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ANALYSIS AND CHECKING OF STONE DUST AS A REPLACEMENT MATERIAL OF SAND

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Abstract: In this paper the study is done for analysis of stone dust as a replacement material of sand. The whole analysis is mainly done only for replacement material of sand by stone dust which is used in mortar and concrete. Stone dust is such materials which is easily available in large quantities from crusher units. Diminishing natural sand resources have increased and the efforts to identify substitutes for natural sand as a constituent of Portland cement concrete. The use of crusher stone dust in making concrete and mortar by partial/full replacement of Natural River sand not only provides economy in the cost of construction but at the same time solves the problem of disposal of stone dust.

Keywords- Stone dust, Sand, Cement, Mortar, Water



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INTRODUCTION

Mortar is a product composed of cement and fine aggregate. In which water is added to make mixture. Water is added to make mixture, and when we add water to mixture cement is activated which acts as a binding material. Mortar works as a matrix in concrete. Mortar is different from concrete. Mortar is basically made by cement and fine aggregate and concrete is made by mixture of cement, coarse aggregate and fine aggregate. Concrete acts in a similar way of mortar but which contains coarse aggregate which is bound together by the cement. Also mortar is an integral part of masonry wall systems. Mortar also provides protection to the outer part of structural concrete from detrimental effect, consisting the outer layer.

When water mixed in cement it reacts with cement and forms a harsh, stiff paste that is unworkable and becomes hard very quickly. Some Portland cement assists the workability and plasticity of the mortar. It also provides early strength to the mortar and speeds setting. Sand is the general component of mortar which gives its distinctive color, texture and cohesiveness.

Sand which is used for concrete and mortar must be free of impurities, such as salts, clay or other foreign materials. The three key characteristics of sand are particle shape, gradation and void ratio. Sand is mainly used as inert material to give volume in mortar for economy. The strength of mortar is largely affected by the fine aggregates. The main constituents of mortar are sand, which are mainly natural resources. Stone dust, fly ash, silica fume, wheat husk etc. are the waste materials. Exchange of normal sand by stone dust will assist both solid waste minimization and waste recovery. Stone dust is such a material which is easily available in large quantities from crusher units. Diminishing natural sand resources have increased and the efforts to identify substitutes for natural sand as a constituent of Portland cement concrete. The use of crusher stone dust in making concrete and mortar by partial/full replacement of natural river sand not only provides economy in the cost of construction but at the same time solves the problem of disposal of stone dust.

II LITERATURE REVIEW

Tasnia Hoque, Muhammad HarunurRashid, MD. Rokon Hasan, Ebna Forhad Mondol^[1]

Natural river sand is one of the key ingredients of concrete, is becoming expensive due to excessive cost of transportation from sources. Mortar is one of the most important components in which sand and cement is used and also important in reinforced concrete structural member. In reinforced concrete structures mortar has some inseparable influence. Lacking in mortar is very dangerous and it affects the whole structure. Now a day it is seen that many structures

fails due to lack of strength. In this paper an investigative experiment is reported on the mechanical properties of mortar modified by stone dust as replacing material of both fine aggregate and cement. Properties of mortar are investigated with the replacement of 25% and 50% of fine aggregate and also 5% of cement by stone dust. Cubes samples were casted and tested after a curing period of 3, 7 and 28 days. Several samples were made by using above proportion to get the effect on mortar^[1]

Sudhir S.Kapgate And S.R.Satone^[2]

Mortar is one of the most important components in reinforced concrete structural member. Use of natural river sand in large scale depletion of sources creates environmental problems. To overcome these problems there is a need of effective alternative and innovative materials which is economical and easily available. Amongst all waste material quarry dust is most famous and easily available. Quarry dust is a waste obtained during quarrying process. It has very recently gained good attention to be used as an effective filler material instead of fine aggregate. Also, the use of quarry dust as the fine aggregate decreases the cost of concrete production in terms of the partial replacement for natural river sand. Design mix of M25 grade concrete with replacement of 0%, 20%, 25%, 30%, and 35% of quarry dust organized as M1, M2, M3, M4 and M5 respectively have been considered for laboratory analysis viz. slump test, compaction factor test, compressive strength, split tensile strength and flexural strength of hardened concrete. In the present paper, the hardened property used of concrete using quarry dust were investigated^[2]

A.V.S.Sai. Kumar¹, Krishna Rao B²^[3]

In this investigation it is observed that researcher is taking interest in finding alternative material for replacement of cement materials by waste materials or waste products produced from industries and quarries which are harmful to environment. In this investigation partial replacement of cement with quarry dust and metakaolin which are having silica used as admixture for making concrete is used. First quarry dust is made partial replacement of cement and found that 25% of partial replacement is beneficial to concrete without loss of standard strength of cement. Making 25% partial replacement of cement with quarry dust as constant, 2.5%, 5.0%, 7.5%, 10.0%, 12.5% metakaolin was made in partial replacement of cement and results were found that quarry dust and metakaolin usage in partial replacement to cement can be made^[3].

Priyanka A. Jadhav, Dilip K. Kulkarni^[4]

The effect of water cement ratio on hardened properties of cement mortar with partial replacement of natural sand by manufactured sand is investigated. Designed mortar mix having proportion as 1:2, 1:3 and 1:6 with water cement ratio of 0.5 and 0.55 respectively is used in experimental study. Mortar cube specimens are tested for evaluation of compressive strength. The mortar exhibits excellent strength with 50% replacement of natural sand by manufactured sand. This paper puts forward the applications of manufactured sand as an attempt towards sustainable development. It will help to find viable solution to the declining availability of natural sand to make eco-balance^[4]

Lohani T.K.1, Padhi M.2, Dash K.P.3, Jena S.4^[5]

Sand is collected from river and then transport it to the site . In this process transportation charges is also increases and in large scale exploitation of natural sand creates environmental impact on society. River sand is most commonly used fine aggregate in concrete but due to acute shortage in many areas, availability, cost & environmental impact are the major concern (Ahmed et.al., 1989,) Partial replacement of sand with quarry dust can be an economic alternative. In developing countries like India, quarry dust has been rampantly used in different construction purposes but replacement technology has emerged as an innovative development to civil engineering material. Design mix of M20 grade concrete with replacement of 0%, 20%, 30%, 40%, and 50% of quarry dust organized as M1, M2, M3, M4 and M5 respectively have been considered for laboratory analysis viz. slump test, compaction factor test, compressive strength (cube, cylindrical sample), split tensile strength, flexural strength, modulus of elasticity, water absorption of hardened concrete. The durability of concrete was studied by immersing the concrete cube in 5% solution of MgSo₄, 5% solution of NaCl and 2N solution of HCl for 28 days and 91 days and results were compared with the standards to achieve the desired parameters^[5]

R. Ilangovana¹, N. Mahendrana¹ and K. Nagamanib^[6]

Use of stone dust as a replacement of fine aggregate in concrete and mortar draws serious attention of researchers and investigators. This paper presents the study on the usage of Quarry Rock Dust as hundred percent substitutes for Natural Sand in concrete. Mix design has been developed for three grades using design an approach IS, ACI, USBR, RN.No.4 and BRITISH for both conventional concrete and quarry dust concrete. Tests were conducted on cubes and beams to study the strength of concrete made of Quarry Rock Dust and the results were compared with the Natural Sand Concrete. An attempt has also been made to durability studies

on Quarry Rock Dust when compared with the Natural Sand concrete. It is found that the compressive, flexural strength and Durability Studies of concrete made of Quarry Rock Dust are nearly 10% more than the conventional concrete^[6]

V. Bhikshma, R. Kishore & N.H.M. Raju^[7]

It is seen that use of sand behaves as a very important constituent as a fine aggregate in mortar and concrete. Sand is occurred from river. In developing countries like India it is seen that the consumption of sand is more for construction as a result various government agencies have put restrictions on sand quarrying to conserve this diminishing natural resources. This has prompted many engineers to look for alternate materials that are cheaper while possessing similar characteristics. One such alternative among all waste material is quarry dust byproduct of crushers. This study indicates that this material can be used as partial or full replacement of river sand as fine aggregate without altering the strength, workability or setting characteristics of concrete. It presents the results of tests on cubes (150×150×150 mm) and under reinforced concrete beams (150×230×1500 mm) in order to obtain the flexural behavior of under reinforced RC beams. A total of 24 cubes and 10 beams were tested for direct compression and flexure at 28 days^[7] H. M. A. Mahzuz1*, A. A. M. Ahmed2 and M. A. Yusuf^[8]

The study focuses to determine the relative performance of concrete by using powder sand. From laboratory experiments, it was revealed that concrete made of stone powder and stone chip gained about 15% higher strength than that of the concrete made of normal sand and brick chip. Concrete of stone powder and brick chip gained about 10% higher strength than that of the concrete normal sand and stone chip concrete. The highest compressive strength of mortar found from stone powder which is 33.02 Mpa, shows that better mortar can be prepared by the stone powder. The compressive strength of concrete from stone powder shows 14.76% higher value than that of the concrete made of normal sand. On the other hand, concrete from brick chip and stone powder produce higher compressive value from that of brick chip and normal sand concrete^[8]

III RESEARCH METHODOLOGY :

The use of these byproducts not only helps to utilize these waste materials but also enhances the properties of mortar in fresh and hydrated states . In the first stage of this investigation, the compressive strengths of different grades of cement mortar are observed by replacing natural sand by CRP at different levels of replacement namely 10%,20%,30%,40% . Two mortar are mixes in ratio of 1:4, 1:5, selected for the study of both CRP and wheat husk ash. Moulds of size

70.7mm x 70.7mm x 70.7mm were used which gives cross sectional area of 5000mm². The compressive strength of both types of mortars are obtained at age of 3days, 7days and 28days.

1. Collecting the crushed rock powder from locally available quarry.
2. For the replacement of sand, stone dust with moisture will be dried in oven at 105°C for 24 hours. After drying screening process was performed
3. For sand replacement the gradation and fineness modulus of stone dust will kept similar to the sand.
4. Preparing plain mortar of different proportions i.e 1:4 & 1:5
5. Preparing mortar using different percentage of sand & crushed rock powder (i.e. 10%, 20%, 30% & 40%).
6. Physical properties of stone dust have to performed i.e specific gravity, bulk density, absorption (%), moisture content (%), sieve analysis.
7. These casted mortar specimens are to be cured for 3 days, 7 days, 28 days.
8. After curing the specimens are tested for compressive strength and shrinkage
9. Finally the results are computed and analyzed with varying percentages of CRP comparing it with normal mixture of mortar.

IV. OBSERVATIONS

1. In this analysis we are going to study mortar properties in which crushed rock powder is utilized as a replacement for fine aggregate in mortar. Crushed rock powder is replaced at 10%, 20%, 30%, 40% .
2. The study on mortar includes determination of compressive strength at different mortar mixes i.e. 1:4, 1:5.
3. The new alternative material i.e. stone dust is to replace the fine aggregate, such that excess river erosion and harm to environment is prevented.

Physical properties of stone dust

1) Sieve Analysis

Weight of Sample :- 1000gm

IS Sieve (mm)	Weight Retained(gm)	Percentage Retained (%)	Cumulative Percentage Retained (%)	Percentage Passing (%)	Permissible Limit
4.75	0	0	0	100	90-100
2.36	117.2	11.72	11.72	88.28	75-100
1.18	89.8	8.98	20.7	79.30	55-90
600u	335	33.5	54.2	45.80	35-59
300u	345.1	34.51	88.71	11.29	8-30
150u	85.9	8.59	97.3	2.7	0-10
pan					

2) Fineness Modulus

Total Commulative = Percentage Retained / 100

$$= 272.63/100$$

$$=2.73 \%$$

3) Silt Content

$$= 15/528$$

$$=2.84\%$$

4) Bulkage of sand

i) Weight of empty graduated jar (w1) = 224 gm

ii) Weight of graduated jar + sand (w2) = 2200 gm

iii) Weight of sand (w2-w1) = 1976gm

iv) Initial height h1= 690ml

Sr No.	Percentage of water to be added (ml)	Height (h2)	Bulking $= \frac{(h2-h1)}{h2} * 100$
1	19.76	730	5.47
2	19.76	750	8.00
3	19.76	770	10.39
4	19.76	760	9.21

CONCLUSION

1. Quarry dust were studied by researcher Tasnia Hoque, Muhammad HarunurRashid, MD. Rokon Hasan, Ebna Forhad Mondol, indicated that 25% replacement level exhibit higher strength than the controlled sample. This study presents that the compressive strength of mortar is increased when using stone dust as sand replacing material. But the strength get decreased by the replacement of cement.
2. Quarry dust at 25% replacement increases compressive strength but exceed than 35% replacement decreases strength. the flexural strength of concrete mix also decreases with increase in dust percentage replacement.
3. Compressive strength is increasing in addition of stone dust and by use of metakaolin.
4. The partial replacement of sand in mortar with different proportion and with different water cement ratio proves that The overall strength of mortar linearly increases
5. Concrete does not give adequate workability with increase of quarry dust. It can be due to the extra fineness of quarry dust (Jain et.al., 1999). Increased fineness require greater amount of water for the mix ingredients to get closer packing, results in decreased workability of the mix
6. It is found that the compressive, flexural strength and Durability Studies of concrete made of Quarry Rock Dust are nearly 10% more than the conventional concrete
7. The stone dust as replacement for natural sand enhances the strength of concrete mix. The rough profile of stone dust provides good interlocking and bond between ultra fine particles of cement paste. The concrete is less permeable and durable than conventional concrete with river sand. The compressive strength increased significantly up to about 20 percent for concrete with crusher dust compared to conventional concrete

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