

Study on the penetration resistance of suction bucket foundation in sand

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Abstract

Suction bucket foundations are likely to become one of reliable and cost-effective options for offshore wind turbine foundations. Suction piles have numerous advantages over conventional underwater foundation systems. The most significant advantages are: easy installation, large bearing capacity, and retrievability.

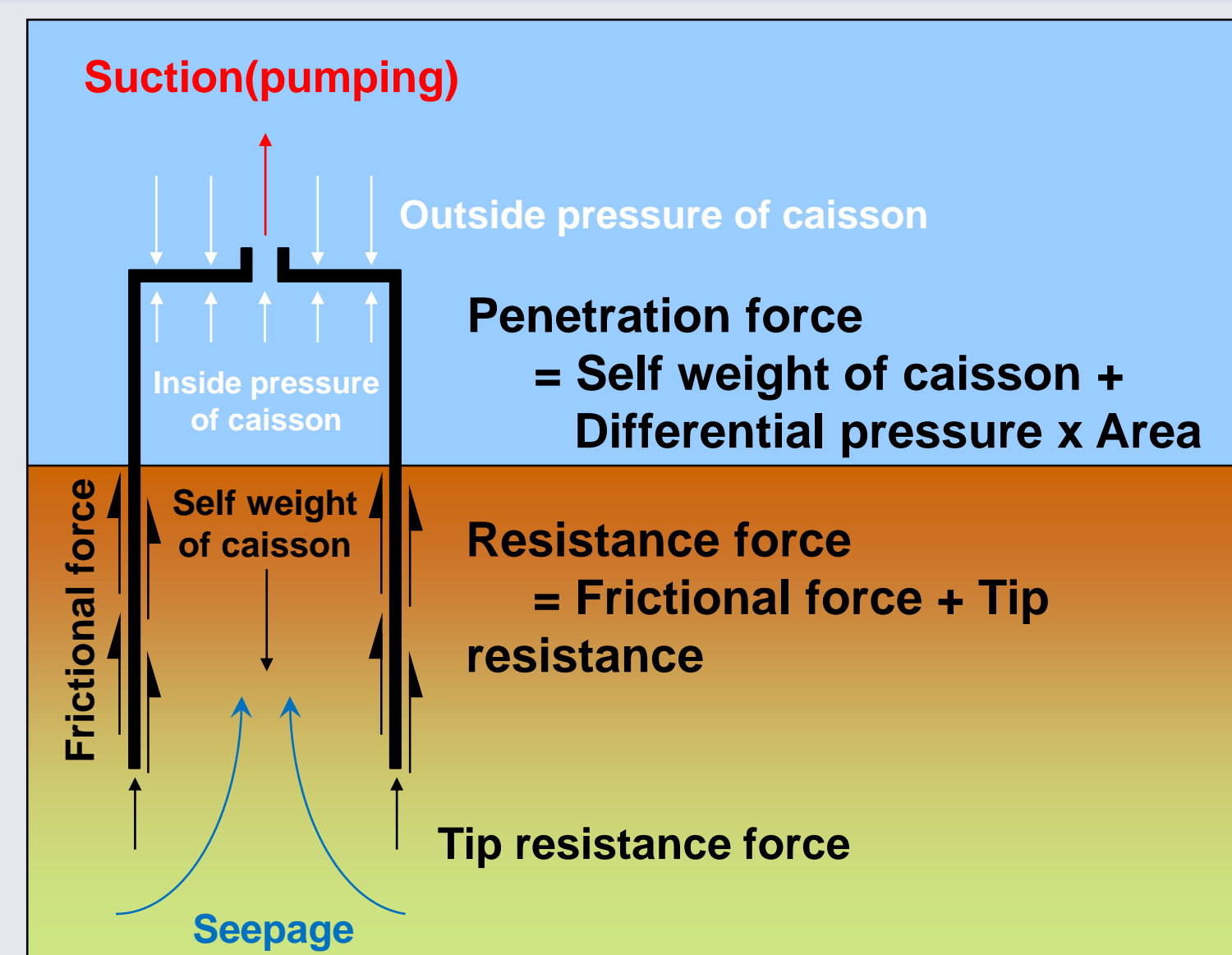
In the design of the suction pile, the evaluation of the resisting force of the ground against the pile penetration is crucial. In this study, the laboratory model tests that are simulating the installation process of suction bucket foundation on the sand are performed. The penetration resistance of suction bucket foundation was investigated through a series of model tests.

Introduction

❖ Suction Bucket Foundation

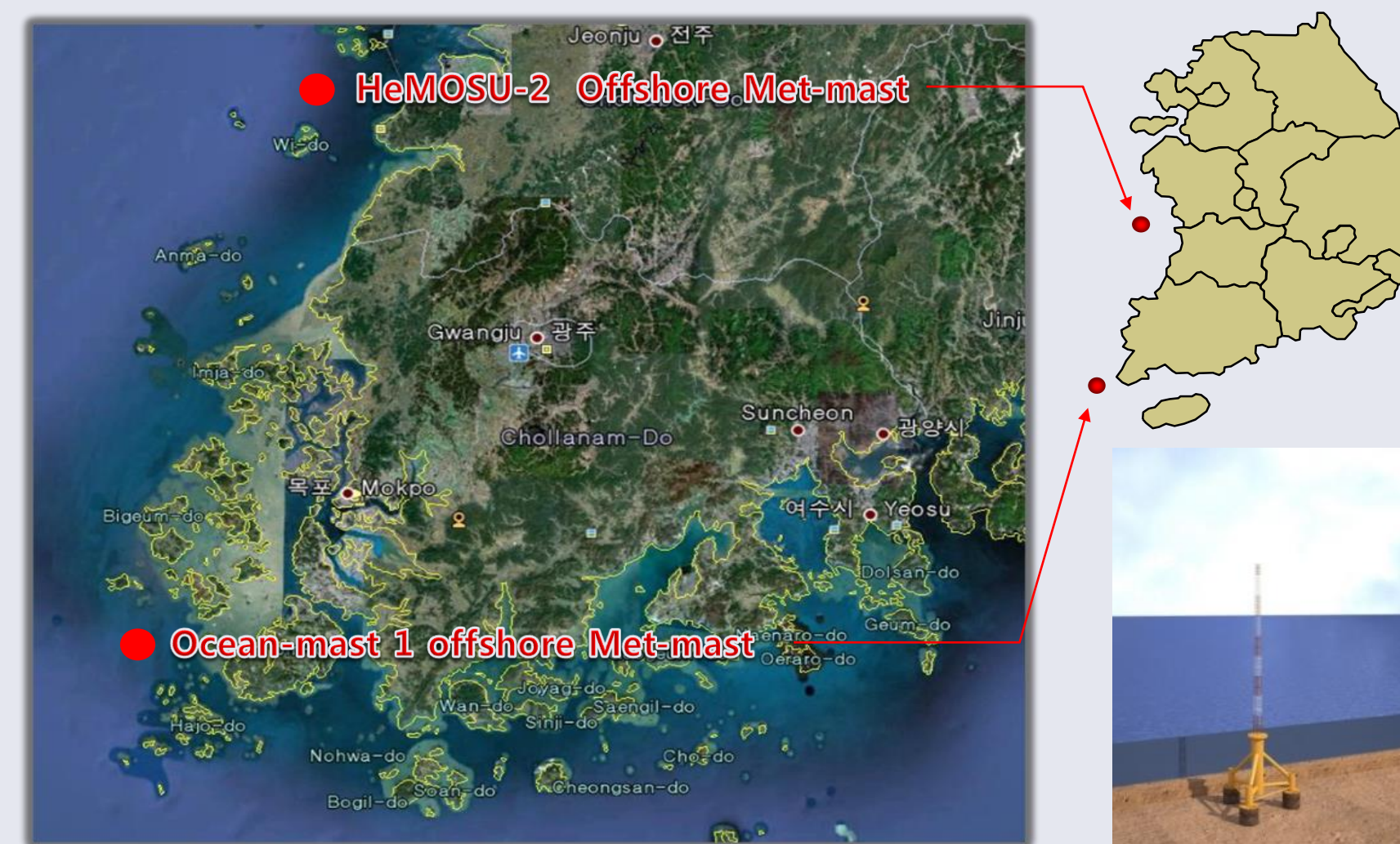
One of favorable foundation types for offshore wind turbines.

The suction bucket foundation is like a large upturned bucket. On lowering them to the seabed, they cut in a small distance. The water trapped inside the bucket is then pumped out, penetrating the foundation to its final position.



❖ Field Applications

In Korea, a couple of off-shore wind farms have been planned to be built off the west coast of Korea. They are West-South project with a total capacity of 2.5 GW and Jeonnam project. Meteorological towers with tripod suction bucket foundation were constructed.

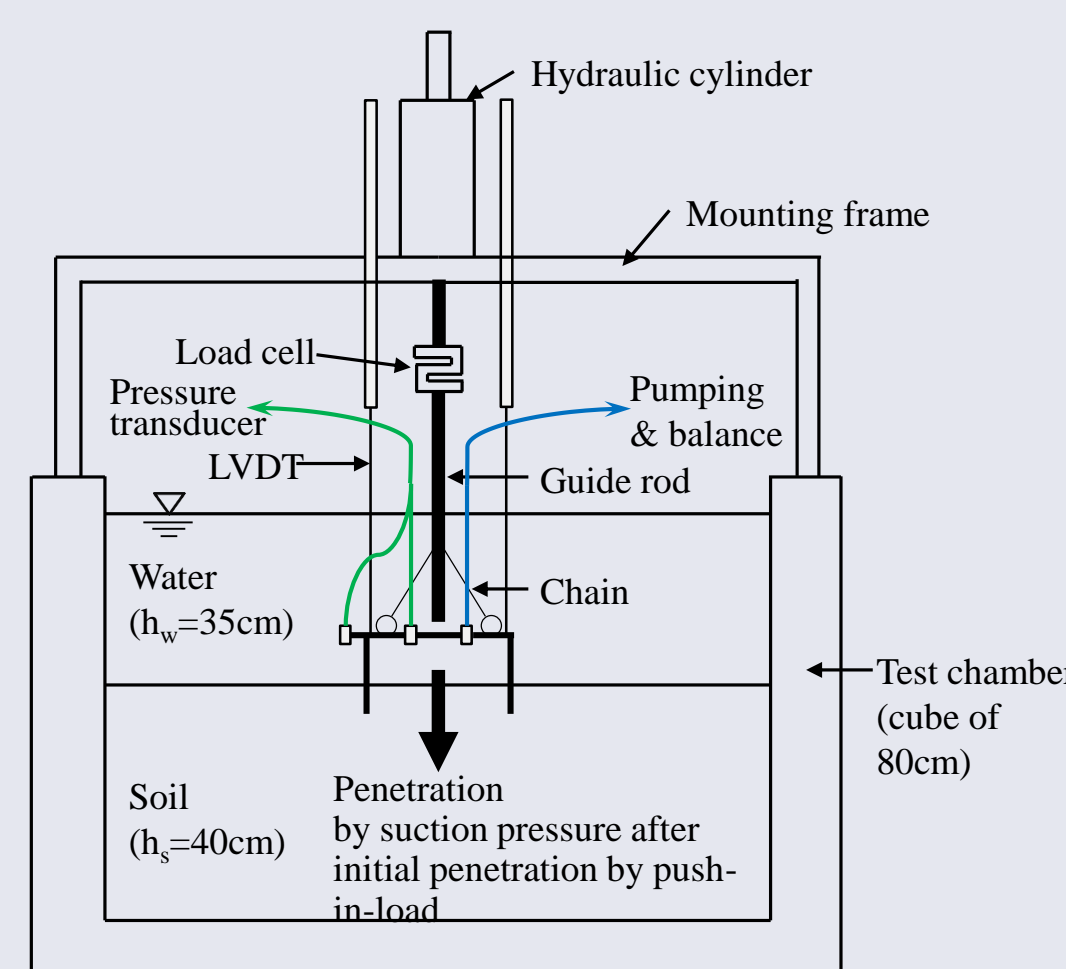
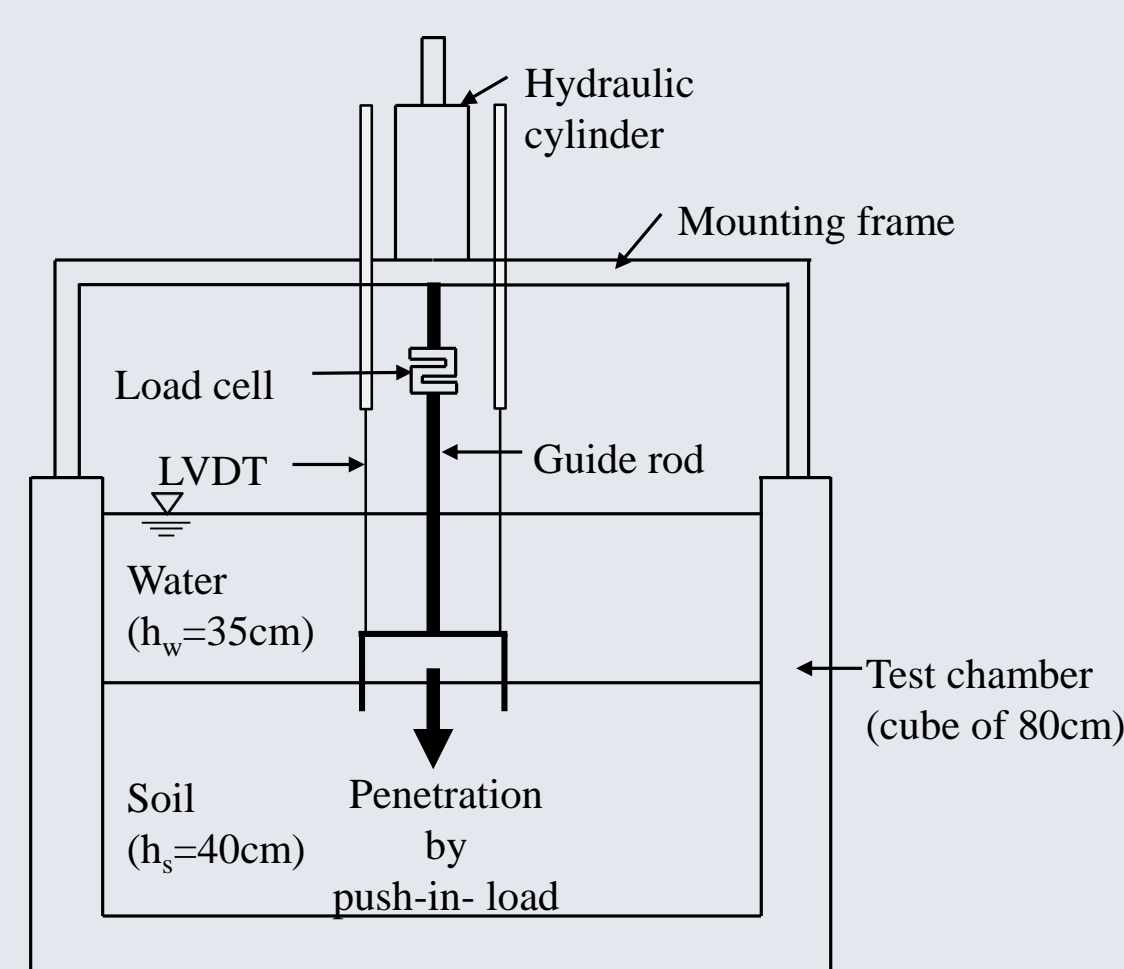
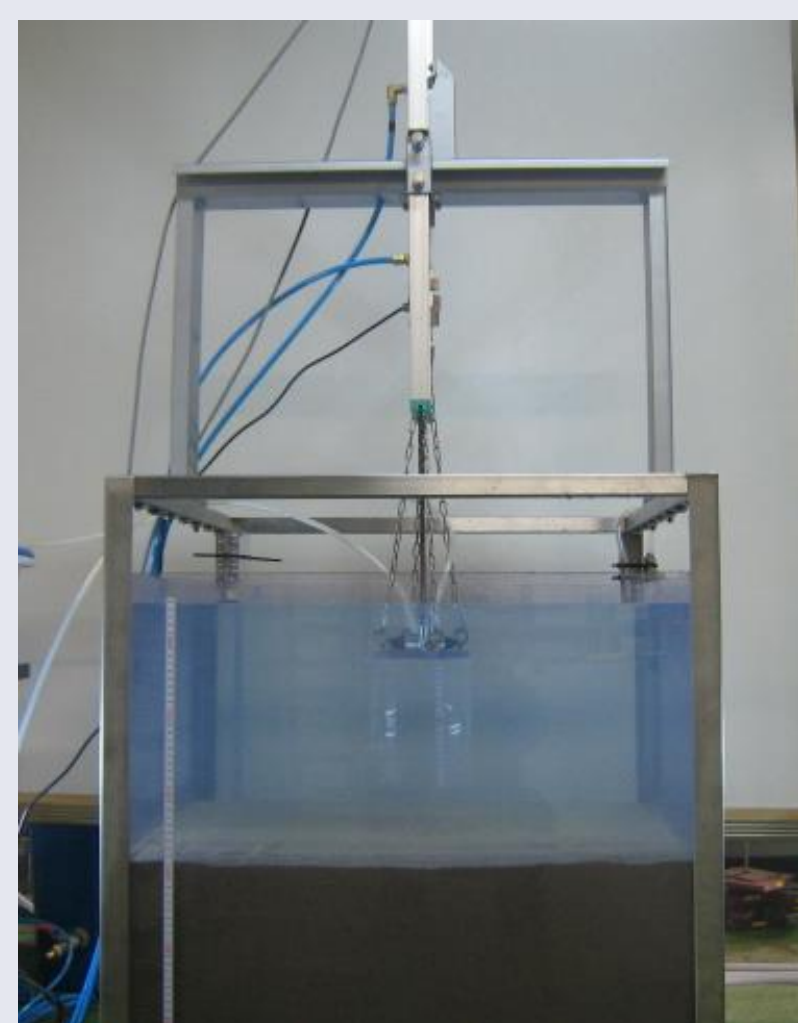


Item	HeMOSU-2 Met-mast	Ocean-mast 1
Estate Name	South-Western sea 2.5GW OWF	Mokpo-Jindo OWF feasibility study
Organizer	KETEP/KEPCO/SPC(KOWF)	Private/Mokpo national Univ.
Location	Gunsan-si 126-12-45.04 / 35-49-39.26	Shinan-gun 125-54-54.99 / 34-28-35.04
Water Depth	(DL-26.9m)	(DL-7.8m)



Methods

❖ Test Chamber



❖ Bucket models

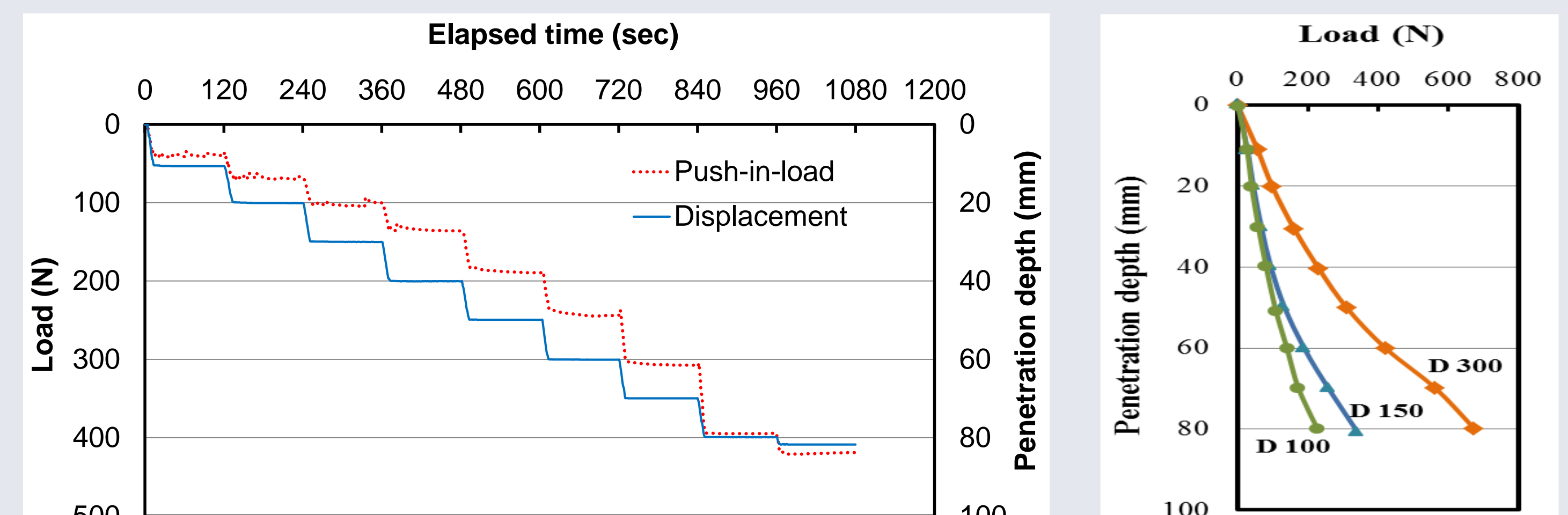
Diameter, D (mm)	100	150	300
Aspect ratio, L/D	1	0.67	0.33
t/D	0.05	0.033	0.017
Interior area, A _i (mm ²)	6,361.7	15,393.8	66,052.0
Tip area, A _t (mm ²)	1,492.3	2,277.7	4,633.8



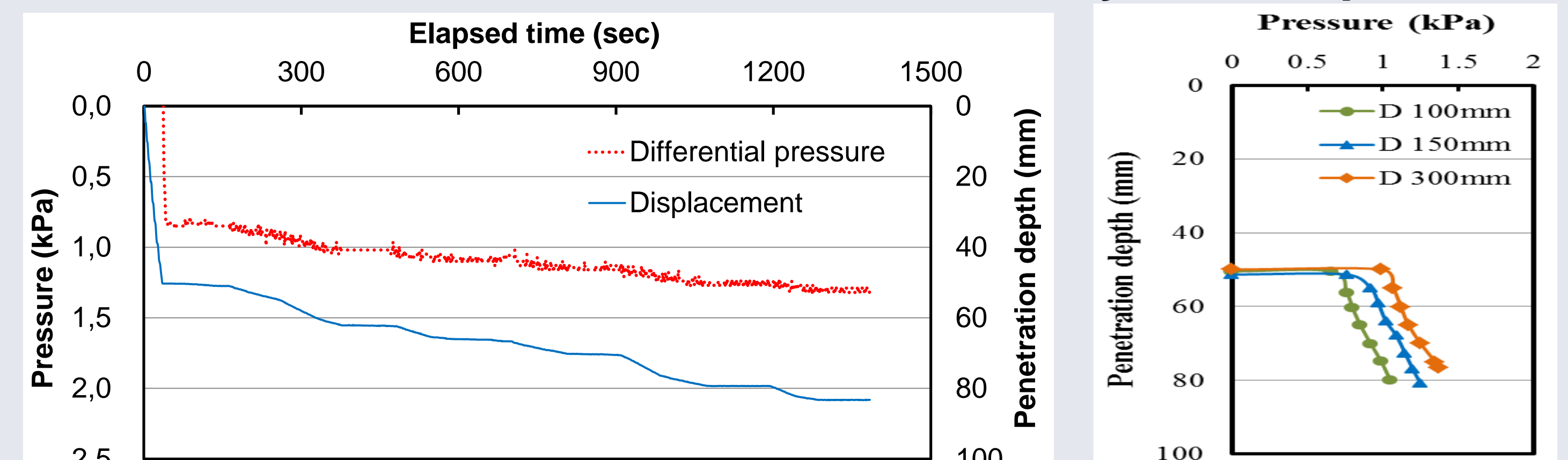
Results

The model tests of the suction bucket foundation are performed on the sand ground. This study carried out a series of model tests to investigate the penetration resistance of suction bucket foundation. And the mobilized soil strength factor was reviewed through comparing the experimental results by two installation ways (e.g., push-in-load and suction) and the results calculated by the conventional equation.

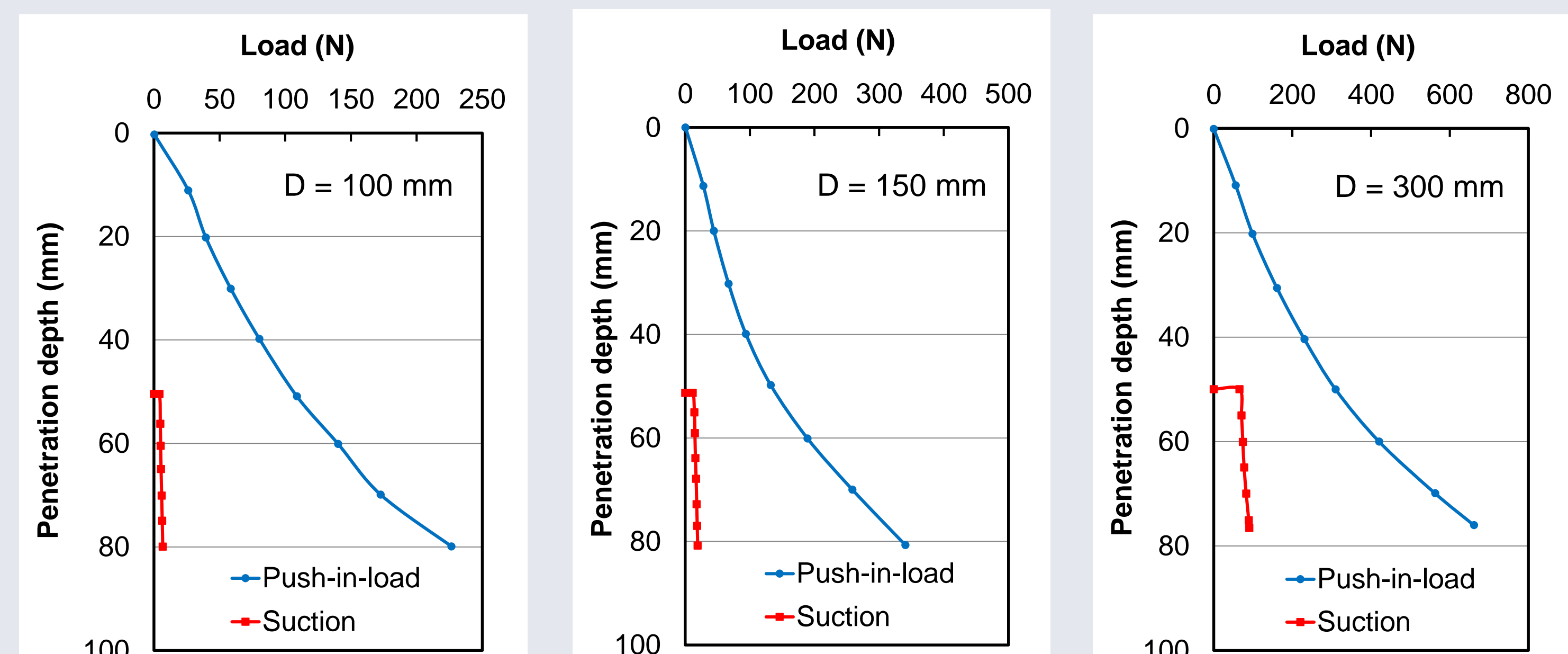
❖ Penetration behavior of bucket foundation by push-in-load



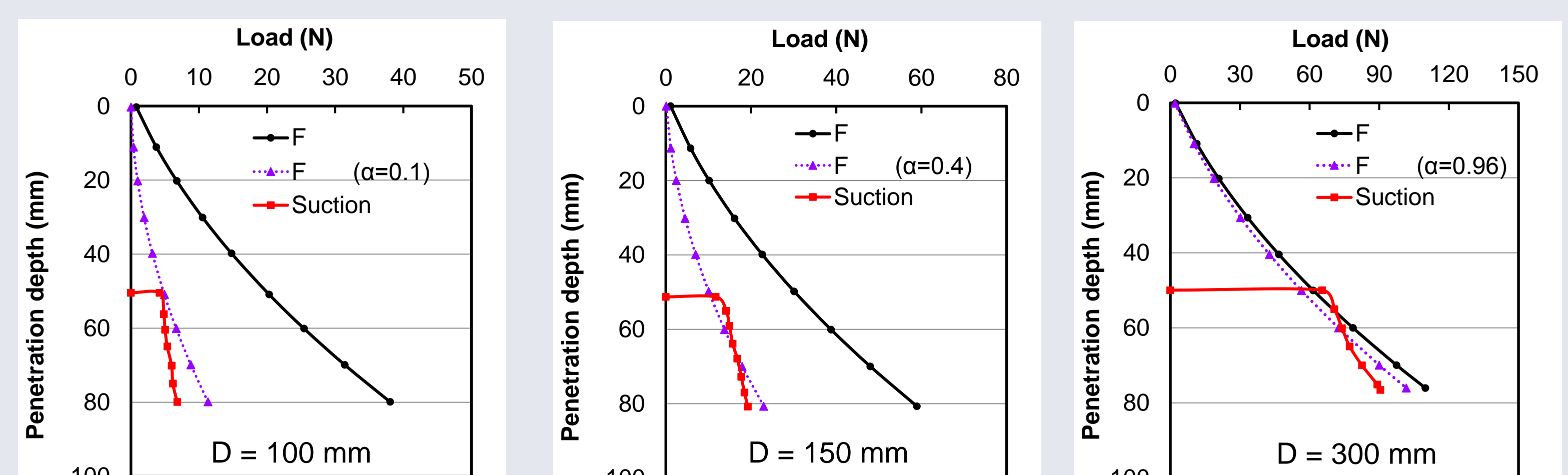
❖ Penetration behavior of bucket foundation by suction pressure



❖ Comparison of penetration resistance with penetration methods



❖ Penetration resistance derived by introducing the mobilized soil strength factor(α)



Conclusions

When suction is applied in the suction bucket foundation, seepage developed from outside into inside of bucket results in decreasing the effective stress of sand and friction angle between sand and foundation. To consider the reduction of the shear strength of the soil inside the bucket due to the applied suction, the mobilized effective soil friction angle ratio can be applied. From the laboratory model tests, mobilized soil strength factor on sand was ranged from 0.1 to 0.96. The penetration resistance when the bucket pile is penetrated on sand by suction is 3.5~16.8 % of penetration resistance when the bucket pile is penetrated by push-in-load method.

Acknowledgement

The present work is a result of the project "Development of the design technologies for a 10MW class wave and offshore wind hybrid power generation system". All support is gratefully acknowledged.

