

INTERNATIONAL SOCIETY FOR SOIL MECHANICS AND GEOTECHNICAL ENGINEERING



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possible cannot be answered at the present stage of our scientific research and knowledge. However, it is probably of considerable extent as may be seen from the change in the altitude above sea level of buildings situated on the sea coast, where the influence of the tide is felt in areas situated far inland. The knowledge of this fact provides the possibility of being able very quickly to change the weight of clay layers over long distances. This

may be utilised when stemming land-slides and stabilising clay slopes successfully by sinking boreholes in which the water level is kept low. Besides, axial load should be considered in the case of shafts and similar structures, unless it be preferred to eliminate friction between bottom and building structure by lubrication.

REFERENCE

1) Bernatzik: Baugrund und Physik. Zürich 1947.

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SUB-SECTION VI d

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SPECIAL PROBLEMS IN FOUNDATION ENGINEERING

THE RESISTANCE TO REVERSING AND THE STABILITY OF THE FOUNDATIONS OF PYLONS

Experimental Study

Research effected at the initiative of the
SOCIETE INTERCOMMUNALE BELGE D'ELECTRICITE

I. OUTLINE OF THE MOTIVES AND ORIGIN OF THE RESEARCH.

The electricians of big lines know the economic importance of the question of the foundations of pylons, foundations of which the cost amounts to about 20% of the fully installed lines.

Besides, the constructors also know the uncertainty of the calculation of foundations in general and of foundations of pylons in particular.

From what precedes may be concluded, that the capitals invested in the foundations of electric pylons are by far not so judiciously used as those, which are consacrated to other parts of the lines.

Very interesting from both economic and technical point of view, the problem of the foundations of pylons is not less interesting from the scientific point of view, because it depends on the mechanism of terreous pulverulent or coherent soils and because in this part many affirmations or deductions are neither conclusive, nor convincing and consequently ask for an experimental control.

For these three reasons of economic, technical and scientific nature, the SOCIETE INTERCOMMUNALE BELGE D'ELECTRICITE has entered into its programme of research, the experimental study of the stability of the foundations of pylons.

This initiative has first of all been encouraged by the subsidies of the FONDS NATIONAL DE LA RECHERCHE SCIENTIFIQUE allowed by right of Science and Industry ; next by those of the INSTITUT POUR L'ENCOURAGEMENT DES RECHERCHES SCIENTIFIQUES DANS L'INDUSTRIE ET DANS L'AGRICULTURE. (I.R.S.I.A.).

Such is in short the outline of the motives and origin of the research.

II. THE EXPERIMENTAL METHOD AND ITS FUNDAMENTAL PRINCIPLES.

Considering in the first place, that the

problem of the foundations of pylons in natural coherent soil can not be solved before the simpler problem of the same foundations in pulverulent soil, without cohesion, the Commission Directrice has fixed the first two essential points of its programme of research, i.e. :

- to study first the stability of the foundations of pylons in a pulverulent soil.
- to study next the stability of the same foundations in natural coherent soils and to deduct from its results the corrections to which the results of the preceding study are liable.

Establishing next the absolute impossibility to carry out sufficient experiments on the foundations of real-sized pylons, the Commission has been compelled to carry out systematically experiments on reduced models only. As a matter of fact the Commission had been preceded in this way by Professor E.H. Lamb who in 1931 made a remarkable communication on this subject at the Conférences Internationales des Grands Réseaux. x)

Besides these systematical experiments on reduced models, the Commission evidently entered into its programme experiments of control also - inevitably less numerous - on the foundations of real-sized pylons.

Moreover, the interpretation of the results obtained on reduced models implies the establishment and the utilisation of the laws of similitude, which constitute the fundamental principle of the experimental method adopted by the Commission.

III. THE EFFECTED EXPERIMENTS, THE OBTAINED RESULTS

The experiments on reduced models which have been made up till now are grouped as fol-

- x) Foundations of Pylons by Professor E.H. Lamb, M. Sc. (The British Electrical and Allied Industries Research Association - Londres).

lows :

1. Experiments on models of driven foundations, that is pillars which are simply driven into the soil.
2. Experiments on models of foundation-flagstones, i.e. on foundations which are constituted by a socle solidary to a jutting out flagstone.
3. Experiments on models of foundation-blocs, i.e. on foundations constituted by a prismatic or cylindrical sunk bloc.

In all that precedes, there is only question of foundations of pylons or pillars, which are subject to efforts of capsizing.

As complementary information this study has required :

4. Experiments on models of foundations, placed on the surface of the ground.
5. Experiments on models of foundations placed at various depths and submitted to centered charges.
6. Experiments on various models tending to control certain hypothesis, relative to the causes of the observed facts.

All the above mentioned experiments have been made in pulverulent soil, i.e. without cohesion and consequently easy to reconstitute.

Despite the rather big experimental discrepancies (+ 30 %) resulting from the irregularities of ramming, the results obtained correspond in a very satisfactory way : they have been repeated with intervals of several months, sometimes even several years, with other preparers and other experimentalists.

Finally, by an experiment on a real-sized model in a natural coherent soil (compact clay) the effect of the cohesion of the experimented soil could be determined approximatively.

IV. PROVISIONAL CONCLUSIONS

From the effected experiments it positively results, that the theories, which are generally admitted in the mechanism of pulverulent soil do not correspond with reality.

Especially for foundations which are posed at various depths and submitted to centered charges, the coefficient of Prandtl, resulting from the theories of Boussinesq, is nullified.

Are nullified also the methods of calculation, based on the theories of elasticity.

Is nullified equally the hypothesis of Mohr, which supposes a parabolic repartition of the pressures of the soil on a driven in foundation.

Is nullified at last the hypothesis accord-

ing to which it was supposed that the pressures exerted by the soil on an interred foundation are proportional to the movements, which are imposed to same by the efforts, which are applied to it.

It is evident, that if instead of being nullified, one of the examined points had been averred to correspond with reality, be it only approximatively, it would have been a convenient basis for the mechanism of pulverulent soil on which a series of easy reasonings, as well as very sure methods of calculation might have been established.

Unfortunately for the calculators as well as for the constructors, the phenomena which have been studied, are more complicated than it had been imagined.

In order to be just, it must also be owned, that the mechanism of pulverulent soils (and a fortiori that of coherent soils) lacks experimental results and that it is based on opinions, suppositions and hypothesis of which the least that may be said is, that they are not conclusive.

That is why we have based our research from the very beginning only on

1. the principles of the dimensional analysis.
2. the laws of similitude, which are used with so much success in hydro and aerodynamics and to which it would be desirable to have recourse more often as regards the resistance of materials.
3. the law of friction of Coulomb which has been confirmed experimentally by Morsch for pulverulent soils.

Finally, and this is in our opinion very important for the graphic pointing of our experimental results, we have stated that the representation of Bélenger (or its derivatives) is the only one that permits to solve all the problems of foundations, according to the laws of dimensional analysis and the principles of similitude.

For the Commission of Research on the Foundations of Pylons,

The President of the Commission :

Ch. Ramelot, ingénieur, Directeur de la Société Intercommunale Belge d'Electricité

The Director of Research :

Lucien J. Vandeperre, Ingénieur, Docteur Spécial en Mécanique appliquée, Professeur à l'Université de Bruxelles.