COMPUTERIZED STATIC AND DYNAMIC PASSIVE EARTH PRESSURES BY THE METHOD OF ASSOCIATED FIELDS

PART II

A. Fakhimi
School of Engineering, Shiraz University

*1. Rehpoor and A. Ghahramani
Faculty Members, School of Engineering
Shiraz University, Shiraz, Iran

The method of associated fields relating the field of stress characteristics to the field of strain characteristics by using soil properties and boundary conditions has been computerized. This computerized scheme makes possible the evaluation of the static and dynamic passive earth pressures on retaining walls of various shapes. Furthermore the computerized solution makes possible the evaluation of the pressure as a function of wall movements. The computation difficulties of using radial acceleration and the instability problem of characteristics fields have been removed. The results of computations compare favorably with the experimental earth pressure measurements. In part I the theoretical basis was discussed, and in part II results and discussion are presented.

INTRODUCTION

In part I of this paper the method of associated fields was introduced and previous works were reviewed. Also the theoretical basis was discussed. The computer program developed for evaluation of static and dynamic earth pressures is composed of three basic routines: Routine X, Routine Zero and Routine Displ2. The function of each routine was discussed in Part I. In this part the results of computations are given and conclusions are discussed.

RESULTS

Extensive series of tests were carried out by Cambridge University researchers James and Bransby [1] for a 50 centimeter high retaining wall for dense and loose sand. The wall was rotated about the bottom. The shear strain contours are presented in Fig. 1 and the stress distributions on the wall obtained experimentally by Cambridge University are presented in Fig. 2.
The results of shear strain obtained from the computer program developed by authors are presented in Fig. 3 for dense sand. Similarity of shear strain contours obtained by computer program to that prepared experimentally by Cambridge University is evident.

The results of stress distribution on the wall obtained by computer program for static and dynamic cases, for rotation of the wall about the toe for dense sand are presented in Figures 4 and 5.

Similarity of trends for static stresses is evident. Experimental measurements for dynamic case were not available for comparison.

The results for rotation of the wall about the top and for translation of the wall have been also prepared by the computer program developed [2].
If for a vertical wall the passive earth pressure coefficient $K_p$ is evaluated as

$$K_p = \frac{F}{0.5 \gamma H^2} \quad (1)$$

(where $F$ is passive force per unit length of the wall and $H$ is height of the wall) and the dynamic passive earth pressure coefficient $K_{p,\text{dyn}}$ is evaluated as

$$K_{p,\text{dyn}} = \frac{F_{\text{dyn}} - F_{\text{sta}}}{0.5 \gamma H^2 \left(\frac{a_{\text{max}}}{g}\right)} \quad (2)$$

(where $a_{\text{max}}$ is the maximum acceleration of the wall), then the total force on the wall is evaluated as

$$F_{\text{total}} = \left( K_p + K_{p,\text{dyn}} \frac{a_{\text{max}}}{g} \right) (0.5 \gamma H^2) \quad (3)$$

For loose sand $K_{p,\text{dyn}}$ have been evaluated by computer program to be 3, 2 and 1.25 for wall translation, rotation about the top and rotation about the bottom respectively. The results obtained by Sabzevari and Ghahramani [3] were 2.2, 0.9 and 0.78. Theoretical work by Clemence and Ghahramani [4] showed that the ratios of $K_{p,\text{dyn}}$ for translation, rotation about top and rotation about bottom are as $1/2$, $1/3$ and $1/6$ or 3, 2 and 1 which are comparable to the computer program results.

The stress and displacement fields predicted by the program are shown in Figures 6 and 7 for loose sand for static and dynamic translation and static rotation about the top as sample results of the program.

**CONCLUSIONS**

Based on the above results the following conclusions can be made.

1- The method of associated fields is capable of predicting dynamic and static passive earth pressures.

2- The comparison with experimental results shows better agreement for the rotation of the wall about the bottom.

3- The two different fields of stress characteristics and strain characteristics can better be associated to each other by using fixed grid points.

4- The computational difficulties of abrupt changes of displacement fields for rotation about top and translation of the wall needs further research.
Fig. 3. Shear strain contours by computer program for dense sand for static (top) and dynamic (bottom) cases.
Fig. 4. Normal stress distribution on wall for dense sand and static rotation about toe.

Fig. 5. Normal stress distribution on wall for dense sand and dynamic rotation about toe.
Fig. 6. Stress and displacement fields for loose sand: (a,b) at $K_0$ state, (c,d) static translation
Fig. 7. Stress and displacement fields for loose sand: 
(a,b) Static rotation about the top, (c,d) 
dynamic translation
ACKNOWLEDGEMENTS

The authors wish to thank Mrs. Z. Sarmadi for her fine effort in typing the manuscript and Mr. Bodnam for drawing the figures.

REFERENCES


