

STUDY OF REPLACEMENT OF SAND USING FOAM CONCRETE

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RESEARCH OF USING FOAM CONCRETE TO REPLACE SAND

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ABSTRACT

Foam concrete has been a subject of interest in Civil Engineering field for many years. Yet, so far there are not much research had been done on the possibility of using foam concrete as a backfill material. Due to the properties of foam concrete which is light in weight and thus low in density, this research has been designed in a way that the feasibility of using foam concrete as a floating foundation is carried out. In this study of replacing sand using foam concrete, there were two sets of tests which were carried out. The methodology of this study was designed together with experienced long time researcher in concrete technology, Dr Mohd Ibrahim Safawi Hj. Mohd. Zain, together with Master Degree student Mr Lai Phui Hua. The samples of foam concrete were produced in the laboratory of UNIMAS Concrete Laboratory. The research is mainly focused on the possibility to use foam concrete as a

ABSTRAK

Konkrit Buih merupakan satu subjek yang menarik dalam bidang Kejuruteraan Sivil selama ini. Tetapi, tidak banyak penyelidikan yang telah dibuat untuk mengkaji kemungkinan untuk menggunakan konkrit buih sebagai bahan penimbunan. Disebabkan oleh ciri-ciri konkrit buih yang ringan serta mempunyai ketumpatan yang rendah, penyelidikan ini telah direkakan untuk mengkaji kemungkinan untuk menggunakan konkrit buih ini sebagai “floating foundation”. Dalam penyelidikan ini, sebanyak dua set kajian telah dilakukan. Metodologi dalam penyelidikan ini telah direkakan bersama penyelidik yang berpengalaman dalam bidang teknologi konkrit, Dr Mohd Ibrahim Safawi Hj. Mohd. Zain, dan juga pelajar Ijazah Sarjana, Encik Lai Phui Hua. Contoh konkrit buih telah dihasilkan di makmal konkrit UNIMAS. Penyelidikan ini mengutamakan kemungkinan untuk menggunakan konkrit buih sebagai “floating foundation” untuk menggantikan pasir. Dipercayai bahawa keputusan penyelidikan ini ada sangat berguna untuk pengajian pada masa yang akan datang.

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LIST OF ABBREVIATION

UNIMAS	University Malaysia Sarawak
m	Meter
m ²	Meter square
m ³	Cubic meter
mm	Millimeters
kg	Kilogram
G	Gram
ISO	International Organization of Standardizations
BS	British Standards
Φ	Phi
OPC	Ordinary Portland Cement
N	Newton
%	Percent (or percentage)
log	logarithm
PFA	Pulverized Fly Ash
m _m	Mass of Mould
m _c	Mass Of Sand Filled Together With Mould
m _p	Mass Of Sand
L, H, W	Length, Height, Width
θ	Degree Of Rotation

CHAPTER 1

Introduction

1.1 Background

Sand land construction had always been a problem constantly to all structural engineers. Sand unique properties had been one of the major concerns of structural engineers.

Nevertheless, it is unavoidable to face this situation. Facing the problems or challenges to design and to construct on a piece on sandy land will sooner or later be faced by an engineer in his/her years of practice.

Due to the sand natural properties, which is the liquidity to be exact thus making it crucial that the concerned area which is to be casted with concrete to be tested before any construction works can be done.

Foam concrete had been a subject of interest in the world of engineering, civil engineering to be specified. Foam concrete can be mixed into different types of functions depending on the method of mixing and of course, the mixture proportion which had been adopted.

Foam concrete had always been given credits due to the fact that it possessed low density, high thermal resistance, high flow ability, high workability and also other properties which will be discussed into further details in the text below.

In order to replace sand using foam concrete as a backfill material, the main feature which comes into consideration is the ability of the concrete to ‘float’ in the location which it will be placed. And by this, it also means that the foam concrete will have to be impervious so that the external factors such as saline water intrusion will not destruct the stability of the concrete and in turn the stability of the super structure which is placed on top.

1.2 STUDY CONCEPT

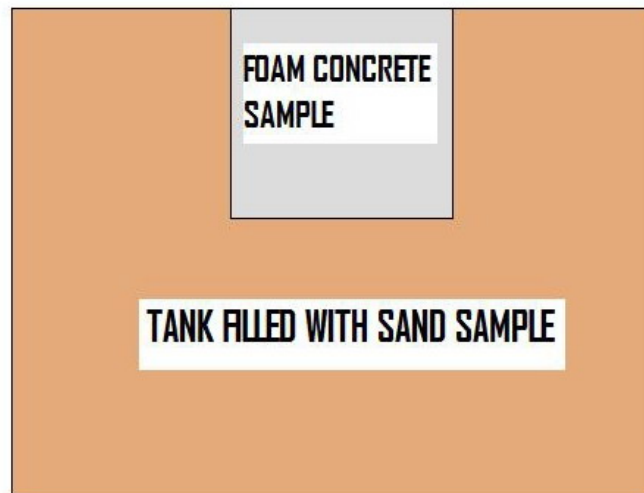


Figure 1: Foam Concrete As a Floating Foundation In Sand

Sand, due to the high liquidity of its nature, had always been a problem to be loaded on top with loads of buildings which were to be built and thereby, had always been a problem to be solved for the structural engineers who were responsible for any construction works to be performed.

Due to the high liquidity of sand, strengthening works needed to be done before hand. Even though the strengthening works had already been done, there is no way that we could foretell what will happen to the structure which is beneath the soil.

When it comes to the matter of replacing a sand area by the use of foam concrete, the following considerations must be taken seriously.

First and foremost, the density of the foam concrete to be placed is the most crucial factor. The reason why foam concrete is chosen to be the subject for studies is due to its light weight properties. The density of the foam concrete which is to be placed must be at least the same as

the surrounding soil or better yet, lower than the surrounding soil. This is to make sure that the concrete placed will be able to act like a floating foundation. Thus, it is essential that the control of the density to be carried out through the mix proportion.

Other than that, it is also crucial not to forget that the concrete will be placed in a surrounding of sand. The porosity of sand will result in the seeping through of water more easily to reach to the surface of the concrete. And thus, making the properties of the concrete poured changed. Therefore, it is crucial that relevant protection of the foam concrete which is to be placed into sand as a replacement to be done.

Therefore, this research aimed to solve the stated problems by producing a foam concrete which targeted density to be below 900 kg / m^3 and also the protection surrounds the foam concrete to make sure it can last long when it is placed.

1.3 AIM AND OBJECTIVES

Several aims were set out to be achieved in this project. The aim of this project is to produce a foam concrete mixture which is low in density and also be able to withstand the condition in the sand surrounding. The objectives of this study are

1. To verify the feasibility of replacing sand with foam concrete mixture.
2. To experiment different sizes and shapes of foam concrete used as floating foundation.
3. To produce foam concrete with low density and high strength for purpose of precast blocks.

1.4 SCOPES OF STUDY

The scopes of the study were developed in accordance to the objectives which is completed through the laboratory tests. The project is focused to achieve the targeted foam concrete mix proportions and also fit for the intended usage.

The scopes of study were broken down into a systematic way to achieve the aim of the project. Below are the intended works to be done

1. To replace sand using foam concrete with applying certain loading being to check for stability.
2. To carry out study by using sand sample in dry, saturated and also over saturated condition.
3. To replace sand using foam concrete.

But there are certain difficulties in carry out the tests which similar to the actual environment on actual sand land due to certain conditions which cannot be simulated through the laboratory tests such as below.

1. The possibility of currents of water flow beneath the actual sand land.
2. The proper method to push in the foam concrete sample and also to collect the sand displaced out due to the fact that works are done manually.
3. The sand displaced out is impossible to be collected 100% efficiently since there might be parallax occurred.

4. The reading might not show the actual case which had happened due to the fact that the shaft of dial gauge might get stuck by the sand trapped inside.

1.5 BENEFITS AND POTENTIALS

From this study, the possibility of utilizing the sandy lands into developable areas with the use of foam concrete is to be realized. This is crucial for intended development projects in sandy lands regardless to the locations. Currently, sandy lands construction is still considered as difficult in general as it is a problematic soil. Therefore, it is hoped that through this study, the foam concrete which is produced can be a solution to these problems.

1.6 STRUCTURE OF THESIS

In this thesis, the topics which would be covered in chapter one will include introduction, study concept, aim and objectives, scopes of study and also benefits and potentials. This chapter basically spells out the outline of the study. The listed topics in above is aimed to give an overview to the readers about the works which will be done in the study and the targeted objectives to be achieved.

In chapter two, the findings of data and relevant information mainly on the World Wide Web, with minimal supports of written materials would be shown.

In chapter three, the method which will be used in carrying out the study will be discussed.

The methods to carry out the experiments for this study are established methods published in journals, books, and some of the methods are referred from local engineers who had been involved in the related works.

In chapter four, the findings and also the results through the laboratory tests will be shown. An explanation of the trends shown in the produced graphs which will be included in the Appendix 1, 2 and 3 will be included. This is to give a clear explanation to the readers what are the message which was conveyed in the graphs.

Finally, in chapter five discussions and also conclusion which can be made throughout the research will be included. Discussions presented are noted throughout the period of time of this study being carried out whereas the conclusion is made based on the results which were collected from the laboratory tests.