# COMPUTATION OF GROUND BEARING CAPACITY FROM SHEAR WAVE VELOCITY

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## Introduction

Ground bearing capacity, which stands for the maximum pressure that the base can bear without collapsing, depends on mechanical features such as ground's weight per unit volume, shear strength and deformation characteristics; on the initial tension status and hydraulic conditions and on the geometrical and physical conditions such as depth, shape and load the base bears. Traditional method is to use the ground bearing capacity formula of Terzaghi. Ground bearing capacity can be computed by substituting the data from the results of soil mechanics laboratory and field experiments to Terzaghi's formula. Among field experiments, SPT (Standard Penetration Test) is included. If the strong relationships between shear wave velocity of Imai and Yoshimura (1975) and the SPT; and between shear wave velocity and unconfined pressure strength are taken into account, ground bearing capacity can be computed from shear wave velocity. Ground bearing capacity can be calculated from the relation:

$$q_f = V_s \gamma T_s / 40 \quad (\mathrm{kg/cm^2})$$

and safe bearing capacity can be computed from:

$$q_a = q_f / 3$$

This method is compatible with classical Terzaghi method.

Earth's surface is covered with structures made of earth and rocks. Rocks are formed as a result of geological events. Materials called earth have been formed by degradation and destruction of the rocks through physical (e.g. temperature differences, freezing, wind, water and plant roots) and chemical environmental effects. These solid bodies and the space between them forms the ground. Ground spaces can be partially or fully filled with water.



D. Bergman et al. (eds.), Continuum Models and Discrete Systems, 173-180.

Civil engineering structures such as buildings, bridges, roads, airports, dams etc. are mostly placed on grounds. Loads from weights of the buildings and mobile loads are transferred to ground and rock layers through bases. When the bearing limits of the ground is exceeded, safety of the buildings are in danger. For this reason it is important to investigate the ground characteristics. When examining characteristics of the ground, it is possible to make use of the concepts of mechanics. However, air and water within the ground among solid bodies must be taken into account. Presence of water effects the behavior of the ground. Grounds show various behavior depending on environmental effects and geological history. They are neither homogeneous nor isotropic. Each project field has to be experimented separately. For this reason, experimental methods are part of ground mechanics. Misunderstanding of the experimental methods can be misleading. Muds, sand, silts and turbas have been a problem for the buildings which are placed on them.

## 1. Ground bearing capacity

When sizing the bases, ground bearing capacity and ground characteristics are taken into account.

When the equations regarding bearing capacity are considered, Rankine's (1857) following relation is found:

$$q_u = \gamma D_f \tan^4(45 + \phi/2) + c\ \cot[\tan^4(45 + \phi/2) - 1].$$

$q_u$: final bearing capacity (kg/cm$^2$)
$\gamma$ : density of the ground (gr/cm$^3$)
$DF$: Base depth (m)
$\phi$ : Internal friction angle
$c$ : Cohesion (kg/cm$^2$)

Prandtl proposed the below relationship (1920) by taking the shear under the base by a degree of $(45 + \phi/2)$:

$$q_u = c\ \cot\phi[\tan^2(45 + \phi/2)e^{\pi\tan\phi}]$$

In this relationship, $C$=0 condition which corresponds to bearing capacity of zero in a sandy ground is impossible. This relation is not used today but is important historically.

Taylor (1948), Caquot and Buisman, being effected by Prandtl developed various bearing capacity relationships. Afterwards, the works of Terzaghi, Meyerhof, Brinch Hansen Caquot and Kerisel attracts attention.

Terzaghi (1943), applying Prandtl equation to ground conditions, developed the bearing capacity relation below: