THE EFFECT OF U ND REPLACEMENT MATERIAL C.. COMPRESSIVE STRENGTH OF CONCRETE

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ABSTRACT

Common river sand is expensive due to excessive cost of transportation from natural sources. Also large-scale depletion of these sources creates environmental problems. As environmental transportation and other constraints make the availability and use of river sand less attractive, a substitute or replacement product for concrete industry needs to be found. River sand is most commonly used fine aggregate in the production of concrete poses the problem of acute shortage in many areas. Whose continued use has started posing serious problems with respect to its availability, cost and environmental impact.

Otherwise, in such a situation the quarry dust can be an economic alternative to the river sand. quarry dust can be defined as residue, tailing or other non-voluble waste material after the extraction and processing of rocks to form fine particles less than 4.75mm. Usually, quarry dust is used in large scale in the highways as a surface finishing material and also used for manufacturing of hollow blocks and lightweight concrete prefabricated Elements. Use of quarry dust as a fine aggregate in concrete draws serious attention of researchers and investigators.

Therefore, this study is the use of quarry dust, which is inert material or waste that is not useful, as a substitute for sand in concrete. The main objective of the implementation of this study was to determine the optimum content suitable quarry dust and workability of concrete containing quarry dust vary. The samples were prepared in the laboratory sample cubes with quarry dust composition from 0% to 25% where each sample is added 5% quarry dust. From the results, the optimum content of quarry dust which reached a maximum strength is 5%. Workability while decreasing with increasing quarry dust.

ABSTRAK

Pasir sungai biasa adalah mahal dari segi kos pengangkutan kerana pengambilan yang berlebihan dari sumber semula jadi yang sangat terhad. Kesusutan sumber-sumber ini juga boleh menimbulkan masalah kepada alam sekitar. Sebagai pencinta alam sekitar, kekangan lain juga membuatkan penggunaan pasir sungai di dalam pembinaan kurang efisien. Justeru, pengganti atau produk gantian bagi pasir sungai bagi industri pembinaan perlu dicari ganti pengganti yang sesuai. Pasir sungai yang paling biasa digunakan adalah sebagai agregat halus dalam pengeluaran konkrit menimbulkan masalah kerana kekurangan sumber dalam banyak bidang. Penggunaan yang berterusan telah mula menimbulkan masalah serius terhadap kos pengangkutan dan kesannya terhadap alam sekitar.

Oleh yang demikian, debu kuari difikirkan sesuai dijadikan sebagi bahan alternatif untuk menggantikan penggunaan pasir sungai di dalam industri pembinaan. Debu kuari boleh ditakrifkan sebagai sisa atau bahan buangan lain dari pengekstrakan dan pemprosesan batu-batu dari proses kuari dimana akan membentuk zarah halus dengan saiz kurang daripada 4.75mm. Biasanya, debu kuari yang digunakan dalam skala besar di dalam pembinaan lebuh raya dan dijadikan sebagai bahan turapan dan juga digunakan untuk pembuatan blok berongga dan konkrit ringan pasang siap. Penggunaan debu kuari sebagai agregat kasar dalam penghasilan konkrit telah menarik perhatian yg serius kepada para pengkaji.

Oleh itu, kajian ini ialah tentang penggunaan debu kuari yang merupakan bahan lengai atau bahan buangan yang tidak berguna, sebagai pengganti pasir dalam binaan konkrit. Objektif utama perlaksanaan kajian ini ialah untuk menentukan kandungan optimum debu kuari yang sesuai dan kebolehkerjaan konkrit yang mengandungi debu kuari berbeza-beza. Sampel yang disediakan di dalam makmal ialah sampel kiub dengan komposisi debu kuari dari 0% hingga 25% dimana setiap sampel ditambah 5% debu kuari. Daripada keputusan, kandungan optimum debu kuari dimana mencapai kekuatan maksimum ialah 5%. Manakala kebolehkerjaan semakin merosot dengan peningkatan penambahan debu kuari.

TABLE OF CONTENT

LIST OF TABLE

LIST OF FIGURE

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background Of Study

Concrete has been the popular construction material used since the past until now. Normally the concrete is mixed from cement, sand, stone and water sometime with use admixture. At present the cost of sand and stone are higher because the material for using has been lost and the pumping of sand from the river affects to the environment problems. From the exploding the mountain the stone has been crushed to be small size and with this method the quarry dust was occurred and becomes useless material and also makes air pollution too.

Concrete also is the most important part in a building for more than 80% in the structure is composed of concrete construction. The quality and quantity of materials to make concrete in certain grades obtained and controlled during the concrete mix done (Kamarudin Mohd. Yusof ,1995). Fresh concrete mixed will go through further stages of construction, such as transport, pouring, compacting and curing. Proper operation during the construction phase is very important to avoid problems that can cause quality decreasing and fail to meet the best specification of concrete when the concrete become hardened (Mat Lazim Zakaria,1992).

In this research, the main important part in this experiment was to make replacement of quarry dust to sand by percentage weigh of sand in concrete. Quarry dust is a useless waste then recycled as an additive or an alternative in the production of concrete.

1.2 Problem Statement

The quarry dust is taken as alternative measurement to replace sand in concrete construction work. Quarry dust which is inert material and useless waste found in any factory quarry. At this time, the demand for sand for construction purposes is increasing. In addition, the sand mining activities can also lead to disturbed ecosystems in the river. So, taken quarry dust as alternative measures to replace sand in concrete construction work is to reduce the higher demand of sand uses in construction and to maintain the ecosystem & environment.

1.3 Objective

The main purpose of the implementation of this research are:

i. To determine the optimum compressive strength of quarry dust as sand replacement in concrete under the different percentage.
ii. To identify the workability of concrete containing quarry dust.
iii. To investigate the relationship between the compressive strength and the density of the concrete samples.

1.4 Significant Of The Study

The main purpose of the implementation of this research is to study the suitability of using quarry dust as a replacement material in concrete. In addition, this study also can be used as a guide for the futher researchers that interest in conducting the similar studies.

1.5 Scope Of Study

In this research, laboratory testing includes slump test, vebe time test and compaction factor test to identify the workability of the concrete when sand will be replace by quarry dust with different percentage composition by weigh of sand

The main part is do the compressive strength test on concrete samples to determine the optimum compressive strength on concrete gain due to replacing of quarry dust with the different percentage by weight of the sand with different composition of 0%, 5%, 10%, 15%, 20% and 25% of quarry dust.

CHAPTER 2

LITERATURE REVIEW

2.1 Types Of Concrete Strength

The strength of concrete can be categorized into a number of burdens imposed on him. Therefore, various types of forces or loads that can act on the concrete structure (Kamarudin Mohd. Yusof ,1995) as discussed below.

2.1.1 Compressive Strength

Concrete compressive strength of concrete is defined as the capacity of a material or structure to withstand axially directed pushing forces (Kamarudin Mohd. Yusof ,1995). Compressive forces occur when the forces acting perpendicular to a plane and the action to the body. Concrete has high compressive strength compared to other forces. Thus, concrete can be used as a building material, especially large

building that can withstand the compressive force. The test performed to assess the strength of concrete is based on compressive strength.

2.1.2 Tensile Strength

The tensile strength of concrete is defined as the ability to withstand tensile forces (Kamarudin Mohd. Yusof ,1995). The tensile force occurs when the forces acting perpendicular to a plane and the action out of the body. However, the design is not based on the tensile strength of concrete because it is a low relative.

Tensile strength of concrete problems can be solved by using steel reinforcement in concrete. Reinforcing steel placed in concrete to increase the strength of the concrete structure. Type of aggregate used also affects the tensile strength than compressive strength.

2.2 Costruction Concrete Material

Concrete is a composite material consisting of basic materials such as cement, aggregates and water. Quality and quantity of raw materials to design a particular grade of concrete is known and can be controlled during the concrete mix is provided (Mat Lazim Zakaria,1992).

The concrete batching will go through further stages of construction, such as transport, pouring, compacting and curing. If the operation of the wet concrete through the process is properly not done, the concrete degradation will occur and can

cause the reduce the quality of concrete and cannot fulfill the required specifications of the concrete hardened.

2.2.1 Cement

Cement is a material that has a cohesive and adhesion when wet and then solidifies includes hardens and binds the material into a cohesive body. Cement can be classified into two types of hydraulic cement and non-hydraulic cement.

Hydraulic cement solidifies and hardens upon reaction with water, such as Portland cement consisting of silicate and aluminate. It cannot be exposed to air or drying. In fact, it can harden even soaked in water. Non-hydraulic cement will not solidify and harden in the water because it requires chemical agents for reactions occur such as lime.

Each type has a difference in terms of cement composition and fineness of particles. In general, the use of cement containing quantities of tricalcium silicate (C_3S) more quickly achieve high strength and large impact on the early strength of concrete from cement that containing high calcium silicate (C_2S).

2.2.2 Coarse Aggregates

The quality of the aggregates can affect the strength and durability of concrete. The selection of a suitable aggregate for construction purposes requires an understanding of the properties of the aggregates. These properties can be determine through experiments as specified by the codes in the British Standard(BS).

Aggregates are divided into two main parts such as fine aggregate and coarse aggregate. Nominal size of the sand is less than 5 mm and gravel are aggregates of nominal size greater than 5 mm. Coarse aggregate can be obtained from natural or artificial sources. Natural resources are usually from the Granite or Limestone (BS 812: Part 1: 1975). This rock group is used for normal construction and usually a relative density of the aggregates is in the range of 2.500 to 2.700 kg/m3.

Artificial aggregates can be obtained from industrial wastes. Heavy iron balls to concrete, clinker or slag for lightweight concrete products of combustion. Lightweight aggregates generally have low strength and weight aggregates have high strength. Common nominal size is 10 mm, 20 mm and 40 mm. The maximum size depends on the type of construction such as a compact arrangement of reinforcement and building a thick or thin.

The strength of the aggregates has an effect that many of the characteristics of concrete such as concrete strength, deformation, durability, change in volume, specific gravity, transparency and chemical reactions. Usually the strength of the aggregates is higher than the strength of concrete will be designed. The strength of concrete is usually between 30 MPa to 50 MPa and the strength of strong concrete is in the range 80 MPa to 350 MPa (Shirley D.E,1992) . Therefore, the igneous rock is stronger than the sediments and Metamorphic rocks.

2.2.3 Sand

Sand is commonly used for river sand free from chemical impurities. However, manufactured sand is sand of a large fraction of gravel can be used as a substitute.

In ordinary concrete, 25% - 40% are made up of sand. Coarse sand to produce concrete of low workability. Meanwhile, the fine sand to produce concrete that is not economical. According to BS 882, divided into three grades of sand is coarse grade, medium grade and fine grade. In general, sand is defined as the aggregate of the size less than 5 mm. Sand consists of two types namely as natural sand and manufactured sand. Natural sand usually found on the beach, rivers and mines.

Manufactured sand is sand made of crushed rock at the factory until it reaches the desired size. Usually manufactured sand with sharp and rough texture of the form compared with the natural sand. The sand used was derived from the river because it can prevent sulfate attack. Sulphate attack common in sand taken from the beach which will cause a failure in terms of durability and thus weaken the strength of a concrete building.

2.2.3.1 Moisture Conditions And Absorption Of Sand

1. Dry Outline

This situation occurs as the sand that will be placed in an oven for the drying of the aggregates as a whole. If these conditions exist, the sand used to absorb water during the mixing process done. This should be considered in the design of concrete mixtures made.

2. Cleaning the air

The air dry conditions that exist where the sand appears on the surface but there is moisture on the inside of the sand itself. This situation usually will absorb some water, but less than the dry frame.

3. Saturated and dry surfaces

This situation is the most ideal conditions in the sand mixing concrete. This is because this type of sand does not absorb water and contribute to the excess water during the mixing process. In this case the sand are rarest and it is only used as an ideal theoretical calculation alone.

4. Wet

Sand in a moisture condition is most commonly found in Malaysia in view of the high humidity here contribute to the excess water in the concrete mixing process. This situation must be taken into account in the design mix.

2.3 Quarry Dust

Quarry dust is a by product of the process of breaking large block of granite or natural aggregates that do not have a specific commercial value. Quarry dust produced during the breakdown of rocks directly done. The physical characteristics of the aggregates are approximately equal to the fine aggregate, better known as the sand.

Quarry dust in the form of a flat, long, angular, and sometimes gray. Rougher surface texture than ordinary sand and has a fine dust. In theory, the rough surface texture will produce a stronger bond than sand texture with a smooth surface.

According to ASTM C 128-88, bulk specific gravity of quarry dust in saturated surface dry condition was determined using micrometer. Found that the bulk specific gravity of 2.65 worth of quarry dust fall in the range of natural aggregates. In addition, the absorption of water in the saturated surface dry condition

must be determined. Quarry dust in the dry saturated surface is dried in an oven at 105°C for 24 hours. Absorption value is the percentage differences quarry dust mass before and after drying, divided into the mass prior to drying. The value of quarry dust absorption was 0.6%. The value of this absorption will affect the mixing water is added to the production of concrete (Tan Yoke Sin,2000).

According to sieve analysis tests carried out based on ASTM C 136-84, the fineness modulus of quarry dust obtained is 4.2 (Tan Yoke Sin,2000). Quarry dust in dry conditions are expected to absorb sufficient water so that it is in saturation. Meanwhile, the moisture content in the quarry dust used was 0.3% and this small value can be ignored in the calculation of the mixing water and mixing the water corrections are not made for this factor.

2.4 The Application Of Quarry Dust

Through a number of studies carried out previously, the quarry dust waste is recycled for use in various fields such as construction, manufacturing, agriculture and horticulture.

2.4.1 The Application Of Quarry Dust In Construction

In construction work, quarry dust is used as a substitute for sand in concrete and mortar. In India, Centre for Planning & Building Housing to build several models of low-cost housing using quarry dust. Studies conducted on the cost of construction to prove that the use of quarry dust is more economical when

compared to sand. The use of quarry dust in the road construction as sub-base layer or the site is also very widespread, including in Malaysia.

2.4.2 The Application Of Quarry Dust In Manufacture

In India, quarry dust is used as a building material in the manufacture of stone blocks. The materials used in the production of stone blocks is a mixture of quarry dust, lime and gypsum. Besides India, the use of quarry dust in the manufacture of stone blocks are widely practiced in South Africa.

Apart from manufacturing stone blocks, quarry dust is used in the manufacture of tiles. Tiles made from a mixture of green quarry dust as it is said to be made from waste materials. For example, tiles produced by Quarry Tile Company that uses 70% recycled waste glass that is material, industrial waste such as computers, rock and quarry dust. The company is producing 50 different types of tile colors and sizes suitable to be installed on floors and walls.

2.4.3 The Application Of Quarry Dust In The Landscape And Recreation Area

The use of quarry dust as the base in the landscape and recreational area is well known in America States, Australia and New Zealand. In recreation areas, quarry dust used as a base in walking street for pedestrians and fertilize for ornamental trees.

2.4.4 The Application Of Quarry In Agriculture

In agriculture, quarry dust is said to be able to act as a fertilizer that can provide nutrients to plants. Studies conducted at the University of Massachusetts to prove that the four types of plants that use the quarry dust as a fertilizer salad, corn, tomatoes and apples can live in fertile and growth fast.

2.5 Properties Of Concrete

Concrete has relatively high compressive strength, but significantly lower tensile strength, and as such is usually reinforced with materials that are strong in tension (often steel). The elasticity of concrete is relatively constant at low stress levels but starts decreasing at higher stress levels as matrix cracking develops. Concrete has a very low coefficient of thermal expansion, and as it matures concrete shrinks. All concrete structures will crack to some extent, due to shrinkage and tension. Concrete which is subjected to long-duration forces is prone to creep.

Concrete hardens and freezes with the presence of water. Concrete strength properties is important in construction, especially in the construction of a wet basis. Concrete does not rust or rot and free from attack by termites and other insects. Concrete can also be mixed to make any form of mold and heat-resistant concrete and not burn (Kamarudin Mohd. Yusof ,1995).

The quality of the concrete mixture depends on the quality of mixing, the mixture ratio, how to mix and transport, the quality of the mold is used, when placed in a compression mold and curing was done.

2.5.1 Workability

Workability of concrete is termed pleasure compacted concrete without segregation. Workability properties belong to the plasticity properties of concrete (Kamarudin Mohd. Yusof,1995).

According to a study done in 1992, the ruins of tests conducted in the USA around the year 1910 for the purpose of looking plain concrete workability in wet conditions (G.F Blackledge,1992). Workability of concrete is said to have worked better if simple, the ability to stick on a vertical surface, associated with Cohesive, mobility, internal friction, ability to be pumped and the ability to finish. In addition, the concrete flow properties, easily compacted, and able to fill the narrow space (G.F Blackledge,1992).

Factors that influence the properties of the water content and workability of cement-sand ratio. Therefore, the selection of sand grade is determined by the concrete mix done. If fine sand is used, there are many surfaces that are exposed to the inadequacies of the excess cement and water in the concrete workability produced resulting in low (Shirley D.E,1992).

Figure 2.1: Slump test

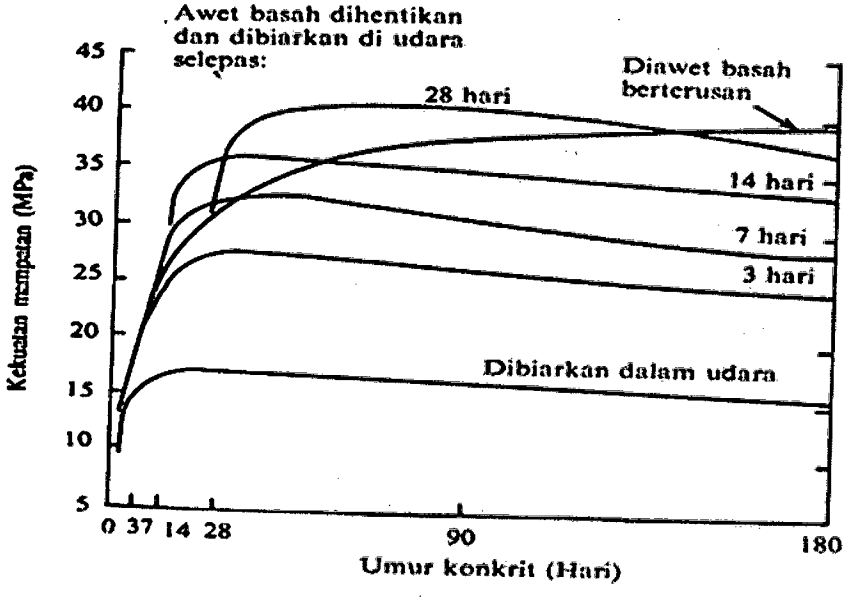

Figure 2.2: Graph of compressive strength concrete due to curing age

2.5.2 Strength

Historically, curing requirements are based on the strength that will be considered for any structure. The strength of the concrete mix as a whole can be reached within 28 days from the date when most of the cement mix used to achieve ultimate strength at around 70% -80% and then a slow increase in strength (Kamarudin Mohd. Yusof,1995). Therefore, the growth is dependent on the strength of concrete curing time. The specification was released in 1945 on the preservation and specified in the code of practice for the British to provide basic needs for the construction of concrete curing.

At present, their preservation in the United States is based on research and past experiences which have concrete compressive strength of less than 40 MPa (6000 Psi) (Shirley D.E,1992). According to a study conducted at UTM in 1995, the parameters that influence the strength of concrete is the water-cement ratio, curing, aggregate, bonding materials and additives used (Kamarudin Mohd. Yusof,1995).

Besides, the mechanical property of concrete is the compressive strength. Study done by previous researcher has reported that the compressive strength of the concrete decreases exponentially with a reduction in density of the concrete. The specimen size and shape, the method of pore formation, direction of loading, age, water content, characteristics of ingredients used, and the method of curing are reported to influence the strength of concrete in total. Other parameters affecting the strength of foam concrete are cement sand and water cement ratio, curing regime, type and particle size distribution of sand.