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REVIEW ON LATERALIZED DUST AND CRUSHED BRICKS AS SUBSTITUTES FOR CONVENTIONAL CONCRETE

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Abstract
Sand collected from Aeolian deposits is expensive due to the unwanted cost of transportation from natural sources. Large-scale exploitation of natural sand creates an environmental impact on society. River sand is the most commonly used fine aggregate in concrete but due to acute shortage in many areas, availability, cost & environmental impact are a major concern. To overcome from this crisis, the partial replacement of sand with quarry dust can be an economic alternative. In developing countries like India, quarry dust has been rampantly used for different construction purposes but replacement technology has emerged as an innovative development for civil engineering material.
Keywords: [Quarry dust; workability; hardened concrete; durability]

Introduction:

Concrete is an assemblage of cement, aggregate, and water. The most commonly used fine aggregate is sand derived from river banks. The global consumption of natural sand is too high due to its extensive use in concrete. The demand for natural sand is quite high in developing countries due to rapid infrastructural growth resulting in supply scarcity. Therefore, developing countries' construction industries are stressed to identify alternative materials to replace the demand for natural sand. On the other hand, the advantages of utilization of byproducts or aggregates obtained as waste materials are pronounced in the aspects of reduction in environmental load & waste management cost, reduction of production cost as well as augmenting the quality of concrete. In this context, fine aggregate has been replaced by quarry dust a byproduct of the stone crushing unit, and a few admixtures to find a comparative analysis for different parameters which are tested in the laboratories to find the suitability of the replacement adhered to the Indian Standard specifications for its strength. Concrete is a versatile engineering material consisting of cementing substances, aggregates, water, and often a controlled amount of entrained air. It is initially a plastic, workable mixture that can be molded into a wide variety of shapes when wet. The strength is developed from hydration due to the reaction between cement and water. The products, mainly calcium silicate, calcium silicate hydrate, calcium aluminates, and calcium hydroxide are relatively insoluble which bind the aggregate in a hardened matrix. Concrete is considerably stronger in compression than in tension; for structures required to carry only compressive loads such as massive gravity dams and heavy foundations, reinforcement is not required and the concrete is consequently called plain concrete. Steel bars are embedded in the concrete when the structure is subjected to tensile stresses. Quarry dust has been used for different activities in the construction industry such as road construction and the manufacture of building materials such as lightweight aggregates, bricks, and tiles. Crushed rock aggregates are more suitable for the production of high-strength concrete compared to natural gravel and sand. The high percentage of dust in the aggregate increases the fineness and the total surface area of aggregate particles. The surface area is measured in terms of specific surface, i.e. the ratio of the total surface area of all the particles to their volume. The main objective is to provide more information about the effects of various proportions of dust content as partial replacement of crushed stone fine aggregate on workability, air content, compressive strength, tensile strength, and absorption percentage of concrete. Attempts have been made to investigate some properties of quarry dust. The use of quarry dust in concrete is desirable because of its benefits such as useful disposal of by-products, reduction of river sand consumption as well as increasing the strength

parameters and increasing the workability of concrete. The sand was replaced with granite powder in steps of 0, 25, 50, 75, and 100% and cement was replaced with 7.5% of Silica fume, 10% of fly ash, and 10% of slag. Experimental results indicated that the increase in the proportions of granite powder resulted in a decrease in the compressive strength of concrete. The highest compressive strength was achieved in samples containing 25% granite powder concrete. The overall test performance revealed that granite powder can be utilized as a partial replacement for natural sand in high-performance concrete. Concrete is a versatile engineering material consisting of cementing substances, aggregates, water and often a controlled amount of entrained air. It is initially a plastic, workable mixture which can be moulded into a wide variety of shapes when wet. The strength is developed from hydration due to the reaction between cement and water. Concrete is considerably stronger in compression than in tension; for structures required to carry only compressive loads such as massive gravity dams and heavy foundations, reinforcement is not required and the concrete is consequently called plain concrete. When the structure is to be subjected to tensile stresses, steel bars are embedded in the concrete. Since 70- 80% of concrete is made up of aggregates, its types, quality and general properties determine the quality of concrete. There are many uses for crushed brick, such as ground cover, land and filler for concrete construction and road building. Some of the uses for crushed brick are in the creation of clay tennis courts and roofing materials. Most of the crushed brick remains its original red or brown colour, but some companies dye the finished product to add a colourful touch to landscaping and walkways. Whether the brick is being used on its own or as an aggregate component of another material, it is an appropriate choice when attempting to use environmentally friendly construction techniques on nearly any building project. Many brick structures are demolished, creating untold numbers of used, unwanted and often damaged bricks. One option to dispose of the bricks is to place them in a landfill. A second option that has become an accepted method in the building community is to crush the brick into small chips or rubble-like pieces. The crushed brick is then used in several aspects of building and construction. Brick is often used in place of wood chips for a much longer-lasting material that provides a visual aspect to the area as well as a very durable solution to weed control. Many builders and contractors recommend crushed material for walkways and even driveways in some tropical areas where the use of blacktop creates excessive and unwanted heat. Another use for the recycled material can be found in the roofing industry. Some roofing installers have used crushed brick instead of pea stone to add weight to rubber roofing on flat roofs. The crushed brick allows for superior drainage as compared with many other materials, and the weight of the brick provides a good anchoring system for the rubber roofing material in periods of high winds. In some applications, brick is even more cost-effective than comparable materials and works as well or better than traditional building materials.

Literature Review:

Subramanian and Kannan. [1] reported that the Physical and chemical properties of quarry rock dust is satisfied the requirements of code provision of IS 4032/1968 in properties studies. Natural river sand, if replaced by hundred percent Quarry Rock Dust from quarries, may sometimes give equal or better than the reference concrete made with Natural Sand in terms of compressive and flexural strength studies Nagaraj T.S. (Proportioning Concrete Mix with Rock Dust as Fine Aggregate) studied the consumption of cement content, workability, compressive strength and cost of concrete made with Quarry Rock Dust. The overall test results revealed that quarry waste fine aggregate can be utilized in concrete mixtures as a good substitute for natural sand. It is found that the compressive, flexural strength and Durability Studies of concrete made of Quarry Rock

Dust are almost equal to that of conventional concrete.

Hanifi Binici [2] determined the mechanical properties of concrete containing marble dust (MD) and limestone dust (LD). Seven concrete mixtures were produced in three series with control mixes having 400 kg cement content. Fine aggregate was replaced with MD and LD. The replacement percentage of MD was 5 and 10% and it replacement percentage of LD was 15%. The compressive strengths of concrete cubes were found on the 7th, 28th, 90th and 360th day. Sodium sulphate resistance was found after 12 months. Also, abrasion resistance and water penetration of concrete were investigated. Results indicated that MD and LD fine aggregate concrete had good workability and abrasion resistance. Abrasion resistance increases as the rate of fine MD and LD increase. Furthermore, the results indicated that the increase in the dust content caused a significant increase in the sodium sulphate resistance of the concrete.

Oyekan G.L and Kamiyo O.M [3] studied the performance of hollow sand concrete blocks containing cement, sharp sand and granite fines in varying propositions to determine their structural and hygrothermal properties. The percentage of granite fines by volume of the total fine aggregate was varied in step of 5 to a maximum of 30%. Results of the tests indicated that the inclusion of granite fines in the sand-cement matrix has a very significant effect on the compressive strength of sandcreate blocks. It was also, observed that for both mix propositions, 15% granite fines content was the optimum value for improved structural performance.

Kanmalai Williams et al. [4] examined the performance of concrete made with granite powder as a fine aggregate. The sand was replaced with granite powder in steps of 0, 25, 50, 75 and 100% and cement was replaced with 7.5% Silica fume, 10% fly ash and 10% slag. Experimental results indicated that the increase in the proportions of granite powder resulted in a decrease in the compressive strength of concrete. The highest compressive strength was achieved in samples containing 25% granite powder concrete. The overall test performance revealed that granite powder can be utilized as a partial replacement of natural sand in high-performance concrete.

Shahul Hameed and Sekar A.S.S [5] investigated the usage of quarry rock dust and marble sludge powder as possible substitutes for natural sand in concrete. They also carried out durability studies on green concrete and compared it with natural sand concrete. They found that the compressive, split tensile strength and durability of concrete were good when the fine aggregate was replaced with 50% marble sludge powder and 50% Quarry rock dust (Green concrete). The resistance of concrete to sulphate attack was enhanced greatly.

Bahar Demirel [6] investigated the effects of using waste marble dust (WMD) as a fine material on the mechanical properties of the concrete. For this purpose, four different series of concrete mixtures were prepared by replacing the fine sand (passing 0.25 mm sieve) with WMD at proportions of 0, 25, 50 and 100% by weight. To determine the effect of the WMD on the compressive strength with respect to the curing age, the compressive strengths of the samples were recorded at the curing ages of 3, 7, 28 and 90 days. In addition, the porosity values, ultrasonic pulse velocity (UPV), dynamic modulus of elasticity and the unit weights. of concrete were determined. It was observed that the replacement of the fine material passing through a 0.25mm sieve with WMD at a particular proportion has displayed an enhancing effect on compressive strength.

Felixkala T and Partheeban P [7] examined the possibility of using granite powder as replacement of sand along with partial replacement of cement with fly ash, silica fume and blast furnace slag. They reported that granite powder of marginal quantity as partial replacement to sand had a beneficial effect on the mechanical properties such as compressive strength, split tensile strength and modulus of elasticity. They also

reported that the values of plastic and drying shrinkage of concrete with granite powder were less than those of ordinary concrete specimens.

Bouziani Tayeb et al [8] studied the effect of marble powder content (MP) on the properties self compacting sand concrete (SCSC) at fresh and hardened states. Values of slump flow, the V-funnel flow time and viscosity were found on fresh concrete. At the hardened state, on the 28th day, compressive strength was found. The obtained test results showed that larger MP content in SCSC (350 kg/m3) improved the properties at fresh state by decreasing V-funnel flow time and increasing the slump flow values (from 28 to 34cm). With the use of 250 kg/m3 of MP, the highest initial viscosity was obtained while retaining good fluidity at high rotational.

Shirule P.A et al [9] determined the compressive strength and split tensile strength of concrete in which cement was partially replaced with marble dust powder (0, 5, 10, 15, and 20%). The result indicated that the compressive strength of concrete increased with the addition of waste marble powder up to 10% replaced by weight of cement and further addition of waste marble powder was found to decrease the compressive strength. The optimal percentage replacement was found to be 10%.

Conclusion:

It can be seen from the results of this study that the combination of laterite, quarry dust and crushed clay bricks to replace the conventional aggregates in the production of concrete results in structures with reasonable structural characteristics and should be encouraged where there is comparative cost advantage. Alternative concrete made from laterite, quarry dust and crushed clay brick aggregates has a performance comparable to conventional concrete. The compressive strength of the alternative as well as conventional concrete of similar mix ratios was within 10% the workability of fresh alternative concrete was generally within the standards limits for concrete placed and compacted by an internal vibrator.

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