MECHANICAL AND THERMAL PROPERTIES OF SAWDUST CONCRETE

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A project report submitted in partial fulfillment of the
requirements for the award of the degree of
Master of Engineering (Structure)

Faculty of Civil Engineering
Universiti Teknologi Malaysia

JANUARY 2016

This project report is dedicated to my father Dr. Sufi Saleem Pervez, my lovely mother Shahnaz Shaheen and my elder sisters Amrat Pervez Memon and Irum Pervez Memon for their endless support and encouragement

ACKNOWLEDGEMENT

I would like to express my gratitude to all those who gave me a helping hand to complete this thesis. I am particularly grateful to my supervisor **ASSOC. PROF. DR. A.S.M. Abdul Awal** for his valuable and constructive suggestions that helped me in completing this project. Thank you for your efforts in improving my study.

Thanks to the **technicians and individuals** who offered their help directly or indirectly in Highway laboratory. Gratitude also dedicated to all my **friends** who helped and supported me during all the way upon completing thesis.

Furthermore I wish to thank my **Parents** who have supported me throughout this entire process. Without their prayers and support I would have never completed this project.

I will finally like to express my gratitude with a high degree of appreciation to my friend **Nadeem Nawaz**, **Kamal** and **Moazzam Mughal** for their love, care, concern and support morally, my gratitude knows no bound. I say a big thanks to my friend **Ghasen Zalme** for helping me throughout my master project. All words most precious resources would not adequately compensate for his love and sacrifice.

ABSTRACT

Sawdust is the by-product of wood. It is considered as waste material but nowadays this waste material is utilized in the construction of the building as sawdust concrete. It is utilized to make light-weight concrete and possess long duration heat transfer. In this research sawdust concrete was made at three different mix proportions of cement to sawdust of 1:1, 1:2 and 1:3 by volume. At these proportions mechanical and thermal properties like density, workability, strength, elastic modulus and heat transfer were investigated after, 7 , 28 and 56 days of air curing. It was found that with the increase in the amount of sawdust, the workability and strength decreased however, in terms of thermal conductivity concrete with higher amount of sawdust performed very well. It was also found that the heat transfer of sawdust concrete decreased. Considering the overall physical and mechanical properties, sawdust concrete can be used in building construction.

ABSTRAK

Serbuk kayu adalah produk daripada kayu. Walaupun ia dianggap sebagai bahan buangan namun tetapi ia telah dimanfaatkan di dalam bidang pembinaan bangunan sebagai konkrit yang diasaskan dari serbuk kayu. Ia telah digunakan untuk membuat konkrit lebih ringan dan tahan lama semasa pemindahan haba. Dalam kajian ini konkrit berasakan serbuk kayu dibuat dengan tiga berlainan nisbah campuran simen kepada serbuk kayu iaitu 1:1, 1:2, dan 1:3 dan bentuk isipadu. Dalam nisbah ini sifat mekanikal dan haba seperti ketumpatan, kebolehkerjaan, kekuatan, modulus keanjalan dan pemindahan haba telah diuji selepas 7 hari, 28 hari dan 56 hari pengawetan udara. Ia telah didapati dengan penambahan kuantiti serbuk kayu, kebolehkerjaan dan kekuatan bahan menurun namun begitu dari segi pengaliran haba konkrit ia menunjukkan prestasi yang baik dengan jumlah serbuk kayu yang banyak. Namun demikan ia didapati bahawa pemindahan haba untuk konkrit berasakan serbuk kayu berkurangan. Dengan mengambil kira keseluruhan sifat-sifat fizikal dan mekanikal, konkrit berasakan serbuk kayu boleh digunakan dalam pembinaan bangunan.

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LIST OF ABBREVIATIONS

ACI	-	American Concrete Institute
ASTM	-	American Standard Testing Materials
BS	-	British Standard
MOE	-	Modulus of Elasticity
OPC	-	Ordinary Portland Cement
SCC	-	Self Compacting Concrete
SDC	-	Sawdust Concrete
W/C	-	Water Cement
HPC	-	High Performance Concrete
LWC	-	Light Weight Concrete
MDD	-	Moisture Dry Density
CBR	-	Calfornia Bearing Ratio
OMC	-	Optimum Moisture Content
LOI	-	Loss of Ignition
SDA	-	Sawdust Ash
NC	-	Normal Concrete

CHAPTER 1

INTRODUCTION

1.1 Introduction

Concrete is the most common used material in the construction over hundred years ago. The mix of normal concrete is cement, fine aggregate, coarse aggregate and water. The rapid development of composite structure nowadays requires a better quality material and concrete performance. Concrete is the most economical material used but because of the high density of the concrete, the dead load of the building also increases. Reducing the density of concrete has several advantages and this will lead to the efficient construction because the cost of handling, transportation and constructability will be reduced.

Concrete is the conventional and one of the most durable building materials for most civil engineering works in the world. It provides superior fire resistance. Structures made of concrete can have a long service life. Reinforced concrete, prestressed concrete and precast concrete are the most widely used types of concrete functional extensions in modern days.

The construction industry consumes more natural resources than any other industry. With increasing public awareness of the needs and demands of sustainable development and environmental conservation, no other industry is called on as much

as the country's construction and building industry to evolve their practices to satisfy the needs of our current generation, without curtailing the resources of future generations to meet theirs. For example, concrete accounts for the most important building material, with billions of tons produced each year worldwide, and without which the nation's infrastructure is inconceivable. Considerable progress and breakthroughs have been achieved in recent years in concrete technology, which has largely gone unnoticed by the public at large.

One alternative to make concrete lighter is introducing lightweight concrete (LWC) in the construction industry. Lightweight concrete has been used recently because of it the capability to reduce the dead load and the earthquake force. The density of LWC is approximately 80% of normal weight concrete. The density of structural LWC typically ranges between 1440 and 1840 kg/m3. Whereas these values vary between 2240 and 2400 kg/m3 for normal weight concrete (Kivrak *et al.*, 2006).

Ever since, concrete has become popular. Research has been devoted towards finding the methods of making it lighter in weight together with better insulating properties and cheaper in cost. Sawdust concrete has received some attention as a lightweight concrete in building construction for a number of years and has been studied in many countries. Since sawdust is available in abundance in tropical countries and is relatively inexpensive, attempts have been made to investigate the suitability of this material for possible use in building construction in the Singapore-Malaysia region (Adebakin, 2012; Mageswari *et al.*, 2009).

1.2 Background of study

History of sawdust technology goes back to at least the 1930’s, and it has been researched and applied in parts of the United State of America, United Kingdom Germany and also Singapore and Malaysia region (Paramasivam *et al.*, 1980). In some instances, the materials (with various adaptations) have been used for flooring as well as wall. The possibilities for this material are probably endless.

Wood wastes in the form of wood shavings can be incorporated into wood sand concretes without any preliminary treatment. The results have demonstrated that the inclusion of shavings in sand concrete not only reduces the density of the material but also improves its thermal conductivity, while the structure of the material remains homogeneous and with strong adherence of the wood to the concrete matrix (Sales. *et al.,* 2011). Implement waste sawdust that has been widely regarded as a partial sand replacement material to produce sawdust concrete, make sure that the overall structure is strong and secure without reliance on the sawdust cement infill (Jian, 2014).

Sawdust has been used in concrete, but not widely. Although seriously limited by its low compressive strength. It has serious limitations that must be understood before it is subject to use. Within these limitations, the advantages that sawdust concrete are offers considerable reduction in weight of the structure, thereby reducing the dead loads transmitted to the foundation , high economy when compared to and normal weight concrete, reduce damage and prolonged life of formwork due to lower pressure being exerted, ,Easier handling, mixing and placing as compared with other types of concrete , improved sound absorbent properties due to its high void ratio (Aberdeen, 1971; Ansari *et al.*, 2000; Bdeir, 2012) , improved thermal insulation because the incorporation of wood aggregates in concrete decreases its thermal properties . For a mass percentage of wood aggregates ranging from 0 to 10%, the reduction in the thermal conductivity increases until 35% for the concrete-sawdust(Taoukil *et al.,* 2011).

The use of sawdust for making lightweight concrete has received some attention over the past years. Although studies on structural properties of sawdust concrete have shown encouraging results (Felix *et al.,* 2002; Paramasivam *et al.,* 1980).

Globally, there is a resurgence of interest in this era of information revolution and environmental awareness. However, modern applications are being discovered and several are based on wood’s unique physical and mechanical properties like strength (Ganiron, 2014).

1.3 Problem statement

The produced sawdust from the milling plants constitutes waste and pollution in the environments, when burnt or used as a fuel. There arises the question for engineering consideration and replacement with cheaper and locally available materials to satisfy this need in order to reduce construction cost, maximize resources and explore the economic values of these materials for sustainable development.

Industrialization in developing countries has resulted in an increase in agricultural output and a consequent accumulation of unmanageable agro wastes. Pollution arising from such wastes is a matter of concern for many developing nations. Recycling such wastes into new building materials could be a viable solution to the pollution problem, but also to the problem of the high cost of building materials currently facing these nations.

The tough problem is nowadays in this world is global warming and green materials are in priority aspects for material use consideration. Reducing the heat transfer of the roofing system and other structural member would be undoubtedly help saving the energy consumption for the building.

1.4 Objectives

The objectives of this research are listed as following:

- To study the fresh properties of sawdust concrete.
- To investigate the physical and mechanical properties of sawdust concrete.
- To examine the thermal behavior of sawdust concrete and find the best mixture proportions for the purpose of save the energy (heat transfer).

1.5 Scope of Study

The study is focused on the use of wooden sawdust in normal Portland cement concrete, in order to determine its workability, density, compressive strength, flexural strength, tensile strength, elastic modulus and also thermal properties of sawdust concrete. This research does not included the cost analysis of using sawdust in concrete but this course does not intend to neglect the study economy to back ground, but rather it is believe that technical issues have to be understood and fixed right before the economic aspect of the study is determine. The scope of the study can be achieved by carrying the research according to the specification and standards of the methods and material.

1.6 Significance of study

The main scope of this research also to implementation of wooden sawdust waste in the concrete technology field in order to get many advantages as much as possible so we can save our economy and as well as environment. Implementation of waste sawdust cannot only decrease environmental damage but also save the concrete materials. Its own stakes many advantages over traditional concrete, low bulk density, better heat preservation and heat insulation property, lower pollution for our environmental, etc. And the implementation of waste sawdust could also be generalized to the use of straw in countryside, which could lead to more environmental saving profit.

Large increasing amount in the population of the world requires a larger establishment of the settlement. Thus new techniques and materials should be designed to construct green buildings. Besides considerable number of the settlement security of those buildings against a natural disaster is the durability of the construction and also thermal conductivity. Lightweight concrete (LWC) is a very versatile material for construction, which offers a wide range of technical, economic and environment-enhancing and preserving advantages and is destined to become a dominant material for construction in the new millennium.

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