioned in the State-of-the-Art Report under discussion.

The same procedure was carried out for σ_3 = 14 kg/cm^2, as indicated in Fig. 3.

Although this method has been under general use among us, and the conclusions above exemplified have been repeatedly confirmed

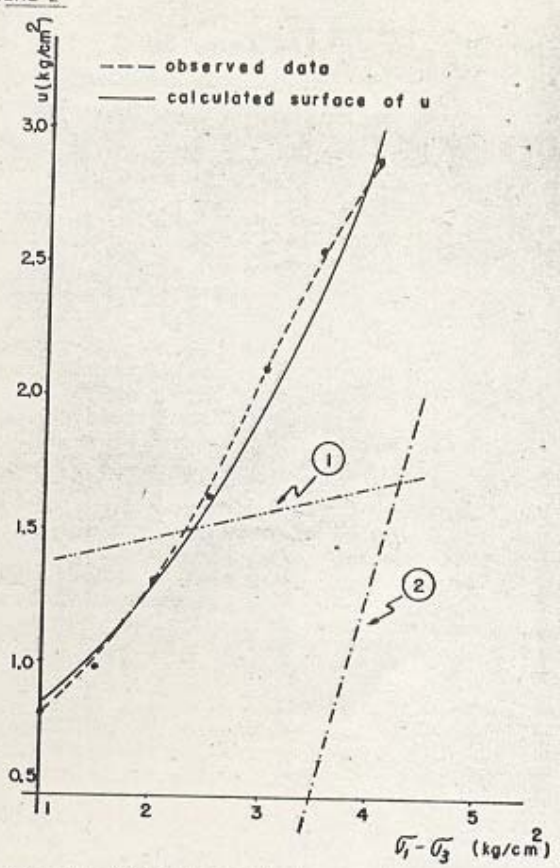


Fig.3 - Comparison between observed and differently calculated values for σ_3 = 14 kg/cm^2

in varying measures depending on soil properties and stress levels, it is felt that the concept of the procedure and its handy computational application is sufficiently documented through the single example presented, based on a very meticulous test program.

defined by the three above variables. The statistical analysis was developed through a computer program, according to the following steps: given several powers of the independent variables (σ_3 and $\sigma_1-\sigma_3$) and their combined products, the program made a research on which of them was the most significant one, established a first best fitting function on this single variable, and analysed its statistical significance; if it proved valid, the research continued in the next step, adding each time the next significant value. Thus, the final equation has the form:

$$\mu = a + b\sigma_3 + C(\sigma_1 - \sigma_3) + d(\sigma_3)(\sigma_1 - \sigma_3) + e\,\sigma_3^2 + f(\sigma_1 - \sigma_3)^2 + g(\sigma_3)(\sigma_1 - \sigma_3)^2 + h(\sigma_3)^2(\sigma_1 - \sigma_3) + i(\sigma_3)^2(\sigma_1 - \sigma_3)^2 + \ldots.$$

in which the coefficients a, b, c... may be zero, or not.

The research starts with two terms (power function of the most significant variable), and, at every step, a new term is added, the most significant one. The research finishes when, from an engineering point of view, the benefit introduced by the addition of a new term is no longer significant.

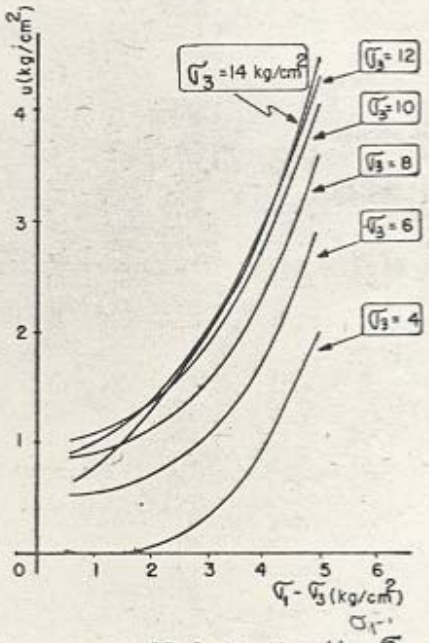
Fig. 1 shows the $\mu = f(\sigma_3, \sigma_1 - \sigma_3)$ best fitting surface determined, which is found to be curved in both coordinates σ_3 and $\sigma_1 - \sigma_3$.

It should be mentioned that, when a surface is established, the values for a hydrostatic pressure ($\sigma_1 = \sigma_3$) would be given by the trace of the general surface of $\mu = f(\sigma_3, \sigma_1 - \sigma_3)$ on the plane of $\sigma_1 - \sigma_3 = 0$, that is, a curve of $\mu = f(\sigma_3)$. However, the statistical analysis seems to indicate that a direct regression on pairs of values of the chamber pressure σ_3 on the samples, prior to the application of any deviator stress ($\sigma_1 - \sigma_3$), does not necessarily belong to the same universe as the surface function of $\mu = f(\sigma_3, \sigma_1 - \sigma_3)$, as may be visualized in Fig. 1b. This means that the pore pressure induced by a hydrostatic pressure on a soil sample does not necessarily follow the same law as that of the pore pressure induced by a deviator stress - which seems to agree with Markus Reiner's considerations about the elasticity theories, on which the pore pressure coefficients are generally based, and about the elastic dilatancy of materials that are constituted by particles.

With a view to establishing the merits of the procedure on the basis of unquestionable experimental data, the exemplifying computations were carried out using the data published in the "First Progress Report on Investigation of Stress - Deformation and Strength Characteristics of Compacted Clays", by Casagrande, A, and Hirschfeld, R.C., Soil Mechanics Series nº 61, 1960, for the Q11, Q12, Q13, Q14, and Q16 tests (table IV and Figs. 28, 29, 30, 31 and 33 loc.cit.), with about the same degree of saturation (around 76%). The values of the confining pressure vary from 4 to 14 kg/cm^2.

Figs. 2 and 3 show comparisons between the observed values during the tests with σ_3 = 6 kg/cm^2 (Fig.2) and σ_3= 14 kg/cm^2 (Fig.3) and the values calculated according to the statistically best-fitting surface - equation of Fig.1. As may be observed, even the highest error, corresponding to Fig. 2, is rather small, even when the equation was established for a relatively large range of the confining pressure values (4 to 14 kg/cm^2).

With the observed values of μ for σ_3= 4 and 10 kg/cm^2, and with $\sigma_1 - \sigma_3$ = 2 and 3 kg/cm^2,



Traces parallel to the μ x σ_3 plane.

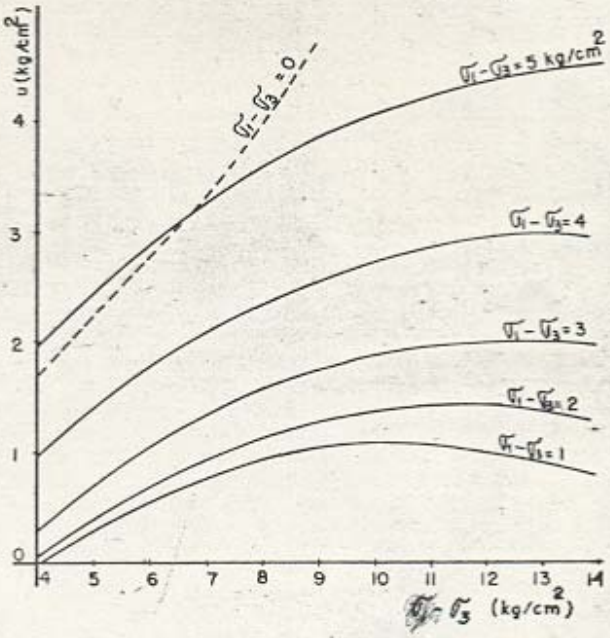


Fig. 1b- Traces parallel to the μ x $\sigma_1 - \sigma_3$ plane

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Upon a suggestion of Prof. Victor F. B. de Mello, consistent with the concept summarized in his remarkable State-of-the-Art Report, and in accordance with a practice employed long since on several earthwork projects on which he is the Soil Mechanics Consultant for Promon Engenharia, we have had some opportunities of establishing for practical use general power functions of $u = f(\sigma_3, \sigma_1 - \sigma_3)$.

In each case, several tests with different values of σ_3 were carried out, and the individual groups of values of (σ_3, $\sigma_1-\sigma_3$, u) were statistically analysed, in order to obtain the best fitting surface in the space

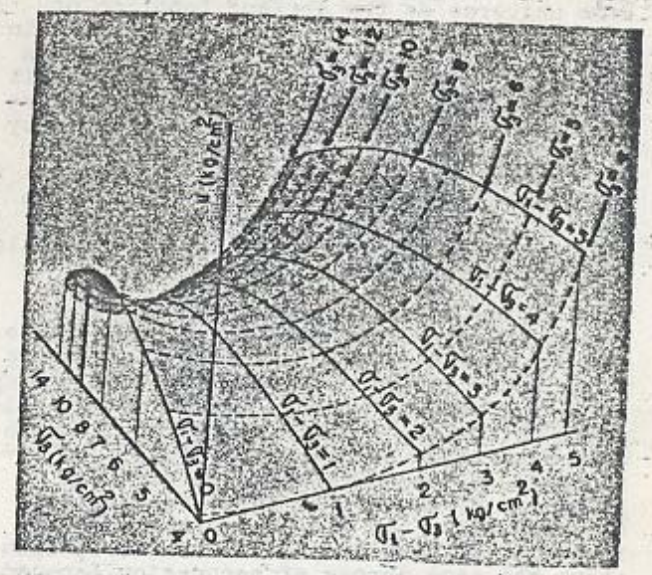

Fig.1 - Best fitting surface