Sustainable Civil Infrastructures

Suman Saha
Sabyasachi Biswas *Editors*

Innovations for Sustainable and Resilient Infrastructure

Proceedings of International Conference on Sustainable and Resilient Infrastructure 2024 (ICSRI2024)

Springer

Sustainable Civil Infrastructures (SUCI) is a series of peer-reviewed books and proceedings based on the best studies on emerging research from all fields related to sustainable infrastructures and aiming at improving our well-being and day-to-day lives. The infrastructures we are building today will shape our lives tomorrow. The complex and diverse nature of the impacts due to weather extremes on transportation and civil infrastructures can be seen in our roadways, bridges, and buildings. Extreme summer temperatures, droughts, flash floods, and rising numbers of freeze-thaw cycles pose challenges for civil infrastructure and can endanger public safety. We constantly hear how civil infrastructures need constant attention, preservation, and upgrading. Such improvements and developments would obviously benefit from our desired book series that provide sustainable engineering materials and designs. The economic impact is huge and much research has been conducted worldwide. The future holds many opportunities, not only for researchers in a given country, but also for the worldwide field engineers who apply and implement these technologies. We believe that no approach can succeed if it does not unite the efforts of various engineering disciplines from all over the world under one umbrella to offer a beacon of modern solutions to the global infrastructure. Experts from the various engineering disciplines around the globe will participate in this series, including: Geotechnical, Geological, Geoscience, Petroleum, Structural, Transportation, Bridge, Infrastructure, Energy, Architectural, Chemical and Materials, and other related Engineering disciplines.

SUCI series is now indexed in SCOPUS

and EI Compendex.

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

ISSN 2366-3405 ISSN 2366-3413 (electronic)
Sustainable Civil Infrastructures
ISBN 978-3-031-91975-6 ISBN 978-3-031-91976-3 (eBook)
https://doi.org/10.1007/978-3-031-91976-3

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Contents

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/cm^2. 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/cm^2). 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 (τf) with displacement

S. Saha and S. Biswas (Eds.): ICSRI 2024, SUCI, pp. 78–85, 2025.
https://doi.org/10.1007/978-3-031-91976-3_8