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# Bottom Breakout of Objects Resting on Soft Clay Sediments

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## ABSTRACT

**Bottom breakout force is the force that is required to free an object resting on a soft saturated clay sediment. This paper summarizes the results of a laboratory study relating to the bottom breakout force of a cylindrical object on three different soft clay sediments. Two important parameters for the estimation of the bottom breakout force are the plasticity of the soil and the in situ rest time of the object on the sediment.**

## INTRODUCTION

Design and construction of offshore gravity structures have gained momentum during the past decade, primarily related to oil exploration programs. During the construction of offshore structures, several components require some degree of mobility to permit inspection for maintenance. This, in turn, requires that the components be recovered and replaced at certain intervals. One of the problems associated with the recovery phase is freeing the object from the clay soil sediment on which it is resting. The force required to free the object is referred to as the bottom breakout force. A knowledge of the bottom breakout force is not only essential for the construction of offshore structures; it may also be effectively used in operations such as salvaging sunken ships and submarine takeoffs.

A survey of existing literature relating to the bottom breakout force in soft clay sediments shows that the data are extremely limited, and most of the information can be found in the works of Foda (1983), Liu (1969), Muga (1967), Roderick (1975) and Roderick and Lubbad (1975). It appears that the problem is complex, and much more work needs to be done. The present study relates primarily to the evaluation of the force required to free an object resting on very soft clay sediment. The results of a number of laboratory model tests to study the bottom breakout of a cylindrical object resting on three different soft clay sediments are presented. The dependency of the bottom breakout time with the *in situ* rest time and the plasticity of the clay sediment is discussed.

## BOTTOM BREAKOUT FORCE

An object partially embedded in a very soft clay sediment is shown in Fig. 1a. If the object is at rest, assuming no side shear, the contact bearing pressure on the clay sediment can be expressed as (Roderick and Lubbad, 1975):

$$q_d A = W - \left[A(H-Y)\gamma_w\right] - \gamma_{sat} AY \qquad (1)$$

where $q_d$ = contact bearing pressure, $W$ = weight of the object in air, $A$ = area of cross section of the bottom of the object, $H$ = height of the object, $Y$ = depth of embedment of the object in the clay sediment, $\gamma_w$ = unit weight of water, and $\gamma_{sat}$ = saturated unit weight of the sediment.

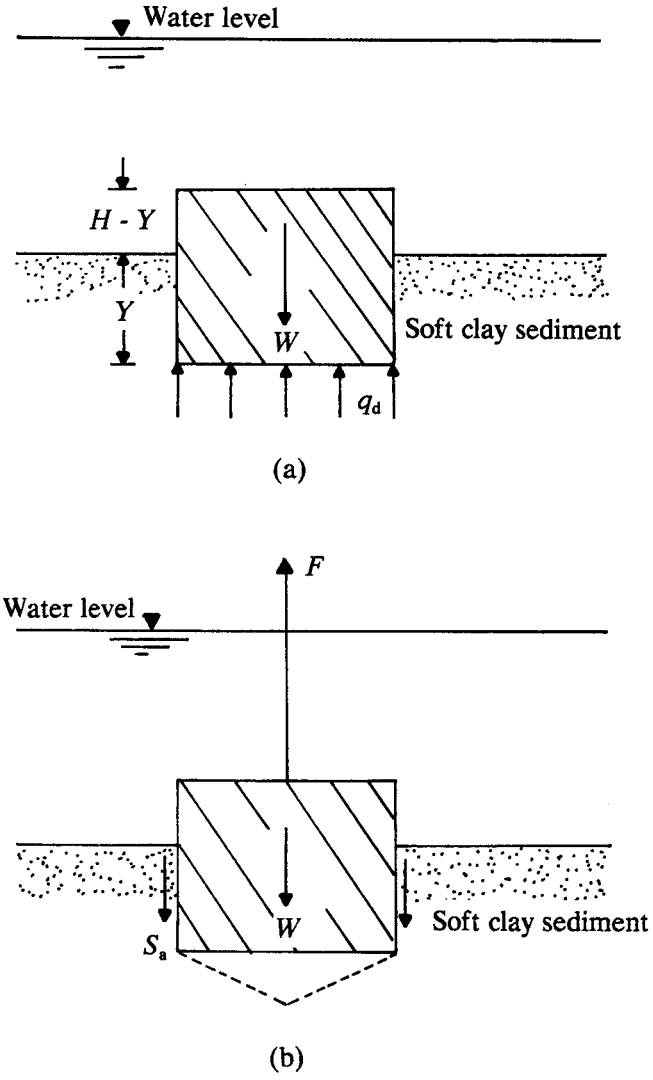


Fig. 1 (a) An object partially embedded in soft clay sediment; (b) force required to free the object

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