

## **Civil Engineering Technology**

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**Abstract:** This compilation of technical papers is aim to encourage participation among diploma of civil engineering students under the guidance of their respective supervisors to write articles pertaining to their innovations in their final year diploma project. It is hope that this compilation will be useful for civil engineering students, budding entrepreneurs and the public at large and in addition will increase the contribution to the University publications.

**Keywords:** Civil Engineering, entrepreneur

# Civil Engineering Technology

**Editors:**  
*Roslan Kolop*  
*Amir Khan Suwandi*  
*Ismail Yusof*

  
**Penerbit  
UTHM**

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**Editors:**  
*Roslan Kolop*  
*Amir Khan Suwandi*  
*Ismail Yusof*

  
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# PREFACE

This book contains 10 chapter that aim to share knowledge based on research activities done by Civil Engineering students of the Centre for Diploma Studies.

Chapter 1 of this book titled Domestic Water Conservation explains the study to determine the effectiveness of a water filter installed on the sink. Air filter medium was created using waste materials such as coconut shell, coconut fiber, charcoal and shells. The resulting water quality must be safe for use in accordance with the standards set by the Ministry of Health (MOH) and World Health Organization (WHO).

Chapter 2 explains the importance of vegetation to prevent erosion and control for slope stabilization has been practiced worldwide. Stabilize slopes approach provides many advantages including increased biodiversity, reduce maintenance costs, as well as environmentally friendly.

Chapter 3 of this book titled Dummy Speed Camera (DSC) is an approach in addressing the problem of speeding specified. This study analyzes the driver's perception when looking at the camera speed traps to study the operation speed of data among drivers. With the presence of DSC, drive speed decreased by 20.4 per cent at the same speed class.

Chapter 4 of this book titled Banana Fibreboard as Formwork. This study aims to explore the potential of banana stem fiber as the material for the board. Researchers studying the possibility of recycling the raw materials to produce products.

Chapter 5 of this book titled Rice Husk Fibre Board Binded with Glue Made from Styrofoam. This study reuse waste rice husk specified by using glue from styrofoam to produce fiber boards and suitable as material for the manufacture of furniture.



Chapter 6 of this book titled Compressive Strength and Shrinkage of Eggshells Based Tiles. This study describes how the eggshell is one type of domestic waste can be used as materials for the tiles. Results also showed that eggshell contains  $\text{CaCO}_3$  can be used as an alternative raw material in the production of tiles to meet the standards requirement.

Chapter 7 of the book entitled The Use of Bamboo in The Construction of Bus Stops. Bamboo is a plant that is easily available in Malaysia at the low price. This study also represents an alternative solution to the problem of rising costs of building materials.

Chapter 8 of this book titled Laminated Bamboo Panel Technology. This study describes the construction of a more sustainable practices with the use of bamboo as a structural building material. Bamboo is a fast-growing plant, light and has great strength to shoulder the burden.

Chapter 9 of this book titled Sand and Roof Tiles from Recycled Plastic. This study describes how to solve the problems faced by consumers in the roof tiles which are often moldy or discolored after several years of use. With this plastic waste collected, incinerated or buried in landfill can be reduced through this innovation.

Chapter 10 describes how to design and produce functional Smart Wheelbarrow. It functions to transport and render mortar to produce a flat floor surface. Smart Wheelbarrow can prove that the user is able to save time and labor costs at the construction site.

Overall, each chapter contributes to the formation of this book. Generally, this book takes a topic of discussion for the various inputs to the reader. Thus it is hopes that this book helps to increase knowledge to its reader developing knowledge among readers.

# APPRECIATION

Book on Civil Engineering Technology (Technical Papers) is edited and efforts were reviewed by Tn. Hj. Roslan Kolop, Tn. Hj. Amir Khan Suwandi, Prof. Madya Hj. Ismail Yusof, Tn. Hj. Masiri Kaamin, Dr. Norhayati Ngadiman and Khairul Zaman Abdul Malek. The organizers have obtained 10 articles in Civil Engineering field.

This book is the product of academic project activities conducted in the Department of Civil Engineering, UTHM since 2009. Final year students from the Diploma in Civil Engineering Programme performed investigate research activities as partial fulfilment towards the award of the said certificate.

In reaching the requirements and the government's desire to put the level of education as a catalyst of progress and strategy covering existing policies that have been strengthened again through new policies, Center for Diploma Studies, UTHM welcomed the suggestion.

## Editor

Masiri Kaamin  
Norhayati Ngadiman  
Khairul Zaman Abdul Malek

# ABBREVIATIONS

**CO** Carbon Monoxide

**CO<sub>2</sub>** Carbon Dioxide

**PIAD** Portable Indoor Air Detector

**MOH** Ministry of Health

**WHO** World Health Organization

**COD** Chemical Oxygen Demand

**DO** Dissolved Oxygen

**NTU** Nephelometric Turbidity Unit

**AES** Automated Enforcement System

**UTM** Universal Testing Machine

**PVC** Polyvinyl Chloride

**LBL** Laminated Bamboo Lumber

# INTRODUCTION

This book is a compilation of selected technical papers produced by students from the Department of Civil Engineering, UTHM. Students in the final year from the Centre for Diploma Studies need to carry out a final year project (FYP) as partial fulfilment of graduation requirements. It is a substantial produce that underwent creative and original thinking. A good FYP starts with the formulation of a problem, suggests alternative solutions, and then implement one of them. Generally, it allow students to demonstrate their cognitive ability by producing a product that went through the analysis, design, testing and evaluation stages.

Students and supervisors justify the chosen analysis, design and made critical evaluation prior to opting in producing the desired product. Procurement exercise to ascertain the required budget for the project execution (including list of components and their price) and the manner by which the required hardware, software and services are going to be made available, were conducted accordingly.

It is expected that this book serves as an avenue for the latest research advancement and findings can be shared. This further will inspire students to create innovate, invent and strategize ways to promote an interdisciplinary final year project which go beyond the Civil Engineering boundary. The research activities engineering, generated from science, technology and mathematics knowledge catalyses' the country's technological advancement in tandem with the developed nations.

# Chapter 1

## DOMESTIC WATER CONSERVATION

*Siti Norazzah Azwa Misman, Nurul Hayati Mat Rozi,  
Nur Syahira Zakaria, Nor Baizura Hamid*

### Introduction

Water is an important resource that has a number of uses including health, recreational, transportation, hydroelectric power, agricultural, livestock, domestic, industrial, commercial uses, sanitation, drinking and many other human needs. Water can be classified according to several indicators of water quality. Indicator needed to control the degree of contamination that exists in the composition of the water. Water quality indicators consist of tests carried out on the water parameters such as COD, DO, temperature, pH and turbidity. Water supply systems get water from a variety of locations after appropriate treatment, including groundwater, surface water and the sea through desalination. This water should comply with drinking water standards by MOH before supplied to community.

Observations showed that the greywater from domestic uses (from sinks home) is usually discharged into the drain and not reused. In order to utilize the greywater discharged from the sink, a water filter system has been designed using waste materials. Furthermore, the use of waste materials promoting new alternative for water filters.

The objective of this study is to treat the water discharged by the proposed water filter based on the parameters COD, DO, temperature, pH, and turbidity. The results then referred to water quality standards for raw water as a reference.

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# Chapter 2

## SLOPE STABILITY

*Nurul Hazirah Afiqah Abu Habidah, Nabila Faiqah Jasmin, Nelia Jomasri,  
Nur Fazlida Ashikin Makhtar, Amir Khan Suwandi*

### Introduction

A slope failure is a phenomenon that a slope collapses abruptly due to weakened self-retainability of the earth under the influence of a rainfall or an earthquake. Because of sudden collapse of slope, many people fail to escape from it if it occurs near a residential area, thus resulting in a higher rate of fatalities.

One of the types of slope failure is landslide. A landslide is a phenomenon in which soil mass on a slope moves slowly along the slip surface downward the slope under the influence of ground water and other causes. Since landslides occur over an extensive area and a large amount of soil mass is moved in general, it can cause serious damages.

The method of slope stabilization that we are focused on is vegetation. This is to prevent from slope failure. Vegetation like grasses is highly effective and advantageous for soil stabilization purpose. As we know, vegetation is multifunctional, relatively inexpensive and visually attractive. So grasses can influence the slope stability when the plant roots act as reinforcement to the soil and.

The scope of the study is limited to three slope soil at hillside areas which is at Batu Pahat, Ayer Hitam, and Kluang. The objectives of this study are:

- 1) To determine the physical characteristic and the dimension of soil slope.
- 2) To compare the effect of grasses root on the stability of slope surface in certain area at Batu Pahat, Ayer Hitam and Kluang.
- 3) To use the slope/W software in analyzing the Factor of Safety of each slope case in different height with grass stabilized and without grass stabilized.

- 2) The safety factor for rooted soil is generally higher compared to the unrooted soil, meanwhile in contexts of the slope parameter, the safety factor is higher at lower slope compared to the higher slope.
- 3) Each type of vegetation have their significant strength characteristics and potential as the slope stabilization method.
- 4) The selection of vegetation and other types of slope stabilization techniques must be represent the actual slope condition, soil characteristics and loading surround the buildings.
- 5) The parametric studies show that the relationship of height and the factor of safety are relevant, increasing of slope height, the lower the FS due to changing in slope height, slope angle and slope length.

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# Chapter 3

## DUMMY SPEED CAMERA

*Mohammad Ellmie Mohd Elias, Annas Anwar, Nurul Syazwani Mohd Alawi, Siti Khuzaliffah Kamaruzzaman, Erwan Sanik*

### Introduction

In the early 1990's, speed camera technology using a narrow beam radar to measure speed had been developed and was in use in USA and Australia. A New Zealand trial involving speed enforcement and publicity focused on road section with high proportion of speed reductions. In October 1993, speed camera operated generally in a highly visible manner were introduced in New Zealand. Radar detector are normally unable to give adequate warning of such devices operation. The speed cameras were used solely on large numbers of stretches of road with a record of speed related crashes, designated as a speed cameras area, which were clearly signpost "Speed Camera Area" at the entry point.

Speeding is one of prevalent factors that contribute to traffic accident or crashes. In United States, speeding-related fatalities increased by 2 % from 10,001 in 2011 to 10,219 in 2012. In Malaysia, according to the Malaysian Road Safety Department (JKJR), 93 out of 445 cases studied for accident reconstruction by the Malaysian Institute of Road Safety Research (MIROS) were caused by speeding. Currently in Malaysia, the Automated Enforcement System (AES) is widely used by authority to control speeding offenses. According to the Road Transportation Department of Malaysia, the implementation of AES is based on it achievement in other countries such as France, Germany, Kuwait and United Kingdom. Besides of issuing summons, the more important goal is to increase the level of Perception of Being Caught (POBC) among road users. As the results, speeding can be reduced and the risk of traffic accident can be controlled.

The road geometry itself may encourage drivers to speed up their vehicle although they realize the bad consequence resulted from this behaviour. Typically, drivers have high tendency to speeding on a

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# Chapter 4

## BANANA FIBERBOARD AS FORMWORK

*Mohd. Shauqi Lutfi Ahmad, Mohamad Asyraf Kamarudin,  
Muhammad Amar Firdaus Yazid, Aslila Abd. Kadir*

### Introduction

Formwork is a mould or box which wet concrete can be poured, compacted and finally set to the inner profile of the box or mould. The most common material used for formwork is plywood. It is easily cut to shape on site. Plywood is a sheet material manufactured from thin layers or “plies” of wood veneer that are glued together with adjacent layers having their wood grain rotated up to 90 degrees to one another. It is an engineered wood from the family of manufactured boards which includes medium-density fiber board (MDF) and particle board (chipboard). All plywood are bind resin and wood fiber sheets (cellulose cells are long, strong and thin) to form a composite material. After used for 3 to 4 times, usually damaged formworks are discarded or burned on-site, hence creating environmental pollution due to the released of carbon dioxide. It is a well-known fact that the increased of carbon dioxide gas in the atmosphere can contribute to acid rain, haze and global warming.

Nowadays, there is growing awareness on environmental issue. Application of natural fiber as a raw material in fiberboard was an alternative way in reducing impact on the environment and also to contribute in achieving sustainability. Natural fiber have many advantages including low cost, low density, high toughness, acceptable specific strength properties, ease of separation, enhance energy recovery, carbon sequestration and biodegradability. There are a number of investigations have been conducted on several types of natural fibers such as kenaf, hemp, flax, bamboo, jute and banana fiber.

Banana fiber at present is a waste product of banana cultivation. It is estimated around 10 million banana trees are cut down each year to produce enough banana to meet demand in Malaysia. Banana trees is usually considerably left to rot in the banana plantation. This decomposition process will produce methane gas, which is one of

## Conclusions

Based on the initial experimental investigation it can be concluded that banana fiber potentially can be used to make fiberboard but it has inferior characteristics compare to ordinary plywood. Non critical section of formwork can be substituted with banana fiberboard to reduce the reliance on ordinary plywood. Further improvement or innovation in making banana fiberboard is needed to enhance the properties of the fiberboard so that it is at par with normal plywood.

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# Chapter 5

## RICE HUSK FIBRE BOARD BINDED WITH GLUE MADE FROM STYROFOAM

*Tay Kian Yen, Mohamad Danial Asyraf Mohamed Isa, Nur Azmina Ismail,  
Raja Hassbiallah Raja Hussin, Roslan Kolop*

### Introduction

Rice husk particleboard is being considered as a potential substitute for wood and wood-based board products. Global rice production was approximately 770 million tonnes and Malaysia's contribution was 2.2 million tonnes. In Malaysia, rice husk is used as a component of animal feed, burnt as fuel, sold as fertilizer and other small scale specialized applications. However, most of this agricultural by-product is simply disposed, thus representing an environmental problem.

Rice husk can be used to produce particleboards to make furniture or used in the construction industries. Using rice husk as a material to produce particleboards can reduce the amount of trash generated besides generating downstream economy activities. Various types of board can be produced from rice husk. These by-products include particleboards, insulation boards and ceiling boards. Commonly used synthetic adhesive in the manufacture of particleboards is urea-formaldehyde. A major drawback in the production of rice husk particleboards using urea-formaldehyde as adhesive is that water causes the boards to stain and warp. Once a particleboard becomes wet, it loses much of its tensile strength. In this project an alternative low cost adhesive from Styrofoam glue is investigated. Recent study also shown that the use of UF will affect our health when it releases formaldehyde in the air which will increase the cancer risk.

Styrofoam is made from petroleum where in its production process, a carcinogenic chemical known as benzene is used. Due to the presence of benzene in Styrofoam, it is inevitable that food in direct contact with the Styrofoam food packaging would be affected. Moreover, Styrofoam is hardly biodegradable and can last almost forever.

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# Chapter 6

## COMPRESSIVE STRENGTH AND SHRINKAGE OF EGGHELLS BASED TILES

*Nur Atikah Kasim, Nur Aiza Darnak, Muhammad Najib Mohd Nasir, Rozainita Rosley, Norhayati Ngadiman*

### Introduction

Shell is also the world's oldest remaining waste. Eggshell is non-hazardous domestic waste in natural. However, generating huge amount of eggshell can cause environment problems. In 2004, the United States produced approximately 76 billion shell eggs from 287 million laying hens (Ohijeagbon, 1995). Eggshell is rich in calcium carbonate ( $\text{CaCO}_3$ ), calcium phosphates ( $\text{Ca}_3(\text{PO}_4)_2$ ) and magnesium (Mg). In addition, calcium carbonate compose the largest portion in eggshell with the same chemical properties of limestone. Therefore, eggshell can be used as an alternative raw material of tile because  $\text{CaCO}_3$  is one of the most important material in ceramic tile (USDA National Agricultural Statistics Service, 2004).

### Literature Review

Eggshell powder is rich with  $\text{CaCO}_3$ . Based on the study conducted by Freire et. al, (2006) reveal that  $\text{CaCO}_3$  in the eggshell rich in can replacing natural carbonate material by up to 15 wt% in ceramic tiles paste. In order to produce tile, the paste containing eggshell powder were dried, pressed and fired at 1150 °C using a fast-firing cycle. Eggshell waste could be used in wall tiles, in the range 5-10 wt%, as a partial replacement for traditional carbonate – based materials with only a slight decrease in the end product properties. Furthermore, study show the eggshell-based tiles which have a high proportion of calcium carbonate, able to stand up to 4.67 kN/mm<sup>2</sup> of force (Freire et. al, 2006). According to ASTM, this value highly stable when subjected to thermal testing and qualified for tile making (USDA, 2004).



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# Chapter 7

## THE CONSTRUCTION OF BUS STOPS BY USING BAMBOO

*Nik Juliana Adlina Nik Shahanshah, Nur Iffatin Taib,  
Rozalina Rosli, Salman Salim*

### Introduction

Bamboo can be used as a component element for bus stop construction. It has been found that bamboo was a high tensile strength as well as compression strength comparable to some wood species. Therefore, the structural frames of the bus stop can be made from bamboo which is capable to carry vertical load from the roofing materials and lateral load from wind. Bamboo is considered as a result of non-wood products that are environmentally friendly and can be used as an alternative to replace wood. This study was conducted to obtain basic information of mechanical properties were suitable for use in the construction of bus stops. Bamboo can be used as decoration in the construction of bus stops. It can be used as an intact structure wall and floor insulation to be used as a decoration for the construction of bus stops. Thus, bamboo is abundant in Peninsular Malaysia.

### Mechanical Properties

The mechanical properties of different bamboo are influenced by the type, age, region and state of growth. The flexural strength, stress, and strain of bamboo is greater at the exterior region compare to the inside region of the stem. The compressive strength of bamboo stems are influenced by moisture content and position in the shaft. For flexural strength, it is influenced by a section of bamboo stem.

Bamboo fiber strength also depends on the type of bamboo used and the age of the bamboo is taken and used. Old bamboo fibers is stronger compared with young bamboo. The younger bamboo and old of the year typically have relatively high water content namely 120 % to 130 % on the base portion and the tip of the bamboo. Bamboo fibers have a higher tensile strength compared with other natural fibers. Table 1 shows physical and mechanical properties of bamboo fibers.

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# Chapter 8

## LAMINATED BAMBOO PANEL TECHNOLOGY

*Muhammad Ejaz Haziq Mahmood, Muhamad Fakhrur Razi Redzuan, Nor Hanani Hasan Nordin, Fara Izzati Jaafar, Salman Salim, Ahmad Hakimi Mat Nor*

### Introduction

Innovation in construction technology due to new findings from each of the equipment and construction materials allows the creation of bamboo connections that can have many advantages and can be used in construction. The use of bamboo in the construction sector in Malaysia at present is insignificant compared to the construction industry in other countries such as China and India. This occurs due to the implementation of the use of bamboo in Malaysia has not been raised for the construction industry, but only to the handicraft sector traditional. In countries like China and India, bamboo is used as one of the popular building material in the construction sector as one of the possibilities, bamboo resources in their country that much and aesthetics found in the reed itself. Bamboo is a type of plant that is unique by its fast growth, bamboo grows up faster compare to any other kind of wood resources and also lighter in weight. It has great strength and can withstand various types of loading and also the price of bamboo is much cheaper compared to timber and other building materials. Bamboo has more potential as a green technology material especially in construction industry in Malaysia because most notably, it is highly renewable; bamboo stalks reach maturity in eight years.

### Literature Review

Bamboo, being a hollow tube, is efficient in resisting bending forces, having a large ratio of moment of inertia to cross-sectional area. It is difficult, however, to create connections for this shape, and tubes cannot be used in applications where flat surfaces are required. Laminated bamboo lumber (LBL) resolves these deficiencies in the natural shape of bamboo because it is formed in rectangular sections that are more suitable for use in traditional structural applications.

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# Chapter 9

## ROOF TILES FROM SAND AND RECYCLED PLASTIC

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### Introduction

Traditionally, roof tiles were usually made of concrete or clay. The new idea of development plastic roof tiles is to generate strong tiles, not moldy and maintain the colour besides there is a lot of plastic waste around us. Normally, waste plastic will be recycled and it requires a procedure that uses a complex cleaning and pollute the water. The most recycle existing material found is Polyethylene Terephthalate (PET) and High-Density Polyethylene (HDPE) plastic. It is also possible to be as a binding material instead of cement in the manufacturing of roofing tiles. The nature of plastic is strong, long lasting and relatively easy to shape and produce. The production of recycle plastic roof tiles also may help in decreasing plastic disposal.

Traditional tiles rely on a complicated process, which can involve burning sand to a particular formula, then coating the sand on the tile after turning it into slurry. With plastic, the use of moulds, plastic tiles can be easily shaped and cut, making for uniformity across a whole production run. When laying plastic tiles on a roof, they are easy to align and lighter to work. They are also less likely to change colour, or to weather, as quickly as traditional methods. When smaller sections are needed on the end of runs, the tiles are easy to cut and fit. The recycling has been of great benefit to the environment. The energy and cost required to produce them is significantly less than for traditional materials.

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# Chapter 10

## SMART WHEELBARROW

*Salman Salim, Ng Yee Leng, Wong Phei Li, Tan Bee Chin,  
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### Introduction

Wheelbarrow is a common transport which used widely in transporting loads. Mortars are transported by wheelbarrow from drum mixer to finishes floor. Rendering are applied during the last phase of the floor finishes in construction process. Trowel is used for rendering to give pressure on mortar to form a smooth surface. Cement and water are the main materials used to form mortar. Traditional practice method is consuming in high cost, low output and needs more workers. Workers face serious ergonomic issues due to long time of staying in squatting posture. Quality of slab completed is depends on the experience of workers and it is not consistent. Skilled workers are needed to carry rendering work. Lacks of skilled workers will cause the delaying of project and turn down the earned profit. Innovation of Smart Wheelbarrow is designed to combine rendering work and transportation. Ergonomic issues can be overcome through this innovation machine. Smart Wheelbarrow is easy to handle and user friendly machine which do not need any complex techniques and skills to operate. Smart Wheelbarrow is more economical as it increases the output and cut down the number of workers required.

### Problem Statement

Rendering process still needs human consumption to conduct a work. This process need more than one worker and cause the high cost on wages for workers. Moreover, it has spent a longer time to precede the process. Besides, it is in commercial as the work process is slow and paid off is high for the worker. This will turn down the earn profit for the project. On the others hands, as a result of prolong time of posing a same posture, occupational safety issues like muscle cramps occurred. Health of workers has been a concerning issues in construction field.



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# CONCLUSIONS

This compilation of student final student civil engineering project papers has shown the ability of student to innovate and create new ideas and transforming it into working models.

Chapter 1 highlighted the effectiveness of using innovative home sink filter using waste materials installed on the sink to filter grease, oil and soap. Due to high rate accident on Malaysia road due to speeding, the student has come with the idea of using dummy speed camera. Installation of such dummy speed camera has shown to reduce vehicle speed as explained in chapter 2. Dwindling wood based resources has an impact on construction industry especially in the reinforced concrete building and construction where large amount of plywood are used for formwork. Alternative agriculture waste from banana stem fiber has the potential to replace plywood. Initial investigation as described in chapter 3 has shown the possibility of using banana fibre board as formwork.

Chapter 4 described how a product based on several indigenous ingredients is capable to be applied on a formwork surface that can lengthen the life span of formwork made from plywood. Light structures such bus stop can be build cheaply using bamboo. Since bamboo is a renewal resources supplies is unlimited and couple with an innovative bamboo connection the design of light structure can be realized as described in article 5. Bamboo also can be used innovatively by forming laminated panel that can be used as structural panel such as wall for light structure as mentioned in article 6.

Agriculture waste such as rice husk has limited usage and produce in abundant in rice growing states. However, it is found as described in chapter 7 that rice husk is suitable for making particle board. Innovative glue form waste Styrofoam was found to be able to bind rice particle to produce strong particle nail able board which would not swelled when in contact with water. Chapter 8 looks at the possibility of using