THE EFFECT OF [illegible] CRETE PROPERTIES (WORK[illegible]ENGTH)

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ABSTRACT

There were many researches to improve the concrete quality whether physical or mechanical properties. One of the technological advances in improving the quality of concrete was by using additives. Additive was the substance that was added into fresh concrete in small quantities to improve its properties. This research was carried out to establish the effects of coconut fibre on workability and flexural strength. The mixes were prepared with fibre-cement ratio of 2%, 3% and 4% coconut fibre and control specimen. The result of adding coconut fibre will be compared with the control specimen and supported journal. There were three tests for workability; slump test, compacting factor test and Vebe test. For the flexural test, there were twenty four beam specimens with dimension 750mm length, 150mm width and 150mm thickness were test for flexural behavior. There are six beam specimens for control, six beam specimens for 2% fibre, six beam specimens for 3% fibre and six beam specimens for 4% fibre. The specimens were tested at 28 days after curing in water tank. The tested was conducted by applying load until the beam failed. The workability test results shown the workability of concrete decrease with the increase of fibre added. The result test for 28 days curing for flexural strength shown the strength was not achieved the control strength.

ABSTRAK

Terdapat banyak penyelidikan untuk meningkatkan kualiti konkrit sama ada sifat fizikal atau mekanikal. Salah satu kemajuan teknologi dalam meningkatkan kualiti konkrit adalah dengan menggunakan bahan tambahan. Bahan tambahan adalah bahan yang ditambah ke dalam konkrit segar dalam kuantiti yang kecil untuk memperbaiki sifatnya. Kajian ini telah dijalankan untuk menentukan kesan serat kelapa terhadap kebolehkerjaan dan kekuatan lenturan. Campuran telah disediakan dengan kandungan 2%, 3% dan 4% serat kelapa dengan nisbah terhadap simen dan satu spesimen kawalan. Keputusan kajian hasil daripada tambahan serat kelapa di dalam konkrit akan dibandingkan dengan spesimen kawalan dan jurnal yang disokong. Terdapat tiga ujian kebolehkerjaan iaitu ujian penurunan, ujian faktor pemadatan dan ujian Vebe. Untuk ujian lenturan, terdapat dua puluh empat spesimen rasuk dengan ukuran 750mm panjang, 150mm lebar dan 150mm ketebalan bagi menentukan kelakuan lenturan. Terdapat enam spesimen rasuk kawalan, enam spesimen rasuk untuk gentian 2%, enam spesimen rasuk bagi gentian 3% dan enam spesimen rasuk untuk gentian 4%. Spesimen diuji selepas dibiarkan di dalam tangki air selama 28 hari. Ujian telah dijalankan dengan mengenakan beban sehingga rasuk gagal. Keputusan ujian kebolehkerjaan menunjukkan kebolehkerjaan konkrit menurun dengan peningkatan serat yang ditambah. Ujian hasil selama pematangan 28 hari konkrit untuk kekuatan lenturan menunjukkan kekuatan itu tidak mencapai kekuatan kawalan.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Many researches were conducted to improve the properties of the concrete by putting new material, whether it is natural materials or recycle materials or synthetic materials in the concrete mix. The additional material used to replace the aggregate, cement or just as an additive. Natural material is one form of the additive. A large amount of agricultural waste was disposed in most of tropical countries especially in Asia for countries like Sri Lanka, Thailand, Indonesia, Philippine and Malaysia. The social and environmental problem will occur if the waste cannot be disposed properly. The high cost of conventional building materials such as cement is a major factor affecting housing delivery in Malaysia. This problem has led many researches into alternative materials of construction (Siti Aminah & Sabarudin Mohd; 2009). As well as to produce a low cost product, it also investigates safe buildings in earthquake prone regions. Earthquakes of considerable magnitudes are occurring frequently in the recent years, and causing mass destruction of buildings because of non-engineered old type of construction. This ultimately results in loss of life and property. To significantly improve life quality, new techniques for economical and safe housing are required (M. Ali et al., 2010). Natural materials like coconut fibre are not commonly used in the construction industry and considered as agricultural wastes. The waste takes a long time to decompose and if not managed well can cause problems to the environment.

1.2 ADDITIVE MATERIALS IN CONCRETE

In this research, the coconut fibre was used in concrete as an additive material. Coconut fibre, also known as coir, comes from the inner husk of coconuts. According to the University of Florida Extension, coconuts are the most widely grown nut in the world and contribute significantly to the economy of many tropical areas. The short, tough fibres can be woven or pressed together for a number of uses. Unlike man-made fibres, coconut was a renewable resource (Cynthia Myers, 2010). There are two types of coconut fibres, the brown fibre and white fibre. Brown fibre extracted from matured coconuts and white fibres extracted from immature coconuts. Brown fibres are thick, strong and have high abrasion resistance. White fibres are smoother and finer, but weaker. Coconut fibres are commercial available in three forms, namely bristle (long fibres), mattress (relatively short) and decorticated (mixed fibres). These different types of fibres have different uses depending upon the requirement. In engineering, brown fibres are mostly used (Majid Ali, 2010).

1.3 PROBLEM STATEMENT

Coir will be the waste if the regular management of waste is not conducted properly. Coir fibres make up about 1/3 of the coconut pulp. The other 2/3 is called the pith or dust; it is biodegradable but takes 20 years to decompose (Tom Woolley et al., 1997). Once considered as waste material, it must be used as a new technology in manufacturing sources. By using the additive material from waste such as coconut fibre can reduce the cost of material and environmentally friendly. The properties of concrete are important such as strength, workability, flexural strength and effect of additive material to concrete mix.

As well as to produce a low cost product, it also investigates safe buildings in earthquake prone regions. To overcome the disadvantages and problems in concrete, the technology of adding additive in concrete mix was applied. This was to increase the quality and properties of concrete such as workability, flexural strength and the effect of adding the additive materials. In this study, the coconut fibre as an additive in concrete and the flexural strength and workability of concrete will be determined.

1.4 OBJECTIVES

There are two objectives of this research:

i. To determine the workability of concrete when the coconut fibre with percentage of 2%, 3% and 4% is added as an additive material compared to control specimen.

ii. To determine the flexural strength of concrete when the coconut fibre with percentage of 2%, 3% and 4% is added as an additive material at 28 days compared to control specimen.

1.5 SCOPE OF WORK

i. Coconut fibre is used as an additive in the concrete mix. Coconut fibre is taking at area Kuantan, Pahang and Pontian, Johor. The percentage of fibre is 2%, 3% and 4 % by weight of cement with one control specimen.

ii. The workability of concrete is determined with the concrete mix design that determined before. Three tests of workability are slump test (BS 1881: Part 102: 1983), compacting factor test (BS1881: Part 103: 1983) and Vebe test (BS1881: Part 104: 1983).

iii. The hardened concrete is tested by flexural strength (Test method BS 1881: Part 118: 1983) with unreinforced beam dimension 150mm x 150mm x 750mm.

iv. The characteristic of concrete (workability and flexural strength) that mixed with the coconut fibre will be determined by compared to the control specimen.

1.6 EXPECTED OUTCOMES

i. The workability of the concrete mixed with coconut fibre achieves the control specimen.

ii. The flexural strength of the concrete mixed with the coconut fibre is increase compare to the control specimen.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

There has been growing interest in recent years in utilizing natural fibres for making low-cost building materials. Investigation carried out on the use of natural fibres in cement paste, mortar and concrete have shown that incorporation of these fibres improves the flexural properties of the matrix. The improvement depends upon a number of factors such as fibre type, form, volume, aspect ratio, mix design, mixing method, casting technique and curing method. Coconut fibre is abundantly available in many countries such as India, Philippines, Indonesia, Sri Lanka, Malaysia and Thailand. Annual production of the fibre in India is about 1.60 million tones. The advantages of coconut fibre are cheap, strong and durable (K.L Aggrawal, 1992).

Coconut fibre is extracted from the outer shell of a coconut. The common name, scientific name and plant family of coconut fibre is Coir, Cocos nucifera and Arecaceae (Palm), respectively. There are two types of coconut fibres. First is brown fibre that extracted from matured coconuts and second is white fibres that extracted from immature coconuts. Brown fibres are thick, strong and have high abrasion resistance. White fibres are smoother and finer, but also weaker. Coconut fibres are commercial available in three forms, namely bristle (long fibres), mattress (relatively short) and decorticated (mixed fibres). These different types of fibres have different uses depending upon the requirement. Brown fibres are mostly used in engineering (Majid Ali, 2010).

According to official website of International Year for Natural Fibres 2009, approximately, 500 000 tonnes of coconut fibres are produced annually worldwide, mainly in India and Sri Lanka. Its total value is estimated at $100 million. India and Sri Lanka are also the main exporters, followed by Thailand, Vietnam, the Philippines and Indonesia. Around half of the coconut fibres produced is exported in the form of raw fibre (Majid Ali, 2010).

Afa Austin Waifielate (2008) mentioned that, coconut fiber has the highest percentage by volume of lignin (bonding), which makes the fiber very tough and stiffer when compared to other natural fibres. From figure 2.1, this can be attributed to the fact that the lignin or lumen helps provide the plant tissue and the individual cells with compressive strength and also stiffens the cell wall of the fibre where it protect the carbohydrate from chemical and physical damage. The lignin content also influences the structure such as properties, flexibility, hydrolysis rate and with high lignin content it appear to be finer and also more flexible.

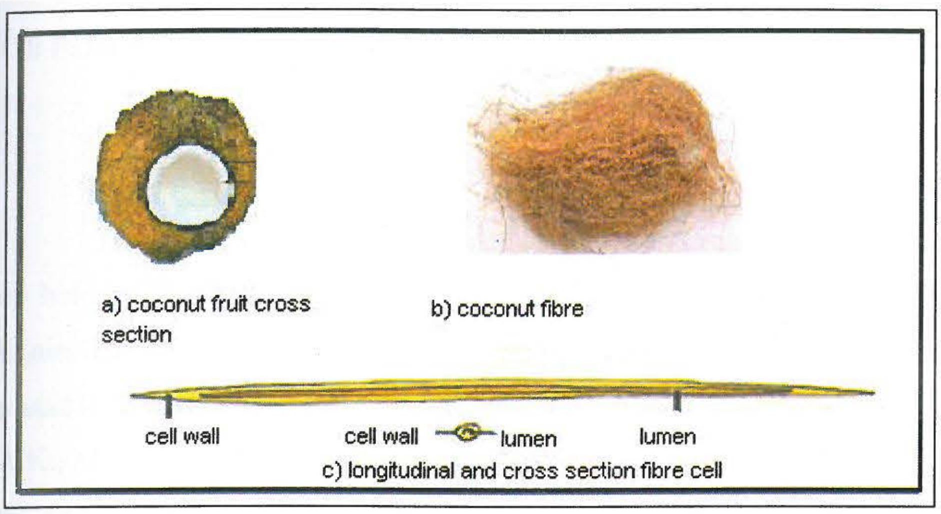

Figure 2.1: Longitudinal and Cross-section of a Fibre Cell (Afa Austin Waifielate, 2008)

2.2 Natural Fibres

There are many natural fibres that can be obtained. Natural fibres are obtained from its stem, leaves, roots and fruits of the plant and they are categorized into two distinct group namely wood fibre and non-wood fibre. Waste disposal has become one of the major problems in modern cities. At present there are two major methods in practice to dispose wastes. One is land filling and the other is burning. First one requires more valuable land and second one pollutes the environment. So, alternate methods to dispose solid waste should be found. New materials that would be cheaper and at the same time offer equal or better properties have to be developed. Many natural resources in this world and researches for it are needed. Development of plant fibre composites has only begun (Tara Sen, H. N. Jagannatha Reddy, 2011). In this research, non-wood fibre is used. Here are some examples of non-wood fibres.

Oil Palm Fibre (OLP)

The fibre is extracted from its oil and always in dirty state; it has to be cleaned up before it can be used. The components that make up the oil fibre are cellulose and lignin. The fibres are porous and have varying diameter, which influence the mechanical property, it is ductile and have lower tensile strength than several plant fibres (Mohanty, A.K., Misra, M., Drzal, L.T. Natural Fibres, Biopolymers, and Biocomposites).

Pineapple Fibre (PALF)

Pineapple is one of the most valuable and commercial fruits of the tropics; the leaves are long, wide and rigid. It also has short stem which is strong and silky. The fibre is a multi-cellular lingo cellulosic. Pineapple fibre is made up cellulose, Polysaccharides and lignin; it is hygroscopic and has a very good mechanical property that can be attributed to its high cellulose content and the small microfibriller angle (Mohanty, A.K., Misra, M., Drzal, L.T. Natural Fibres, Biopolymers, and Biocomposites).

Kenaf Fibre

The best fibre quality is obtained from inception of the flowers. Kenaf has a very high fibre per acre, less lignin, therefore not too tough and the chemicals heat processing time is less, which makes energy input low (Charles, S.T. Kenaf International, LTD, TX [Based on Dempsey, 1975). Absorption of carbon dioxide in Kenaf is more to any plant.

The plant has two fibre types, a long fibre located at the cortical layer and a short fibre, located at the ligneous part and the fibres of Kenaf are short and in the range of 1.5 and 6 mm which contains less non cellulosic material than jute (Mohanty, A.K., Misra, M., Drzal, L.T. Natural Fibres, Biopolymers, and Biocomposites).

Bamboo Fibre

It is suitable for the production of papers, paper board, fishing poles, musical instrument, for food, furniture and local craft, which can be attributed to good strength, its straightness, smoothness, lightness, hardness and its hollow features which can be broken down into various shapes, size, length and thickness. It has been established that the mechanical properties of the plant has significant difference along its length that is from top to bottom, the strength of bamboo also increase with its age. This also depends on the thickness, diameter, moisture content and its density (Thomas, R., Singh, S.P. & Subrahmanyam, S.V & Dransfield, S., Elizabeth, A., 2004).

2.3 Coconut Fibre

Coconut palms are mainly cultivated in the tropical regions of the world and the product from the palm is applied in food and non-food products, which sustains the livelihood of people all over the globe. The coconut palm comprises of a white meat which has a total percent by weight of 28 surrounded by a protective shell and husk which has a total percent by weight of 12 and 35 respectively as shown in figure 2.2. From figure 2.3, the husk from the coconut palm comprises of 30% weight of fibre and 70% weight of pith material. The fibre are extracted from the husk by several methods such as retting, which is a traditional way, decortications, using bacteria and fungi, mechanical and chemical process, for the production of building and packaging materials, ropes and yarns, brushes and padding of mattresses and so on (Van Dam et al., (2004) & Narendra, R. & Yigi, (2005)).

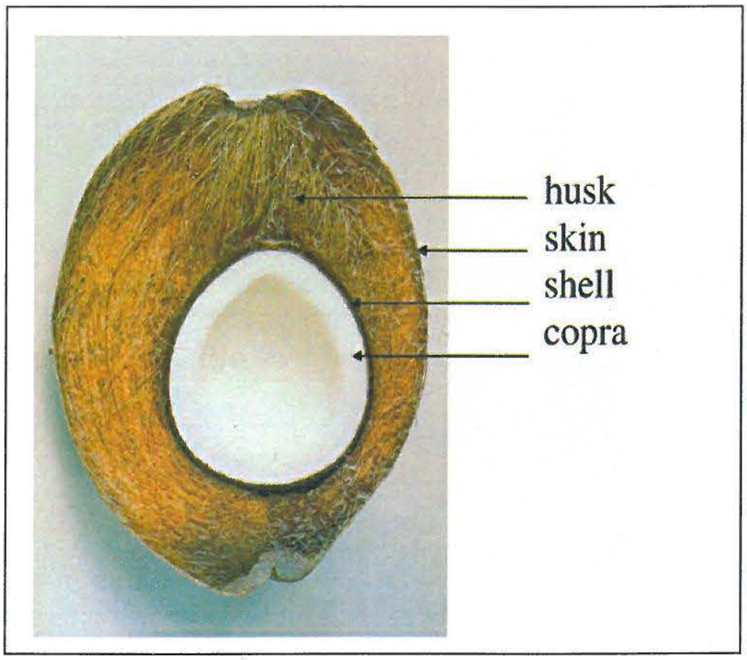

Figure 2.2: View of Coconut Fruit (Van Dam, J.E.G., Van Den Oever, M.L.A., Teunissen, W., Keijsers, E.R.P., & Peralta, A.G., 2004)

Figure 2.3: Brown (Mature) Coconut Fibre

The brown (matured) coconut fibre will be chosen and investigated to ascertain its relevance and important qualities it posses (Afa Austin Waifielate Bolarinwa Oluseun Abiola, 2008). It's a cheap and easy renewable resource. The fibres instead of going to waste are explored for new uses, which in turn provide gainful employment to improve the standard living condition of individuals. Brown fibres are thick, strong and have high abrasion resistance. The fibre has a high degree of retaining water and also rich in micronutrients.

Coconut fibres were selected because of its highest ductility. According to Munawar et al. (2007) and Satyanarayana et al. (1990), they had presented the stress-strain curves for different natural fibres. They had proved that the coconut fibre had the higher ductility compared to the other natural fibre. Munawar et al. (2007) reported that the strain of coconut fibre was 24% while Satyanarayana et al. (1990) was 39% compared to the other natural fibres that had strains in the range of 3% to 6% only.

2.4 Physical and Mechanical Properties

2.4.1 Physical and Mechanical Properties of Coconut Fibre

Table 2.1: Mechanical Properties of Coconut Fibre

Properties	Value	Unit
Young's Modulus	4000 - 5000	Mpa
Tensile Strength	140 - 150	Mpa
Elongation	15 - 17.3	%

Table 2.2: Physical Properties of Coconut Fibre

Properties	Value	Unit
Thermal Conductivity	0.047	W/m.K
Density	1.15 - 1.33	kg/m3
Water Absorption	0 - 10	%

According to the Matbase website, the physical and mechanical properties were stated. Coconut fiber is produced in India, Sri Lanka and Thailand. This coconut fiber is contained in the husk of coconuts. Fiber length ranging from 10-30 cm. Coir fibers are ligth in weight, strong and elastic and have a low light resistance and a high durability (because of the fibre composition; 35-45% cellulose, 40-45 % lignin and 2.7-4% pectin and 0.15-0.25 % hemicelluloses). Table 2.1 and 2.2 shows the physical and mechanical properties of coconut fibre.

Table 2.3: Physical and Mechanical Properties of Coconut Fibres (*Majid Ali, 2011*).

Diameter (mm)	Length (mm)	Tensile strength (Mpa)	Specific Tensile strength (Mpa)	Average Tensile Modulus (Gpa)	Specific Tensile Modulus (Gpa)	Tensile Strain (%)	Elongation (%)	Young's Modulus (Gpa)	Specific Young's Modulus (Gpa)	Toughness (Mpa)	Permeable Void (%)**	Moisture Content (%)	Water Absorption Saturation (%)**	Elastic Modulus (Gpa)	Density (Kg/m^3)	Reference
0.40 – 0.10	60 - 250	15 - 327	-	-	-	-	75	-	-	-	-	-	-	-	-	Ramakrishna et al. (2005a)
0.21	-	107	-	-	-	-	37.7	-	-	-	56.6 – 73.1	-	93.8 – 161.0	2.8	1104 - 1370	Agopyan et al. (2005)
0.3	-	69.3	-	-	-	-	-	-	-	-	-	-	-	2.0	1140	Paramasivam et al. (1984)
-	-	50.9	-	-	-	-	17.6	-	-	-	-	-	180	-	1000	Ramakrishna et al. (2005b)
0.27 ± 0.0.73	50 ± 10	142 ± 36	-	-	-	-	24 ± 10	-	-	-	-	10	24	2.0 ± 0.3	-	Li et al. (2007)
0.11 – 0.53	-	108 - 252	-	-	-	-	13.7 - 41	-	-	-	-	-	85.0 – 135.0	2.50 – 4.50	670 - 1000	Toledo et al. (2005)

Cont. Table 2.3

0.12 ± 0.005	-	137 ± 11	158	-	-	-	-	3.7 ± 0.6	4.2	21.5 ± 2.4	-	-	-	-	870	Munawar et al. (2007)
-	-	500	0.43	2.5	2.17	20	-	-	-	-	-	11.4	-	-	1150	Rao et al. (2007)
-	-	175	-	-	-	-	30	4 - 6	-	-	-	-	-	-	1200	Fernandez (2002)
0.1 – 0.4	-	174	-	-	-	-	10 - 25	-	-	-	-	-	-	16 - 26	-	Reis (2006)
0.1 – 0.4	50 - 250	100 - 130	-	-	-	-	10 - 26	-	-	-	-	-	130 - 180	19 - 26	145 - 280	Aggarwal (1992)
0.10 - 0.45	-	106 - 175	-	-	-	-	17 - 47	4 - 6	-	-	-	-	-	-	1150	Satyanarayana et al. (1990)