SOIL AND FOUNDATION CONDITIONS RELATING TO THE EARTHQUAKE PROBLEM

SUMMARY REPORT

BY J.K. MINAMI

When we look over the papers that have been presented, it will be noted that they have covered a wide field.

For instance, the paper on the Tectonic and Earthquake Risk Zoning in New Zealand by a group of scientists and engineers of New Zealand, gives us a fairly good idea and knowledge of tectonics and earthquake risks to be expected in the North and South Islands of New Zealand. The paper by Prof. Scott gives the geological conditions in Alaska, particularly with respect to the Anchorage area which suffered serious and extensive landslides and subsidence due to loss of bearing capacity of soft cohesive soils. The locally known soil referred to as "bootleg mud", which is barely stable under static conditions and liable to move under slight vibrations. underwent important lateral movement. Prof. Rosenblueth has given us a fairly good idea of soil conditions and general geological formation of the soil layers in Mexico City and the method of determining the predominant periods of these layers. I wish to make a closer study of Prof. Rosenblueth's difficult but interesting theory, as his method appears to have general application. Dr. Nasu has informed us of the type of investigations made in numerous industrial cities in Japan, which are generally known to have poor soil conditions to support industrial facilities, plants and so on.

The problem of loss of bearing capacity of clays and sands under earthquake conditions has been dealt with in other papers. We know definitely that loss of bearing capacity of clayey soil was responsible for the extensive damage in the Anchorage area in the 1964 Alaska earthquake. Subsidence and tilting of many buildings in Niigata, during the June 1964 earthquake, was largely caused by liquefaction of saturated sand.

At the first World Conference on Earthquake Engineering, in Berkeley, 1956, Mr. Moore - of Dames and Moore, outlined the general trend of the bearing capacity of cohesive and cohesionless soils. We were aware of the fact that sandy soils, particularly when saturated, could become very unstable and that normal clays could be expected to behave more satisfactorily. At this Conference, J. Kondner and K. Bazant have presented us with specific methods of estimating quantitively the relationship of the effects of earthquakes on these two principal types of soil, namely clay and sand.

In regard to behaviour of specific types of engineering structures under earthquake conditions, N.N. Ambraseys has given interesting comments on dynamic pore water pressures. In the paper by T. Tajime and co-authors, relating to the behaviour of buildings supported by caissons or piles (deep-type foundations) the results of their research seem to indicate that this type of indirect

foundation construction is not detrimental under earthquake conditions.

J. Krishna has reported on investigations done in the field on the 122m. Ramganga dam and Professor Hatanaka has described the model study on the behaviour of breakwaters consisting of large cylindrical shells.

The fields covered in this Session have been many and extensive, including regional studies and behaviour of specific engineering structures.

In the session set aside for Special Reports on important destructive earthquakes in recent years in Skopje (Yugoslavia), Anchorage (Alaska) and Niigata (Japan), I believe there will be many valuable lessons to be learned on the subject of soil and foundation conditions during earthquakes. The problem of dynamic design of superstructures by various appropriate methods seems to have made satisfactory progress but the important problem of soil-foundation-superstructure interaction under earthquake condition remains to be solved. It is generally agreed that damage to identical buildings located on different soil layers will show different dynamic responses to the same earthquake motion and hence different degrees of earthquake damage. The dynamic response of one building testing on hard soil stratum will be quite different from the dynamic response on the identical building located on softer stratum, for instance. We seem now to have the theories of dynamic response or behaviour of soils fairly well outlined as tools for further research in the papers presented at this Conference and also to have available indications of possible experimental approaches to study further dynamic behaviour of different types of soils. I hope we shall have the opportunity of further studying the papers when the Proceedings of the Third World Conference on Earthquake Engineering are published (and are available).

CONCLUDING COMMENTS BY V.A. MURPHY*- NEW ZEALAND

I would like to make an appeal to authors of papers at future World Conferences to endeavour to follow up any phenomena reported in Damage Surveys of recent earthquakes at any one conference with soil test information and experimental research work for publication at the next World Conference to explain reasons or indicate factors causing the reported damage. For example, experiments showing the danger of a uniform size of grain in sand soils were reported at the Second World Conference (see Page 231 Proc. 2nd W.C.E.E.). This condition, so reported, could have been one factor in the extraordinary happenings in the Niigata earthquake of June 1964 in which buildings suddenly sank or tilted on their foundations. Other factors may have been more important but experiments would determine this. It was reported verbally that the above conditions existed.

The linking together of experimental tests and engineering practice would provide practising engineers with a knowledge of conditions in dangerous soils, which should be looked for in any soil in any country when investigating new sites for buildings or structures.

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