EVALUATION OF DYNAMIC SHEAR MODULUS AT A SITE

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Laboratory and field methods have largely been employed to obtain the dynamic shear modulus of soils. At the site where the present study was undertaken, the alluvial deposit was about 400m thick. Since undisturbed sampling of cohesionless soils is extremely difficult if not impossible, field tests were considered an effective approach to obtain the shear modulus values as a function of the strain amplitude. The in-situ tests performed consisted of (i) Wave propagation tests (ii) Steady state vibration tests on two concrete blocks 1.5m x 0.75m x 0.7m high and 1m dia x 0.7m high under vertical and horizontal excitation (iii) Free vibration tests on the same two blocks and (iv) Dynamic plate bearing tests on a doubly reinforced concrete slab 1m x 1m x 0.3m. The static loads on the slab were applied using reaction loading and dynamic loads at various frequencies using a mechanical oscillator. Dynamic load settlement curves at various frequencies could thus be obtained by adding the dynamic increment in settlement to the previous value of settlement under static load. Laboratory tests were performed on samples at simulated densities on oscillatory simple shear test apparatus. The values of the dynamic shear modulus obtained from the different tests ranged from 885 kg/cm^2 in case of wave propagation tests to 60.5 kg/cm^2 in oscillatory shear. The difference in the values from different tests is because of the reason that the effective confinement and strain levels associated in each of the tests are different. Confining pressures and strains in each case were computed. All values were calculated for a mean effective over-burden pressures of 2 kg/cm^2 which is expected below the actual footing assuming 'G' to vary with square root of mean effective confining pressure. The values so obtained are plotted against the corresponding strain levels in figure 1 and an average curve fitted. Figure 2,

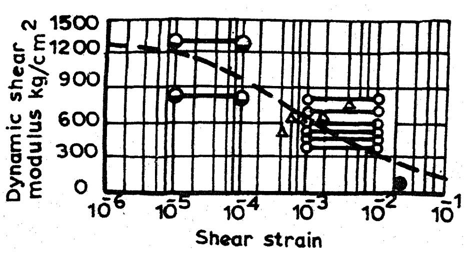

FIG. 1 – DYNAMIC SHEAR MODULUS VS SHEAR STRAIN

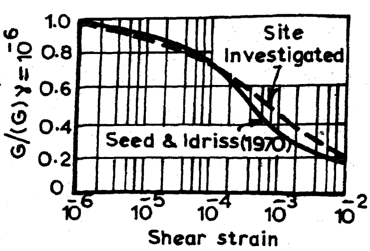

FIG. 2 – $G/(G)_{\gamma=10^{-6}}$ VS SHEAR STRAIN

shows the value of $G/(G)_{\gamma 10^{-6}}$ versus shear strain for the site investigated and for the data reported by Seed and Idriss (1970) and remarkable agreement is observed between the two curves.

REFERENCE

1. Seed, H.B. and Idriss, I.M., (1970), "Soil Moduli and Damping Factors for Dynamic Response Analysis", Report No. EERC 70-10, Dec., 1970, College of Eng., University of California, Berkeley.

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DISCUSSION

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During earlier discussion in this session, Dr. Shamsher Prakash had mentioned the various tests conducted for determination of dynamic properties of soils. We have carried out these tests at a number of places and there are a lot of irregularities in the results noted. Firstly the amplitude frequency curve has never shown a single peak, although if we go by the available theories, we should find only a single peak. In the wave propagation test, it is recommended that we should get a circle as a lissajous figure while moving the geophones on ground. This is a difficult job in the field. We have carried out the cyclic plate load tests and observed that the values of 'C_u' we may be getting from this tests are very low compared to vibration tests and wave propagation tests. Would the author enlighten me on the issue.

Author's Closure

Mr. Bhandari has raised a very pertinent point in his discussion. Much remains to be done regarding the interpretation of field data obtained from tests for determination of dynamic properties of soils. The value of the elastic uniform compression 'C_u' or the dynamic shear modulus 'G' as obtained from the field tests in general show a large variation. The selection of an appropriate value for design should be done by taking into consideration the factors affecting these properties. Such an attempt has been made in our paper where all the values as obtained from wave propagation test, block vibration tests, dynamic load bearing tests and oscillatory tests in the laboratory have been first corrected for confinement and then their variation studied with respect to strain levels associated with the tests. Such an attempt makes it possible to choose a value for design consistent with strains and confining pressures. Some irregularities which have been observed by the discussor regarding the observed data from the field tests are thus taken care of in selecting the values for design.

Further, more than one peak may be observed in some of the vertical vibration tests because of the effect of lower layers. In the wave propagation, the difference in phase between the arrival of waves between two known points (geophone locations) may be measured and plot of distance versus phase angle could be made from which the distance corresponding to phase difference of 90° which corresponds to quarter wave length ($\lambda/4$) can be picked up.