Model Tests of Borehole Excavation for Enlarged-Bottom Cast-in-Place Pile

Osaka Sangyo University, Member Masanobu Kanaoka
HoChiMinh University of Technology Tran Thi Hong
Osaka Sangyo University O Nguyen Hoang Quan
Osaka Sangyo University, Member Tomio Tamano

1. Introduction:

This paper presents the fundamental study by model tests to elucidate the mechanism of the slurry borehole wall stability at the borehole excavation for enlarged-bottom cast-in-place piles. The experimental items are enlarged-bottom form and enlarged-bottom angle, which, through this study, reveal to affect the failure behavior of the ground surrounding the enlarged-bottom slurry borehole wall.

2. Test method and test ground:

There are two types of enlarged-bottom forms as shown in Figure-1, called dome type and bell type in this paper. Three types of plates, which are dimensionally simplified and simulate the enlarged-bottom slurry borehole wall, are applied for the tests: dome type large curved face (with the radius of 6.5cm), dome type small curved face (with the radius of 10.2cm), and bell type straight face. They are named "dome large", "dome small" and "bell" respectively in this paper. The enlarged-bottom angles are settled for 90^0, 45^0, 30^0, 15^0 and $0^0$with each enlarged-bottom form (Table-1).

Aluminum rod mass is used to simulate the sand ground (Murayama and Mastuoka, 1969). The outline of the two-dimensional experimental device is shown in Photo-1. The device is dimension of 60cm x 50cm x5cm. The aluminum rods are length of 50mm, diameter of 1.6mm and 3.0mm, mixed in the weight ratio of 3:2. The aluminum rods mass is stacked with a 1mm-thick copper plate put 5 cm vertically in and out three times each layer of 5cm. This procedure is performed to and fro twice at 1cm interval to produce a dense and homogeneous mass. The aluminum rod mass has unit volume weight of 21.9 kN/m^3, internal frictional angle of 28.4^0 and the skin frictional angle between the aluminum rod mass and the stainless steel plate of 11.1^0.

Photo-1 illustrates how the Rotary Plate Test (RPT) is performed. The rotary plate of 10cm in length and 5cm in depth is rotated at speed of 3.2^0/sec round the rotary axis and the movement of the aluminum rod mass is observed. The image processing instrumentation method is conducted to grasp the movement of the aluminum rod mass and the ground displacement vector is followed up successively for 7 seconds by using the correlation technique of shading (Fujita et. al, 1990).

3. Test results:

Figure-2 shows the variations of the ground displacement vector produced by the rotation of the rotary plate at 2 and 4 seconds in cases of the dome large-30^0 test and the bell-30^0 test.

The outline form deformation in each second of the sliding clod, which can be drawn by the ground displacement vector in Figure-2, is shown in Figure-3. These figures indicate the arching effect and the generating condition of the progressive failure behavior. The progressing speed of the sliding clod calculated in all tests is shown in Figure-4. It results that

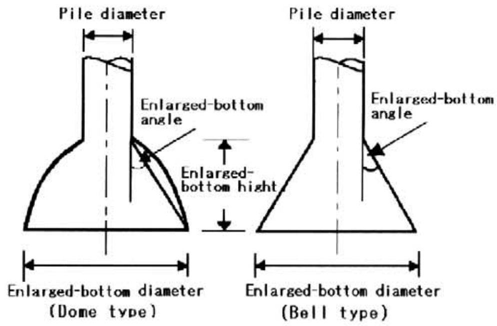


Fig-1 Types of simplified enlarged-bottom form

Table-1 Experimental conditions

Experimental condition	Enlarged-bottom form	Enlarged-bottom angle
Rotary plate test (RPT)	Dome large	90^0, 45^0, 30^0, 15^0
	Dome small	90^0, 45^0, 30^0, 15^0
	Bell	90^0, 45^0, 30^0, 15^0

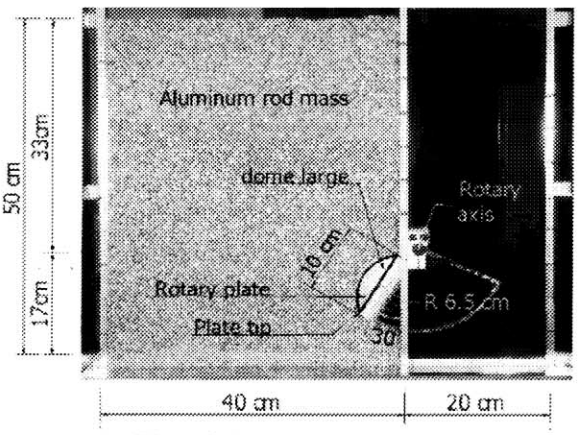
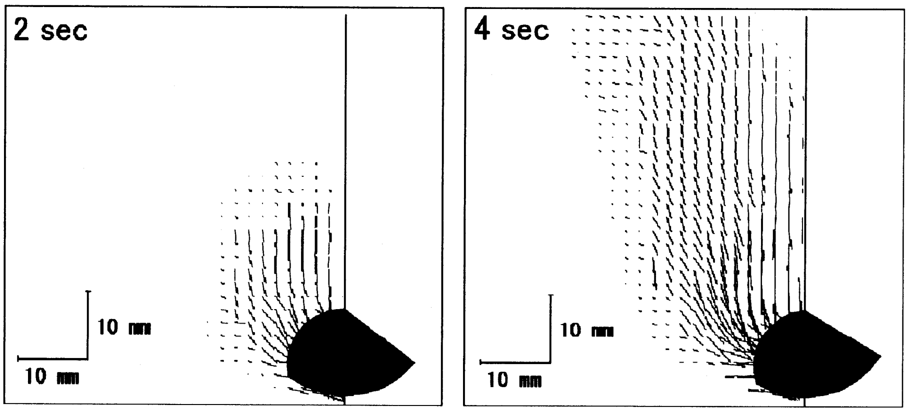
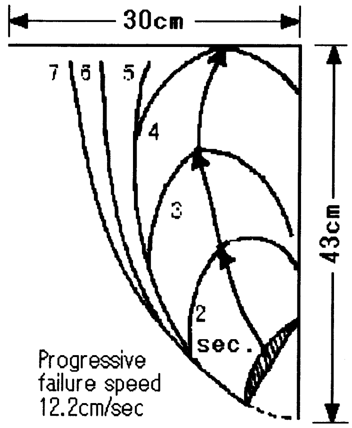


Photo-1 Experimental device (RPT -Dome large-30^0)

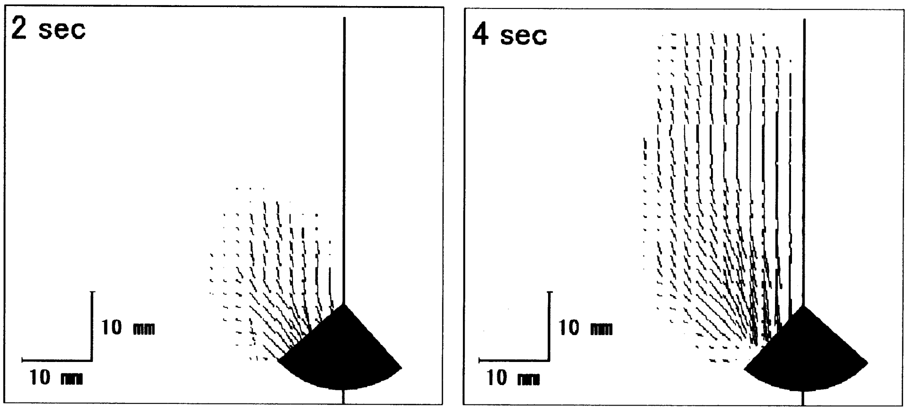
Keyword: Pile, Excavation, Stability Analysis, Progressive Failure, Earth Pressure
Address: 〒574-8530; 3-1-1, Nakagaito, Daito City, Osaka Tel. 072-875-3001 Fax. 072-875-5044



(RPT - dome large - 30°)

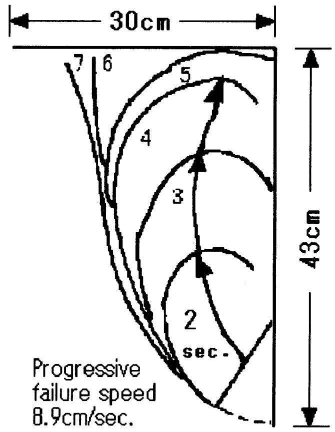


(RPT - dome large - 30°)



(RPT - bell - 30°)

Fig-2 Variations of ground displacement vector



(RPT - bell - 30°)

Fig-3 Progressive failure behavior

the bell type enlarged-bottom form and the larger enlarged-bottom angle produce more advanced arching effect.

With the bell type enlarge-bottom form and the larger enlarged-bottom angle, the progressing speed of the sliding clod is slower and the advanced arching effect is produced.

Among load act on the slurry borehole wall, the load of initial condition and the minimum load caused by 2.0mm displacement of the slurry borehole wall is smaller with the smaller enlarged-bottom angle.

With the bell type anlarge-bottom form and the smaller enlarged-bottom angle, the slurry borehole wall keeps the more stable condition.

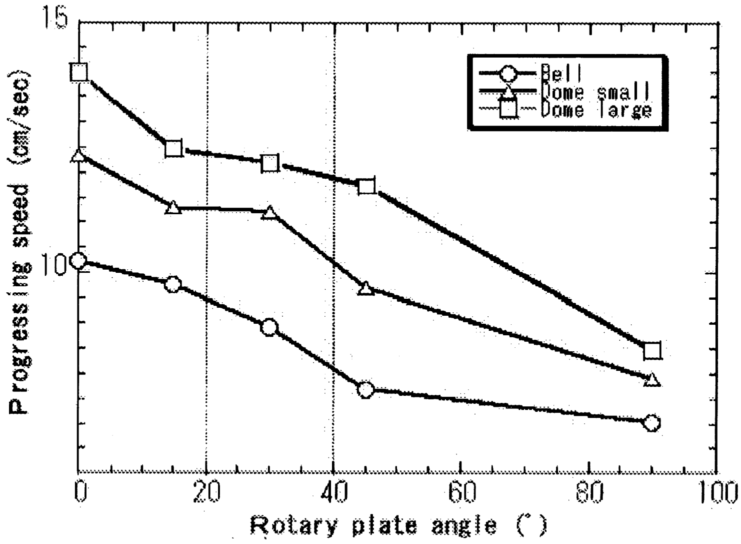


Fig-4 Progressing speed of sliding clod (RPT)

References

Murayama, S. and Matsuoka, H.(1969): On The Settlement of Granular Media Caused by The Local Yielding in The Media, JSCE, No.172, pp.31-41, (in Japanese).

Fujita, I. et al(1990): Analysis of Surface-flow Patterns at a Right Angled Open-Channel Confluence by an Image Processing Technique, Proc. of Hydraulic Engineering, JSCE, Vol.34, pp.683-688,(in Japanese).