CHARACTERISTICS OF SEMI-INFINITE ELEMENT AND ITS APPLICATION TO DYNAMIC PROBLEM

by

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INTRODUCTION

This paper proposes a new element named the semi-infinite element, which is introduced into the dynamic analysis of soil-structure systems by means of the finite element method. The displacement functions in this element are assumed so as to be able to represent the free-field ground motion. If the region where the interaction effect being in existence is divided into finite elements and the semi-infinite element is applied to the region where this effect can be assumed to be negligible small, the dynamic response of such systems will be analyzed with small degrees of freedom.

SEMI-INFINITE ELEMENT

As shown in fig-1, considering a strip element of infinite extent in X-direction, the displacement functions (N_1, N_2) are assumed as follows.

$$N_1 = \frac{y - y_2}{y_1 - y_2} e^{k(x_o - x)}$$

$$N_2 = -\frac{y - y_1}{y_1 - y_2} e^{k(x_o - x)}$$

fig-1
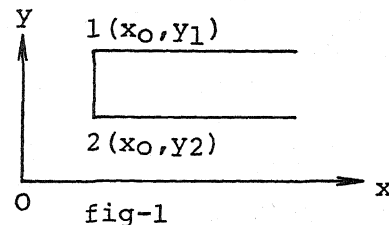
In these equations, k is a parameter and it must be positive in order to converge the intergration of mass matrix and k value is determined so as to represent the free-field ground motion. According to the numerical tests, the above conditions are fulfilled when k satisfies the following equation.

$$0 < k (y_1 - y_2) \leqq 0.04$$

CONCLUSION

The accelerations of the Izu-oki earthquake in 1974 were observed in Tokyo. Applying the observed record in the bed rock, and dividing the ground into semi-infinite elements alone, the ground responses were analyzed. The computed results coincided considerably well with the obserbed records, and it became clear that the behaviour of the free-field ground motion could be well represented by the semi-infinite element. The semi-infinite element was also used for the response analyses of underground LNG tanks and in-ground structures and the analyses were carried out with small degrees of freedom compared to the conventional method.

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