



Geo-Congress 2024

GSP 348

Geotechnical Site and Soil Characterization

Selected Papers from Geo-Congress 2024
Vancouver, British Columbia, Canada | February 25–28, 2024

Edited by

T. Matthew Evans, Ph.D.
Nina Stark, Ph.D.
Susan Chang, Ph.D., P.E.

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Preface

This Volume is the first of six Geotechnical Special Publications (GSPs) containing papers from Geo-Congress 2024: Bridging Government, Industry, and Academia for Resilient Mega-Communities, held in Vancouver, British Columbia, Canada on February 25-28, 2024. Notably, this was the first Geo-Congress held outside of the United States, and the Canadian Geotechnical Society and Vancouver Geotechnical Society served as partnering organizations. The conference hosted the Terzaghi, Peck, Seed, and Prakash Lectures, numerous invited presentations on selected topics addressing the state of the art and practice in geotechnical engineering, and many technical sessions, panel sessions, short courses, and student competitions.

The call-for-papers was distributed internationally and resulted in 885 submissions. Several strong technical themes were observed in the submissions. These included cold regions engineering, machine learning and artificial intelligence, and sustainability, in addition to other traditionally strong tracks such as deep foundations, geosystems, and geoenvironmental engineering. We see these tracks as a reflection of both the location of the Geo-Congress and the topics currently at the forefront of geotechnical research and practice.

This volume includes a collection of papers in the fields of Engineering Geology, Rock Mechanics, Soil Properties and Modelling, and Geophysical Engineering. Each paper was subjected to a rigorous technical assessment by two or more independent peer reviewers. Acceptance required concurrence by at least two peer reviewers, and final decisions were made only after review coordinators confirmed that authors satisfactorily addressed any reviewer comments on their original submission. Ultimately, this resulted in acceptance of 366 papers in total, 64 of which are in this volume. All accepted papers are presented at the conference as posters or technical talks and are eligible for applicable ASCE Awards.

The success of this conference and proceedings would not have been possible without the participation and collaboration of many individuals, including the tireless staff at the Geo-Institute: Barbara Curtis, Lucy King, Krystina Scott, Sean Herpolsheimer, and Brad Keelor. We would also like to extend our gratitude to the Session Chairs and Reviewers, who provided thorough reviews and assessments of the submissions in a timely manner.

The Editors,

T. Matthew Evans, Ph.D.
Nina Stark, Ph.D.
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Sedimentation Characteristics and Retention Ratio Calculation of Dredged Soil

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ABSTRACT

Retention rate refers to the content of soil remaining in the dumped area compared to the left sample during dredged soil dumping. During reclamation construction, the retention rate calculates the amount of dredged soil, so it is essential to determine the exact retention rate. The retention rate may be calculated differently depending on the soil characteristics, but currently, in the case of dredging and reclamation on the West Coast, the retention rate is empirically applied at 70%–95%, or the amount of dredged soil is calculated through examples of application of retention rates in similar districts nearby. Accordingly, in this study, to accurately calculate the retention rate, a separate sedimentation model test was conducted using dredged soil at the location where the actual project was carried out. Separated sedimentation characteristics were confirmed through mechanical and physical tests for each deposition distance, and the retention rate was calculated to be 89.0%, which is relatively higher than the literature and existing cases. This study was used as primary data to confirm the feasibility of the road construction project connecting the Saemangeum area to the north and south.

INTRODUCTION

The territory of the Republic of Korea is 70% mountainous and is a peninsula surrounded on three sides by the sea. Due to urbanization, the city has reached a saturation point, and land reclamation projects are being actively carried out in the west coast area where the water depth is relatively low. The representative areas where the reclamation project has been applied in Korea are Incheon International Airport and Saemangeum. The project related to this study is the road construction project connecting the Saemangeum region to the north and south. Methods for reclamation of public waters include utilizing soil from mountains near the landfill and landfilling by excavating and transferring soil from under the sea using a large dredger (Kim et al. 2013). Because the amount of landfill soil required for large-scale reclamation work is considerable, getting sufficient landfill soil near the site isn't easy. As a result, it is frequently dumped by dredging the seabed's sedimentary soil layer, and if necessary, the ground is improved using the soft ground stabilization method. (Kim et al. 2013).

Furthermore, dredging is generally excavating soil under the water's surface, and excavation and reclamation can be done simultaneously (Kim et al. 2006(a), Kim et al. 2013). Landfilling with dredged soil has become common recently as reclamation techniques and equipment have improved. Much silt, fine grained, and granular sand is contained in dredged soil from the west

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coast region, including Saemangeum in South Korea. As a result, recognizing the sedimentation characteristics of dredged soil is of great importance in using dredged soil as embankment material (Shin et al. 2017, Kim et al. 2002). On the west coast of South Korea, where there is a lot of sand mixed, dredged soil has varied particle size distributions depending on the outlet distance, and the sedimentation and consolidation processes behave differently from dredged clay (Kim et al. 2006(b), Park et al. 2011). As a result, if the effect of particle size distribution by distance is not considered, the landfill settlement amount may be overestimated or underestimated, resulting in enormous construction costs (Lee and Jeon. 2002).

In the area considered in this study, transporting and dumping fill materials from land areas requires a very long transport distance and may require enormous construction costs, so this study was conducted to apply offshore dredged soil dumping. The retention rate refers to the amount of dredged soil deposited in the planned landfill and is the ratio of the amount of sample dumped when dumping dredged soil and the content of soil remaining. The amount of dredged soil to be dumped and the length of the construction period depend on the retention rate. Therefore, the retention rate has a significant impact on construction costs. The retention rate of dredged landfills varies depending on soil and construction conditions and is calculated through existing design data and literature research. Design application data such as loss rate and retention rate were analyzed for dredging and reclamation work conducted in the existing west coast area.

Table 1. Retention ratio in the existing west coast area.

Project	Retention ratio
Saemangeum Waterproofing(Korea Rural Community Corporation, 2010)	75%
Songdo International City Reclamation Construction (Incheon Free Economic Zone Authority, 2009)	85%
Incheon New Port(Incheon Regional Maritime and Port Office, 2008)	80%
Pyeongtaek Dangjin Port(Gyeonggi Pyeongtaek Port Corporation, 2007)	90%
Incheon International Airport construction (Incheon International Airport , 2000)	80%

However, since the retention rate varies depending on soil properties, the retention rate must be determined considering location conditions to evaluate project feasibility accurately (Kim et al. 2002).

MODEL TESTS

Model ground. The samples used in this study were collected from the road construction site, and the fundamental properties of the ground sample's dredged soil are summarized in Table 1. According to the unified classification method, the physical properties of the test sample were classified as silty sand (SM) with a specific gravity of 2.53 and a water content of 25%. The fine content was 14.2%, and the sample used in the experiment was sand that did not feel clay when touched by hand, so the plastic limit could not be determined, so it was classified as non-plastic (NP), and the Atterberg limit test was not performed. Figure 1 shows the particle size distribution curve of the sample used in the experiment.

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