

Sustainable Civil Infrastructures

Suman Saha
Sabyasachi Biswas *Editors*

Innovations for Sustainable and Resilient Infrastructure

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Editors

Suman Saha 
Department of Civil Engineering
National Institute Technology Durgapur
Durgapur, West Bengal, India

Sabyasachi Biswas
Department of Civil Engineering
National Institute of Technology Durgapur
Durgapur, West Bengal, India

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Shear Rate Impact on Sandy Soil Strength Characteristics of Ajay River and Damodar River

Aritra Mullick, Ramesh Mondal, Shovan Roy^(✉), and Sanjay Sengupta

Dr. B. C. Roy Engineering College, Durgapur, India
shovan.roy@bcrec.ac.in

Abstract. Direct shear tests are widely used in geotechnical engineering to ascertain the soil's shear strength. The rate at which the sample is shredded is known as the shear rate (SR), specifically the horizontal movement of the upper portion relative to the lower portion. Different shear rates can significantly impact the properties of the sample's shear strength under test. These characteristics, including cohesion of soil (c), angle of internal friction (ϕ), and maximum peak strength (τ), are crucial geotechnical engineering parameters. The direct shear test is favoured for its simplicity and practicality in applying to both disturbed and undisturbed soils. This study investigates the effects of various shear speeds on the strength parameters during direct shear tests of sand samples with different particle size distributions. Specifically, the research examines two samples of sand from the Ajay River and Damodar River, with varying grain sizes (0.075 mm to 2 mm), across a range of shear rates from 0.125 to 1.25 mm/min, under typical stress conditions of 0.5, 1, and 2 kg/cm². The results indicate that increasing the shear rate leads to higher values of the maximal shear strength and angle of internal friction. These increases are particularly noticeable at shear rates exceeding 1 mm/min. However, the impact of grain size on the shear rate-related variation in strength parameters was found to be restricted to the soils tested in this study.

Keywords: Direct shear test · shear rate · angle of internal friction · shear strength · Ajay River · Damodar River

1 Introduction

To understand the behaviour of soil, it is essential to know its shear force strength parameters: cohesion of soil (c), angle of internal friction (ϕ), and maximum peak strength (τ). This paper compares the strength characteristics of sandy soil from the Ajay River and Damodar River at different shear rates (1.25, 0.625, 0.25, and 0.125 mm/min) and under three normal stresses (0.5, 1, and 2 kg/cm²). The direct shear test, widely used for determining soil shear strength parameters, is particularly favoured for its simplicity and practicality in both disturbed and undisturbed soils.

Horn [1] identified that for loess soil samples (such as sandy, clayey, and silty soils), a shear rate of 0.15 mm/min was the maximum in direct shear tests conducted under laboratory drained conditions, attributing the increase in shear stress (τ_f) with displacement