iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** X **Month of publication:** October 2022

DOI: https://doi.org/10.22214/ijraset.2022.47144

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue X Oct 2022- Available at www.ijraset.com

Experimental Study on Partial Replacement of Natural Coarse Aggregate with Marble Waste Aggregate in Concrete

Rohit Jeengar
M.Tech Scholar, Department of Civil Engineering, Mewar University

Abstract: ***Marble waste is produced from marble industries as a result of production. More production equals more waste, more waste creates environmental contamination. A high volume of marble production has generated a considerable amount of waste materials; almost 70% of the minerals gets wasted in the mining, processing and polishing stages which have a serious impact on the environment. Also, a large amount of marble is accumulating in the environment due to demolition of old structures having marble. This causes environmental pollution. An economically viable solution to this problem should include utilization of these waste materials for new products especially in construction applications which in turn minimizes the heavy burden on the nation's landfills, saves natural resources, energy and reduces environmental pollution. Present study work is concerned with studying the feasibility of partial replacement of coarse aggregates with marble waste. Varying percentages of replacement is considered 0%, 10%, 20%, 30%, 40% and 50% by natural aggregate, From the results of current experimental study, it is concluded that Compressive strength of the concrete cubes at 7 and 28 days shows 29.87 and 41.89 N/mm2 till 40% marble waste coarse aggregate used as replacement of coarse aggregate in concrete. Hence the marble waste coarse aggregates can be used in concrete works up to as 40 % replacement.***

Keywords: Sustainable Concrete, Marble Waste Aggregate (WMA), Compressive Strength, Workability, Waste Utilization, Eco Friendly etc,

I. INTRODUCTION

The stone has played significant role in human endeavours since earliest recorded history. Marble ranks the largest produced natural stone in the world and it accounts for 50% of the world's natural stone production. Approx. 85% of production of marble in India is from Rajasthan state. The marble mining industry has come up significantly in recent past. Rajasthan has around 4000 marble mines and about 1100 marble gang saws (processing plants). The industry involves mines, processing plants, cutters for the production of tiles for walls and floors, household articles.

The industries produce a lot of waste of marble in the form of powder/slurry and pieces of irregular size of stones. The waste generated during the quarrying operations is mainly in the form of rock fragments. The stones obtained from the quarries are usually dumped in empty pits in the forest area; thereby creating huge amounts of waste. There is absolutely no method of systematic disposal of waste in the quarrying areas.

The waste & overburden is dumped on forestland, Roads, riverbeds, pasture lands & agricultural fields leading to widespread environmental degradation. There is no segregation of the overburden from the stones thereby causing a loss of fertile top soil. The quarry operations express their inability in proper segregation and disposal of waste.

Marble waste is produced from marble industries as a result of production. More production equals more waste, more waste creates environmental contamination. A high volume of marble production has generated a considerable amount of waste materials; almost 70% of the minerals gets wasted in the mining, processing and polishing stages which have a serious impact on the environment. Also, a large amount of marble is accumulating in the environment due to demolition of old structures having marble. This causes environmental pollution.

An economically viable solution to this problem should include utilization of these waste materials for new products especially in construction applications which in turn minimizes the heavy burden on the nation's landfills, saves natural resources, energy and reduces environmental pollution. If the waste product of one industry is recycled as a substitute for the raw material of another industry, it will thereby reduce the environmental impact of both.

Fig No 1.1: Marble Waste Coarse Aggregate

II. LITERATURE REVIEW

Kore Sudarshan Dattatraya (2016) In this work, the impact of marble waste as a partial replacement for conventional coarse aggregate on the properties of concrete mixes such as workability, compressive strength, permeability, abrasion, etc. was evaluated. Coarse aggregate (75% by weight) was replaced by aggregate obtained from marble mining waste. The test results revealed that the compressive strength was comparable to that of control concrete. Other properties such as workability of concrete increased, water absorption reduced by 17%, and resistance to abrasion was marginally increased by 2% as compared to that of control concrete.

Jay P. Chotaliya et al. (2015) The objective of this study is to provide a more scientific evidence to support the reuse of accumulated marbles waste in India by investigating into the following hardened properties of concrete with waste marble chips - compressive strength, split tensile strength and flexure strength. These properties were studied by casting cube specimens, cylindrical specimens and beam specimens. Waste marble chips are fully replaced with natural coarse aggregate. The water cement ratio used was 0.45% by weight.

Shubham Sahu, et al (2021) has studied waste marble aggregate has been used as a replacement material of natural coarse aggregate in M20 grade concrete. The objective of this study is to make a comparison of compressive strength between 0% replacement concrete i.e. plain concrete and waste marble used concrete with different percentage of replacement. These plain and replaced concrete specimens were tested under the compressive axial load monotonically. Results of research work have shown that 10% replaced waste marble concrete gives the same strength as plain concrete strength. Waste marble used concrete is a cost-effective material than other replacing material.

III. METHODOLOGY AND WATER QUALITY PARAMETERS

In Present study materials are used in the preparation of concrete are cement (OPC 43), sand, coarse aggregates, Marble waste Aggregate, and water.

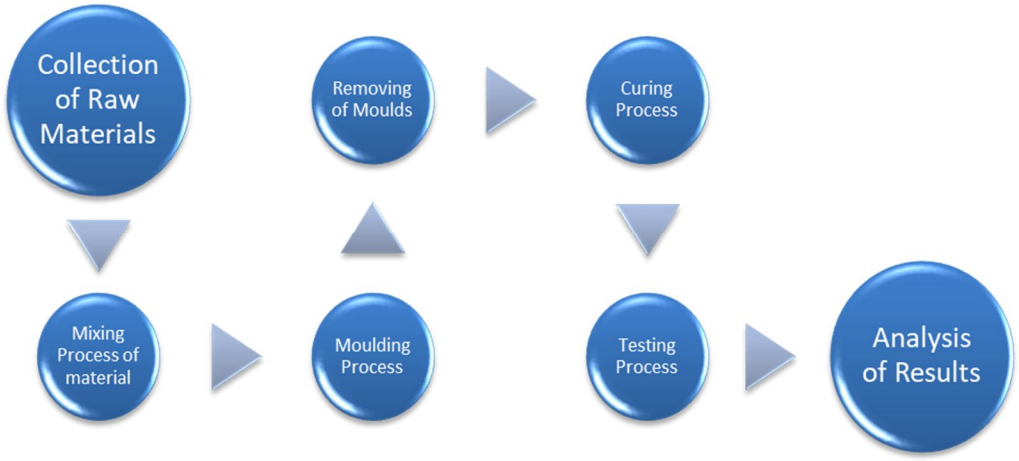


Fig No 3.0:- Flow Chart of Research Methodology

1) Step I: Collection of material: Cement (OPC 43 Grade), Coarse aggregates, Crushed Marble waste aggregates, sand, water etc. Different sieve sample of coarse aggregate, marble waste aggregate should be taken. The aggregate size should be in between 10mm to 20mm.

2) *Step II:* Weighing and Mixing Process: M35 (1:0.5:1) mix design should be used. Material is weighed in a proper way and as required and after than mixed in proper way and by design mix method. Mixing should be done either with the help of concrete mixer or by hand mixing.
3) *Step III:* Moulding process: Moulding Process consists of moulds of cube sized 150x150x150 mm3. Totally 12 cubes are molded, in which 6 cubes are tested after 7 days, and 6 are tested after 28 days. Concrete is thoroughly mixed by hand and slump test and compaction factor test is conducted and it is placed in cubes. Before placing of concrete in cubes, it is very important of oiling of cubes internally. Concrete is well compacted by temping rod and by vibrator for the removal of air voids after placing of concrete in cubes
4) *Step IV:* Removing of mould: After 24 hours of placing of concrete, molds are removed. After demolding, each cube is marked by waterproof marker on the top of the concrete cube for the identification.
5) *Step V:* Curing process: Curing plays an important role in gaining strength of concrete. Concrete cubes are cured for 7 days, 14 days and 28 days in water at room temperature (in water tank). If the concrete cubes are not cured well, it will not gain strength.
6) *Step VI:* Testing process: After removing of mould, concrete cubes are tested in laboratory.
7) *Step VII:* Analysis of Test results: After various test on cube, results are calculated.

IV. RESULT AND DISCUSSION

WORKABILITY OF FRESH CONCRETE

A. *Compaction Factor Test*

The compaction factor test is carried out to measure the degree of workability of fresh concrete with regard to the internal energy required for compacting concrete thoroughly. The compacting factor test is used to find out the low workability of concrete In this work M35 (1:0.5:1) concrete mix was used. The cement used is OPC grade 43. The concrete mix is prepared by replacing the natural coarse aggregate by marble waste aggregate in different percentage 0%, 10%, 20%, 30%, 40%, and 50%.

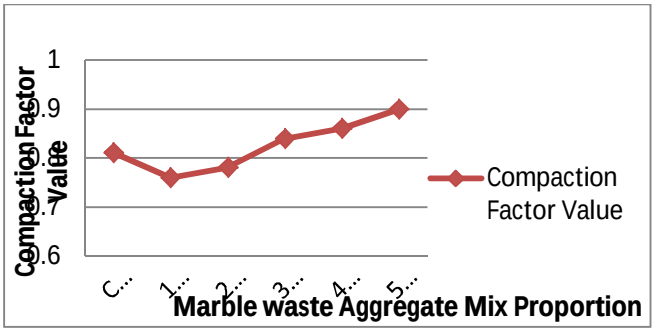


Figure No 4.1.1:- Graphical Arrangement of Compaction Factor Value of Fresh Concrete

B. *Slump Test result*

Concrete slump test is to determine the workability or consistency of concrete mix. In this test OPC 43 and concrete mix of M35 was used. The concrete mix is prepared by replacing the natural coarse aggregate by waste marble aggregate in different proportions 0%, 10%, 20%, 30%, 40%, and 50% of marble waste.

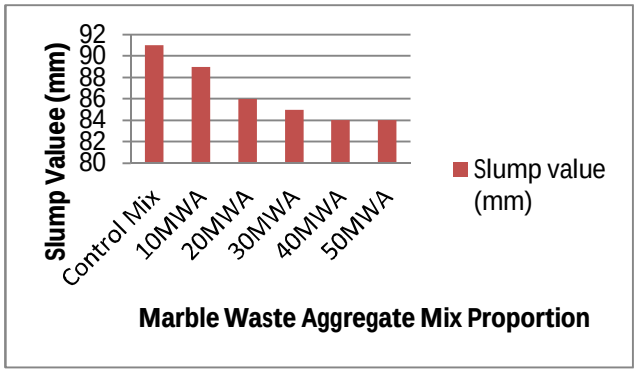


Figure No 4.2:- Graphical Arrangement of Slump Value of fresh concrete

C. Compressive Strength of Concrete

The cube specimens were tested in the compression testing machine with the capacity of 200 tonnes. The upper / bearing surface of the machine is cleaned and kept free from the other loose particles and the; load is applied constantly at increased rate until the specimen got broken. For compressive test specimen were prepared of grade M35 also cured in water tank for 7 and 28 days with marble waste aggregate mix 0%, 10%, 20%, 30%, 40%, and 50% respectively.

Calculations: Compressive strength = Maximum load/ Area = P/A

Figure No 4.3:- Concrete Cube under UTM

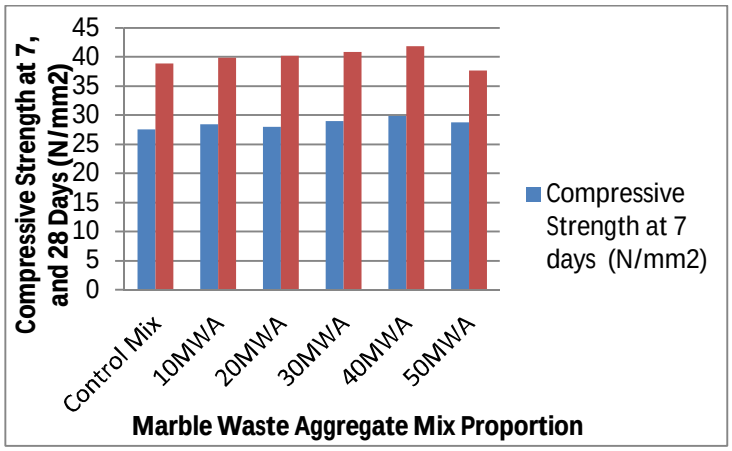


Figure No 4.3:- Graphical Arrangement of Comparison of Compressive Strength at 7 and 28 Days (N/mm2)

V. CONCLUSION

In this research work the partial replacement of coarse aggregate by marble waste coarse aggregate in the M35 grade concrete in the order of 0%, 10%, 20%, 30%, 40%, and 50%, leads to the choice of replacement of 40% waste marble aggregate in concrete because of good result. The compressive strength graph shows that as the marble aggregate content increases the compressive strength at 7 and 28 days also increases upto 40% and above 40% it decreases.

It is suggested that the use of 40% waste marble aggregate in concrete is sufficient and safe to use M35 grade of concrete.

The experimental studies are based on the results obtained from the conclusions are as follows:

1) In present experimental investigation conducted on optimum w marble waste coarse aggregate replacement with natural coarse aggregate. The marble waste is disposed to open land area, it make land pollution and environmental pollution. In road construction it can use as substitute of coarse aggregate, and give enough strength to concrete.

2) From the result, we can see that the workability of all the concrete mixes containing marble aggregate increased as the percentage level of replacement of natural aggregate by marble aggregate is increased.

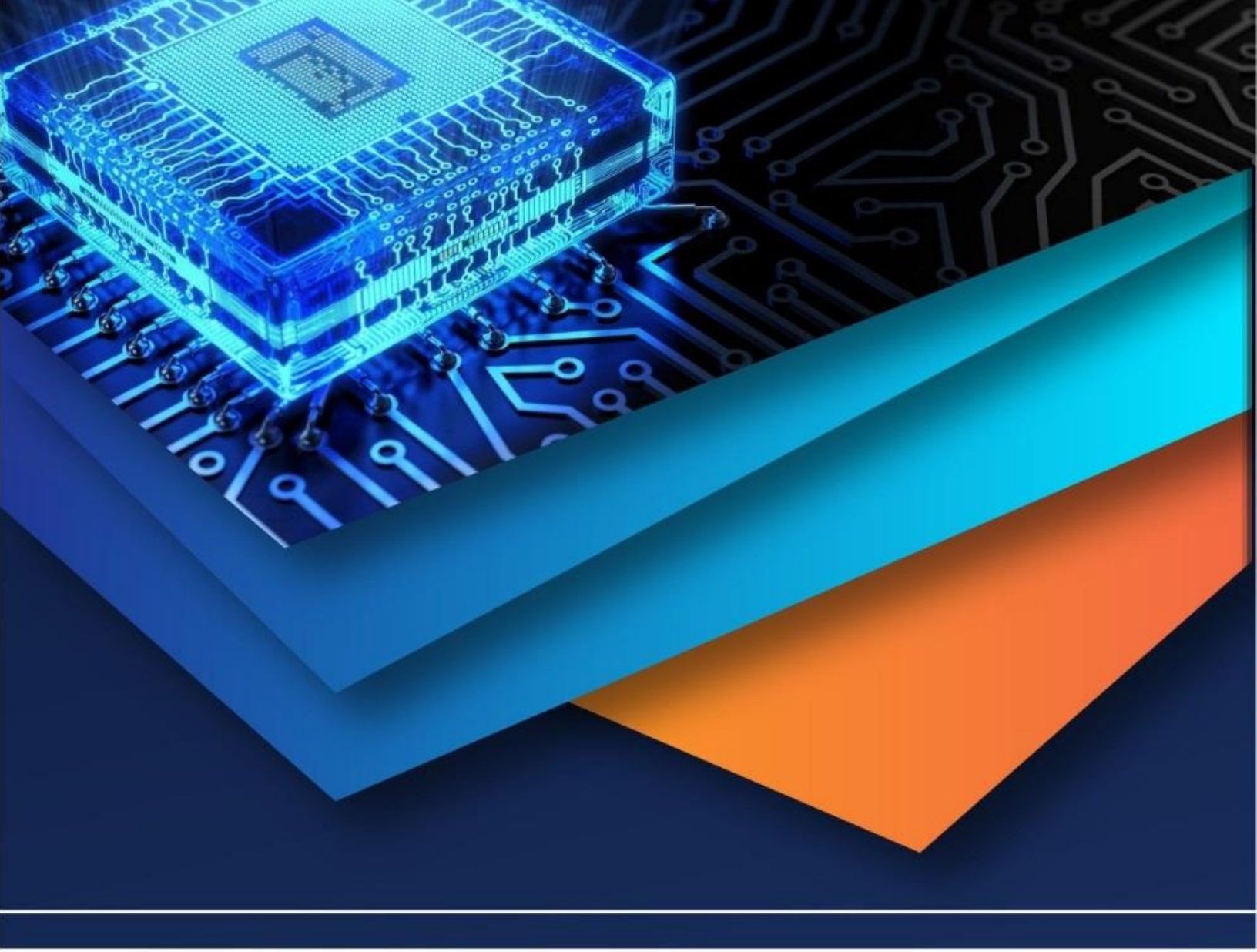
3) Compressive strength of the concrete cubes at 7 and 28 days shows 29.87 and 41.89 N/mm2 till 40% marble waste coarse aggregate used as replacement of coarse aggregate in concrete.

4) Hence the waste marble waste coarse aggregates can be used in concrete works upto replacement as 40%.

REFERENCES

[1] Binici H, Kaplan H, Yılmaz S. Influence of marble and limestone dusts as additives on some mechanical properties of concrete. Sci Res 2007;Essay 9:372–9.
[2] Binici H, Shah T, Aksogan O, Kaplan H. Durability of concrete made with granite and marble as recycle aggregates. J Mater Process Technol 2008;208:299–308.
[3] Corinaldesi V, Giacomo Moriconi G, Tarun RN. Characterization of marble powder for its use in mortar and concrete. Construct Build Mater 2010;24:113–7.
[4] Saboya F, Xavier GC, Alexandre J. The use of the powder marble by-product to enhance the properties of brick ceramic. Construct Build Mater 2007;21:1950–60.
[5] Akbulut H, Gürer C. Use of aggregates produced from marble quarry waste in asphalt pavements. Build Environ 2007;42:1921–30.
[6] Belachia M, Aoun H, Hebhoub H. Marble wastes as a substitute in hydraulic concrete. In: The twentieth international conference on solid waste technology, USA. Proceeding published by Widener University School of Engineering; 2006. p. 456–63.
[7] Belachia M, Aoun H, Bensebti S, Hebhoub H. Use of marble waste in the composition of hydraulic concretes. In: Seventh international congress concrete: construction's sustainable, option: role for concrete in global development, UK; 2008. p. 491–8.
[8] Dupain R, Lanchon R, Saint-Arroman JC. Granulats, sols, ciments et bétons: Caractérisation des matériaux de génie civil par les essais de laboratoire. Ed. Paris: Casteilla; 2000.
[9] Pereira CG, Castro-Gomes J, Pereira de Oliveira L. Influence of natural coarse aggregate size, mineralogy and water content on the permeability of structural concrete. Construct Build Mater 2009;23:602–8.
[10] Binici H, Shah T, Aksogan O and Kaplan H. - Durability of concrete made with granite and marble as recycle aggregates. Journal of Materials Processing Technology. 2008; 208(1-3):299-308. http://dx.doi.org/10.1016/j.jmatprotec.2007.12.120.7.
[11] Akbulut H and Gürer C. - Use of aggregates produced from marble quarry waste in asphalt pavements. Building and Environment. 2007; 42(5):1921-1930.
[12] Zorluer I. Stabilization of soils by waste marble dust. In: Proceedings of the Fourth National Marble Symposium; 2003; Afyonkarahisar, Turkish; 2003. p. 297-305.9.
[13] Cetin A. Assessment of industrial wastes in asphalt concrete pavement mixtures. [Tese]. Eskisehir: Department of Civil Engineering, Natural Science Institute, Anadolu University; 1997.10.
[14] Terzi S and Karasahin M. - Use of marble dust in the hot mix asphalt as a filler material. Journal of Technology Chamber Civil Engineering. 2003; 14:2903-3022.11. Faury J. Le béton. Paris: Dunod; Troisième Édition; 1958.12.
[15] André A, Brito J, Rosa A and Pedro D. - Durability performance of concrete incorporating coarse aggregates from the marble industry waste. Journal of Cleaner Production. 2014; 65:389-396.
[16] Rodrigues F, Evangelista L and Brito J. A new method to determine the density and water absorption of fine recycled aggregates. Materials Research Journal. 2013; 16(5):1045-1051.
[17] Gomes M and Brito J. - Structural concrete with incorporation of coarse recycled concrete and ceramic aggregates: Durability performance. Materials and Structures. 2009; 42(5):663-675.
[18] Fonseca N, Brito J and Evangelista L. - The influence of curing conditions on the mechanical performance of concrete made with recycled concrete waste. Cement and Concrete Composites. 2011; 33(6):637-643.
[19] Barbudo A, Brito J, Evangelista L, Bravo M and Agrela F. - Influence of water-reducing admixtures on the mechanical performance of recycled concrete. Journal of Cleaner Production. 2013; 59:93-98.
[20] Matias D, Brito J, Rosa A and Pedro D. Mechanical properties of concrete produced with recycled coarse aggregates - Influence of the use of superplasticizers. Construction & Building Materials. 2013; 44:101-109.
[21] Brito J, Pereira AS and Correia J. - Mechanical behaviour of non-structural concrete made with recycled ceramic aggregates. Cement and Concrete Composites. 2005; 27(4):429-433.
[22] Evangelista L and Brito J. - Mechanical behaviour of concrete made with fine recycled concrete aggregates. Cement and Concrete Composites. 2007; 29(5):397-401.
[23] Ferreira L, Brito J and Barra M. - Influence of the pre-saturation of recycled coarse concrete aggregates on concrete properties. Magazine of Concrete Research. 2011; 63(8):617-627.
[24] Valadares F, Bravo M and Brito J. - Concrete with used tire rubber aggregates: Mechanical performance. ACI Materials Journal. 2012; 109(3):283-292.23.
[25] Ferreira L, Brito J and Saikia N. - Influence of curing conditions on the mechanical performance of concrete containing recycled plastic aggregate. Construction & Building Materials. 2012; 36:196-204.
[26] Serpa D, Brito J and Pontes J. - Concrete made with recycled glass aggregates: Mechanical performance. ACI Materials Journal. 2012.
[27] Hyungu Jeong (2011). Processing and properties of recycled aggregate concrete, University of Illinois at Urbana-Champaign, 2011.
[28] S.A Abukersh (2011). Recycled aggregate concrete produced with red granite dust as a partial cement replacement, in Construction and Building Materials 25(10):4088-4094 • October 2011
[29] Shi Cong Kou, Chi Sun Poon, Miren Etxeberria(2011). Influence of Recycled aggregates on long term mechanical properties and pore size distribution of concrete in Cement and Concrete Composites 33(2011) 286-291.
[30] M. Shahul Hameed, A.S.S. Sekar, L. Balamurugan, V. Saraswathy(2012). Self-compacting concrete using Marble Sludge Powder and Crushed Rock Dust, KSCE Journal of Civil engineering ,September 2012,
[31] Ankit Nileshchandra Patel, Jayeshkumar Pitroda (2013). Stone Waste: Effective Replacement Of Cement For Establishing Green Concrete International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-2, Issue-5, April 2013
[32] Abd Elmoaty Mohamed Abd Elmoaty(2013). Mechanical properties and corrosion resistance of concrete modified with granite dust in Construction and Building Materials 47(2013) 743-752.
[33] M.Surya, Kantal Rao, P.Laxmy(2013). Recycled Aggregate Concrete for Transportation Infrastructure, 2nd Conference of Transportation Research Group of India (2nd CTRG). 2013-12-2, Volume: 104,Issue Number: 0,Publisher: Elsevier Science,ISSN: 1877-042

[34] Noha M. SolimanÀ (2013). Effect of using Marble Powder in Concrete Mixes on the Behavior and Strength of R.C. Slabs International Journal of Current Engineering and Technology ISSN 2277 – 4106, Vol.3, No.5 (December 2013)
[35] Antonious Kanellopoulos, Demetrios Nicolaides b, Michael F. Petrou(2014). Mechanical and durability properties of concrete containing Recycled lime powder and Recycled Aggregates in Construction and Building Materials 53(2014) 253-259.
[36] Bureau of Indian Standards (BIS), Indian Standard Concrete Mix Proportioning & Guidelines. IS 10262, BIS, 2009.
[37] DIN 1048, EN-Testing Concrete: Determination of Depth of Penetration of Water under Pressure in Hardened Concrete, DIN, 2016.
[38] H. Hebhoub, H. Aoun, M. Belachia, H. Houari, E. Ghorbel, Use of waste marble aggregates in concrete, Constr. Build. Mater. 25 (2011) 1167–1171.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY