ANALYTICAL METHOD OF DETERMINING THE SPRING CONSTANTS AVAILABLE FOR VARIOUS TYPES OF FOUNDATIONS

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Synopsis A simple method of calculating the spring constant of the ground is introduced. It is easy and practicable for various types of structure's foundation.

In the research of the movement of an interrelated system composed of building and ground in an earthquake, a proper evaluation of the rigidity of the ground becomes one of the important matters. Needless to say, such a movement of the system may be expressed by a certain differential equation having usually the so-called "spring constant" which depends upon the rigidity of the ground in contact with the building at its foundation. In this study, our efforts were directed to find out a convenient analytical method of evaluating this constant, and we have gotten a hope of success in applying this method to various types of foundations, such as, direct foundation, group of isolated foundations, pile-foundation and underground room. As to this method we will not speak at full length here, and only give outline.

For example, let us take a certain underground room, and a short explanation will be given of our analytical method adoptable in evaluating the spring constants which fit for this room.

The sides and base of the underground room which are in contact with the ground are divided into a lattice of a proper number of meshes, and all corners of these meshes are defined as the points of loading (J-point, in short), which are denoted by J_i, (i=1,2,...n). Next, the point of displacement (I-point, in short) is taken inside of each mesh, one for each, and denoted by I_i, (i=1,2,3,...n). Applying an assumed load denoted by P(J), i=1,2,3,...n, at each point of loading, the displacement of I-point, i.e., W(I), i=1,2,...n, is calculated by using the Mindlin's solutions I and II. In this case, the displacement at I-point is naturally due to the loads acting at all J-points. Here, a boundary condition is introduced to the displacement of I-point, say W(I), such that, for example, in the case of the spring constant applicable in a horizontal direction, the boundary condition is W(I)=1.0 cm (unity). Then, the assumed load, P(J), and also $\Sigma P(J)$ are evaluated. By using the latter value, the spring constant becomes calculable.

It may be said as a conclusion that our method of analysis which is adoptable in the determination of spring constants is characterized by simplicity and easiness, and it differs in kind from the finite element method. The relations between the spring constants and the shape of any type of foundation have been made clear by virtue of the method which forms the subject of this paper.

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