Table 2 shows the material properties used in the indoor experiment along with the input values used in the numerical analysis program called ‘PLAXIS’. This paper then calibrated the results of indoor experiment on the basis of the aforementioned value. In regard to the modeling calibrated based on the existing indoor experiment, this paper conducted the three numerical analyses as shown in Table 3.

Table 3. Dimensions and gravity used in the numerical analyses

Test type	Footing width(mm)	Soil container(W×L, mm)	Gravity (g)
Laboratory test	100	610×460	1
Centrifuge test	100	610×460	20
Full scale test	2,000	12,200×9,200	1

3 Numerical results

Figure 3 is the unit bearing pressure-settlement curve in relation to centrifuge test and full scale test. The results of centrifuge test were compared by applying the geometric scale ratio in the displacement and 20 in n as presented in Table 1. As shown in Figure 3, there was no significant difference in the unit bearing pressure between the centrifuge test and the full scale test. The results of these two condition states were found to be similar to each other. Also, it was analyzed that the friction angle did not have any significant impact.

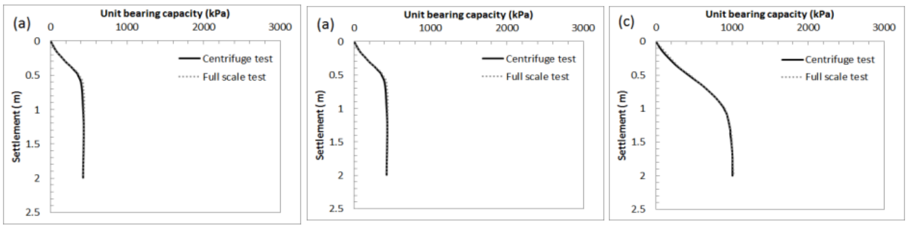

Fig. 3. Unit bearing pressure-settlement curve (a) $\emptyset = 32°$, (b) $\emptyset = 35°$ and (c) $\emptyset = 38°$ of centrifuge test vs. full scale test with different friction angles

This paper applied the geometric scale ratio in the laboratory scale test and n in 20 by utilizing Table 1 in order to compare the laboratory scale test with the full scale test. In addition, this paper obtained the values as shown in Table 4 by utilizing the peak force value in regard to the stress scale ratio ‘N’. As a result, the unit bearing pressure-settlement curve when the friction angle is 38°. There was a significant difference in the unit bearing pressure depending on the depth. It was determined that the difference in the geometric scale ratio ’n’ for displacement was the main factor causing a significant difference in the unit bearing pressure. Moreover, it was found that there was a difference of approximately 2n rather than n in the geometric scale ratio for settlement with the same unit bearing pressure from the laboratory test and full scale test. Thus, this paper utilized 2n rather than n in the geometric scale ratio as shown in Figure 4.

Table 4. Stress scale ratio with different friction angles obtained from peak force

Friction angle (°)	32	35	38	41	44
Stress scale ratio (N)	15.6	15.9	16.2	16.9	16.6

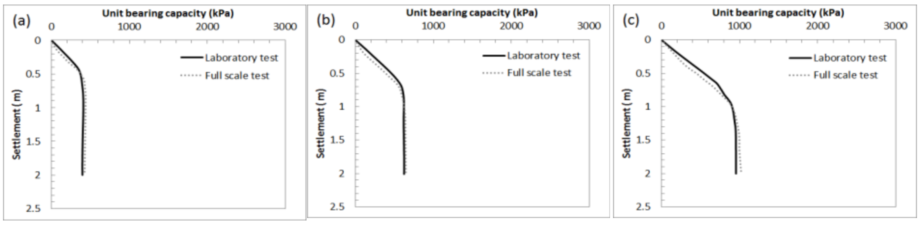

Fig. 4. Unit bearing pressure-settlement curve (a) $\emptyset = 32°$, (b) $\emptyset = 35°$ and (c) $\emptyset = 38°$ of laboratory test vs. full scale test with different friction angles (Geometric scale ratio = 2n)

4 Conclusions

To examine the scaling relations with different friction angles in the strip footing, this paper conducted the numerical analyses under the three conditions by utilizing the 2D finite element method. The conclusions thereof are as follows:

1) This paper obtained the stress scale ratio 'N' by utilizing the peak load in order to compare the laboratory model test with the full scale test. N was calculated at 15.6 to 16.9.
2) It was found that there was a difference of approximately 2n rather than n in the geometric scale ratio for settlement from the laboratory test and full scale test. However, it is believed that the aforementioned difference is caused due to the fact that the elastic coefficient varying with different depths is not taken into consideration rather than the improper consideration of geometric scale ratio.

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