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# Bearing Capacity of Strip Foundations with a Non-Associated Flow Rule Assumption

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**Abstract**

It was found from experiments that most soils obey a non-associative behavior when they are subjected to shear leading to failure. The non-associative nature of soils causes less dilation rather than that predicted by an associated flow rule assumption. Practically this phenomenon results in the mobilization of smaller passive zone against failure loads applied on shallow foundations. Therefore, a relatively lower bearing capacity will be obtained if a non-associated flow rule is assumed to govern soil behavior. This study is specified to investigate the effect of flow rule on the bearing capacity of strip foundations, by employing the Drescher and Detournay [3] assumptions, formerly derived by Davis [16], in the method of characteristics. The third term has been given the most attention.

**Keywords: Stress characteristics, Flow rule, Bearing capacity, Strip foundations, Boundary value problem.**

## 1. INTRODUCTION

There are several researches on the bearing capacity of foundations that have been done with different approaches. The first studies can be attributed to Prandtl and Reissner [10]. Terzaghi [19] who expressed the triple equation for computing the bearing capacity of foundations as follows:

$$q_{ult} = c\,N_c + qN_q + 0.5B\gamma N_\gamma \quad (1)$$

In this equation, $q_{ult}$ is the ultimate bearing capacity, $c$ is the soil cohesion intercept, $q$ is the surcharge pressure, $\gamma$ is the soil weight, $B$ is the foundation width and $N_i$ are bearing capacity factors. The first two factors have been known with theoretical solutions but for third term there is a wide range that indicated by various researchers with different approaches. Afterwards some other researches have been done by Bishop, Hill and Meyerhof [10]. The method of stress characteristics has been used by Sokolovskii [18] who added the weight of soils as the vertical component of body forces, $\gamma$ to the stress characteristics equations and used this method for computing the bearing capacity of foundations. The equations have been extended by other researchers that more important ones are done by Cox [10], Hansen [5], Vesić and Chen [10]. One of the first important researches about the concept of the non-associativity can be attributed to Zienkiewicz *et al.* [14] and Drescher and Detournay [3]. Bolton and Lau [2] presented the bearing capacity factors for both circular and strip foundations with smooth and rough interfaces. Michalowski [10] with using the kinematic approach of the limit analysis did a research on the effect of the flow rule on the bearing capacity of foundations. Calculation of limit loads for non-associated materials was addressed by Michalowski [4] for applications in limit analysis.

There are several more extension of the bearing capacity to consider various affect in the recent years specially with using the method of stress characteristics, e.g., Kumar and Ghosh [8], Kumar and Kouzer [9]. Kumar [7] found the estimation of the bearing capacity factor, $N_\gamma$, with variation of footing roughness. The estimation of the bearing capacity of foundations based on the unsaturated soils was found by Jahanandish *et al.* [6]. Veiskarami *et al*. [12] with using the method of stress characteristics found the bearing capacity of driven piles. Recently the bearing capacity of foundations considering the groundwater flow was found by Veiskarami and Kumar [13].