

## **THE PRODUCTION AND APPLICATION OF RICEBLOCK IN CONSTRUCTION**

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### **ABSTRAK**

*Blok daripada bahan campuran simen dan bahan terbuang seperti sekam padi merupakan bahan binaan terbaru bagi pembinaan bangunan di Malaysia. Ia menghasilkan blok yang ringan dan dapat mempercepatkan pembinaan bangunan kerana tidak menggunakan pengikat mortar yang basah, struktur tertulang tiang, alang dan rasuk tetapi bergantung kepada sistem sambungan kering menggunakan putting khas yang memudahkahkan dan mempercepatkan pembinaan. Kajian ini meninjau dua aspek utama iaitu bahan menggunakan sekam padi dan sistem pembinaan sambungan kering tanpa menggunakan struktur kerangka seperti lazim yang digunakan dalam pembinaan bangunan bata masa kini.*

### **ABSTRACT**

Blocks made from a mixture of cement and agro-waste material such as rice husk can be a new source of alternative construction material in Malaysia for the low income group. The block is light and allow for faster construction which do not use plaster, concrete beam or column but depend on the unique system of dry bonding and interlocking connecting system. In this experimental building system, the main focus is the production of sample block of building material using rice husk and the construction system using dry bonding and interlocking block for house construction. The new block is called the 'RICEBLOCK' is a quick, economical and lightweight block for a fast house construction.

#### **1. Introduction.**

Blocks made from a mixture of cement and agro-waste material such as rice husk can be a new source of alternative construction material in Malaysia for the low income group. The block is light and allow for faster construction which do not use plaster, concrete beam or column but depend on the unique system of dry bonding and interlocking connecting system. In this experimental building system, the main focus is the production of sample block of building material using rice husk and the construction system using dry bonding and interlocking block for house construction. The new block is called the 'RICEBLOCK' is a quick, economical and lightweight block for a fast house construction.

#### **2. Design Concept.**

In the current research attempt has been to produce a block for application in domestic house construction. The main objective is to use a lightweight, an agro-based locally available material employing a building system currently familiar to the local. The system is based on the prefabricated system which is fast, economical and easy construction.

### 3. Production of RICEBLOCK.

#### Base Material

The base material for the production of experimental block is made from a mixture of ordinary Portland cement and ground paddy husk. Cement is important binding material easily available and paddy husk is local agro waste material readily available is known for application in block making. The husk in 3 grades are easily available from local rice mill in Gurun is currently the largest supplier of paddy husk in the northern region.

#### Test Cubes

Several variation of cement mix were explore to test the characteristic of the material prior to the intended mix. Some of the mix carried out includes the following sample cubes;

- Normal cement mix.( Dr Zulkifli Hanafi & others. HBP. USM)
- Aerated concrete mix (Dr. Zulkifli & Dr. Norizal. HBP. USM.1994 & 2007)
- Paper cement mix (Dr. Nasir HBP. USM 2008)
- Cement rubber mix ( Dr. Zailan HBP. USM 2008)
- Cement husk mix ( Dr. Faisal HBP. USM 2007)

A number of cubes of different composition of cement and paddy husk were produced for analysis as shown below; This test cubes indicates the best and optimum composition of the mix for the final block. Several test were carried out including:

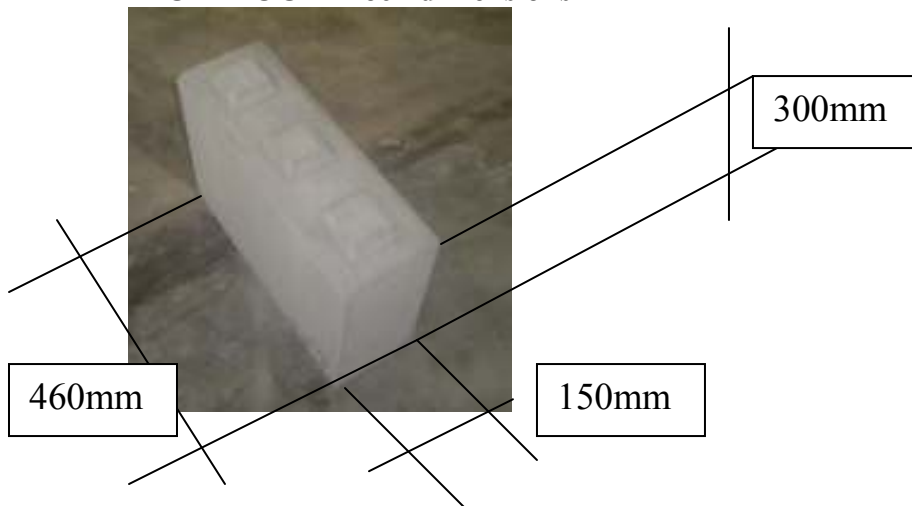
- Blocks using natural grade paddy husk
- Blocks using coarse grade paddy husk
- Blocks using fine grade paddy husk

But several variation of mixture of other chemical and compound were used to obtain variation of samples.



<b>SAMPLE</b>	<b>AMOUNT</b>	<b>GRADE</b>	<b>CEMENT: HUSK</b>	<b>WEIGHT</b>
Sample A:	50 %	fine grade	1:3	1197.0 gm
Sample B:	50 %	coarse grade	1:3	1415.0 gm
Sample C:	50 %	fine grade	1:1	1426.0 gm
Sample D:	50 %	coarse grade	1:1	1540.0 gm
Sample E:	75 %	fine grade	1:1	795 gm
Sample F:	75 %	coarse grade	1:1	855 gm

**RICEBLOCK Block dimensions**



Specimen of test cubes using aerated cube were produced based on the following mix;

Foam Weight (gm/l) :			74.3	78.3	78.6
Mix Date :			08-Feb-07	12-Feb-07	15-Feb-07
Target Dry Density (kg/m <sup>3</sup> )			1000	1000	950
a	Volume of Foam Concrete (m <sup>3</sup> )	Target Mix	0.033	0.033	0.033
b	Wet density of Foam (m <sup>3</sup> )	:+100 of DT	1060	1060	1010
c	Cement to Sand ratio (c/s)		1:1	1:1	1:1
d	Water to cement ratio (w/c)		0.4	0.4	0.4
e	Weight of materials		34.98	34.98	33.33
f	Weight of cement (kg)		14.58	14.58	13.89
g	Weight of sand (kg)		14.58	14.58	13.89
h <sub>1</sub>	Weight of water (kg)	Actual	5.83	5.83	5.56
		Additional	0.3	0.71	0.42
		New total	6.1	6.5	6.0
		New w/c	0.42	0.45	0.43
h <sub>2</sub>	Weight of Admixture (kg)		0.00	0.00	0.00
h <sub>3</sub>	Weight of Plasticizer (gm)		0.00	0.00	0.00
i	Total Weight (kg):	: f + g + h	35.28	35.69	33.75
j	Density of mortar (kg/m <sup>3</sup> )	: measure	2174.7	2182.3	2176.1
k	Volume of slurry (m <sup>3</sup> )	: i / j	0.0162	0.0164	0.0155
l	Workability of mortar (Cone)	( cm )	18.0	18.0	18.0
m	Foam content in mix(m <sup>3</sup> )	: a - k	0.0168	0.0166	0.0175
n	Foam volume required (Liter)	: m x 1000 + l	16.8	16.6	17.5
o	Foam output (Liter/min)	: flow rates			
p	Time of pumping (sec)	: n / o			
q	Actual density of Foam Concrete ( wet density )	: measure	1064.7	1071.3	1018.1

But aerated cement is not the ultimate material proposed for the block. The cube would be used for comparison purposes and analysis of the material character especially in the application of the block

The earlier production of the paddy husk block were based on the following requirement and data;

**Projek :**

**Mortar Bergentian Sekam Padi Bahagian 2**

**Perincian Projek :**

Bahan Gentian	:	<ul style="list-style-type: none"> <li>• Sekam Padi</li> <li>• Saiz Halus– antara 0.6 mm hingga 2.36 mm</li> <li>• Saiz Kasar – antara 2.36 mm hingga 5.00 mm</li> </ul>
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**RINGKASAN MORTAR SEKAM PADI**

Bil	Kod	Jenis Sekam Padi	Sekam Padi	M o r t a r				Mortar Sekam Padi
			Isipadu	Isipadu ( m <sup>3</sup> )	Berat Simen (g)	Berat Pasir (g)	Berat Air (g)	Berat (g)
1	A	Halus	50 %	0.0006	270.0	810.0	120.0	1197.0
2	B	Kasar	50 %	0.0006	270.0	809.0	121.0	1415.0
3	C	Halus	50 %	0.0008	671.0	671.0	318.0	1421.0
4	D	Kasar	50 %	0.0007	571.0	571.0	257.0	1548.0
5	E	Halus	75 %	0.00035	286.0	286.0	129.0	795.0
6	F	Kasar	75 %	0.00045	359.0	359.0	162.0	855.0
7	G	Kasar	75 %	0.0009	809.0	809.0	364.0	1920.0

**4. Design of RICEBLOCK**

Based on the previous findings, the selected samples were reproduced in the actual scale module for testing of the block in application. The selected mix were casted in the steel formwork specially designed to achieve an accurate and refine blocks.

The expected product of the experiment is a block with the required dimensions in 3 modules to be interlocking of dry bonding. The one and two module are for closing block while the third is actually the regular block which is load bearing.

Timber formwork was originally used to produce sample block but produced inaccurate joint finishes. It was replaced by more expensive steel but produced a satisfactory fine jointing finishes required. Most of the later blocks were entirely produced from the steel formworks. To produce the block in large number more of this steel formworks are required.





The production of block is made by casting the mix in the steel formwork. Three type of formworks were used to produce three module of block.

Study model using polystyrene made to actual scale of the block. Three modules were used.



## 5. Experimental Study.

The main focus of the experiment is the material application and the system of construction. Application of material using paddy husk has a distinct advantage for the material is an abundant and cheap agro-waste material. It can also contribute to reduce the impact of the environmental pollution by turning the material useful for building material. But to achieve the desired target, current system of construction must be reviewed and new method should be proposed.

In this experimental new construction system based on modular block is studied. The system to be effective must be lightweight, easy to used and economical. Two aspect of study on focus are; a. material application and b. System of construction. While the physical characteristic of the block is investigated by producing the block in a single space construction for further inspection.



### a. Material application.

The aim of the experiment is exploit the potential use of an agro based material particularly the rice husk which is an abundant product of the rice mill currently estimated at 3 million kg<sup>3</sup> per year. The supply of the material is obtained from two major sources of rice mills in Penang and Kedah.

However, cement based material in the production of bricks and block has been on the market for several decades. Available product such as, aerated concrete has been produced but not widely used, rubber cement brick is a new building material still in laboratory undergoing test, paper cement brick, coconut fiber bricks under experimental and investigation at the workshops all over South East Asian countries including at the school of HBP, USM.

Paddy husk brick has been an interesting subject focus by many rice producing nations but production of block work for building construction purposes is a new and experimental. Data available are scattered and inadequate.

A complete application of block in full scale house construction may be required in order to make observation and detail study of the construction characteristic before it can be fully applied in domestic construction.



**b. System of Construction.**



Conventional construction is based on wet bonding of cement or clay brick and cement plaster on both side is an effective and strong construction. But the demand for faster and easy method of construction is becoming necessity. In some situation such for the provision of emergency and temporary shelter for disaster victim requires a fast and immediate system of construction. Prefabricated system is widely known and accepted as

Effective and fast method but often inadequate in term of material,

heavyweight brick and blocks jeopardized the relief project.

In the current experiment, a new method of construction based on the dry bonding using jointing system is introduce to enhance the freedom and flexibility of domestic construction. Using lightweight block made from paddy husk, wall construction can be made simple and fast. No structural beam and column is required but stability of the wall depend entirely on the bearing capacity of the jointing system. No plaster is needed for the wall finish. Wet matrix using cement is replaced with layers of latex based glue which do not require time to set hence no waiting time for the structure to set is necessary.

**6. Structural System.**

The integrity and strength of the structure depend entirely on the design of the block which is self support. Structural strength depend on the jointing system and the arrangement of the block to form a cohesive and entity without the support of the beam and the reinforced concrete column.

The jointing system using tongue and groove laid in normal block gain additional strength from the glue between the surface of the block. To create opening for doors and windows, special module is used to form a base for door or window jamb. The block is made in 3 module of 1 , 2 and 3 as the main to cater for the need for stopper in the wall construction. Each block weigh between 40kg-15kg respectively.





## 7. Applications.

RICEBLOCK is a potential material in domestic application particularly in the construction of houses for the relief victim. Since the block is economical and simple to construct it can be an effective self service or DIY construction project for the public. Based on the predetermine plan, a simple house construction can be erected with limited number of worker. Some of the potential application of blocks can be summarized as follows;



### **House construction.**

Conventional construction using ordinary brick is in situ and heavy required concrete skeletal frame system is a strong and durable but time consuming for rapid and urgent application unless components re made in precast units. But units are heavy and required mechanical aid to assemble and erect the structure. RICEBLOCK construction is light and transportable to site and can easily be assembled to form the required building. It is based on simple jointing load bearing blocks triple the dimension of the ordinary brick at faster rate.



### **Garden or Storehouse**

A small scale domestic project for storage of gardening tools can be made easily by arranging the required wall using the blocks.

### **Planting blocks**

Block can be used to construct a low level wall construction for planting purposes.

### **Retaining wall block**

Since the block is using interlocking joint it is easier to used in making retaining walls



### **Footing**

Block can be used in making footing for the timber construction

### **Pools**

Using block to make wall for the pool is faster and economical.

### **Fencing**

Block can be used for solid wall fencing.

Possible alternative of wall construction using the RICEBLOCK.



Application of the Module blocks in domestic construction.

## 8. Prospect and Potential.

Paddy husk block can be used for many domestic construction including self help housing, emergency houses, low cost construction projects, store houses, retaining walls and agricultural and landscape construction. The block known as RICEBLOCK is lightweight, easy to use and low cost

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