Assessment of Basaltic Aggregate and Stone Chips In Indian Context

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ABSTRACT –***The producing useful shape of stone the various stone wastes are coming out from the various processes in stone industries. From the preliminary waste named as stone chips, due to minimum cost it is taken out to replace the natural basaltic coarse aggregate utilization in concrete. In current time natural basaltic aggregate are using and as it is costly so it's require to replace by stone waste such as stone chips conserves basaltic aggregate reduces the impact on landfills and for sustainable development. Decreases energy consumption and can provide cost savings also. Stone waste as aggregates are the materials for the future. This research paper reports the basic properties of stone chips aggregates. It also compares these properties with natural basaltic aggregates. Basic changes in both type of aggregate properties were determined by various test as per require IS code, thus, it is a suitable to use Stone Chips as coarse aggregate or partial replacement with natural Basaltic coarse Aggregate.***

Keywords : Stone Chips(kotastone/ Granite/ Marble) , Natural Basaltic Aggregate, Properties

INTRODUCTION

Today, there are critical shortages of natural resources in present scenario. Production of concrete and utilizationof concrete has rapidly increased, which results in increased consumption of natural aggregate as the largest concrete component. A possible solution of these problems is to use of waste of stone industry produce an alternative aggregate for structural concrete in this way stone chips produced by two stages cutting of stone waste in suitable size and decreases energy consumption and can provide cost savings.

Stone wastecan be easily available from stone industries and this stone waste can be crushed and get predominant size by suitable IS sieve analysis after hammering or in available crushing machine and this graded cutting waste called stone chips. Figure 1 shows the Stone waste converted into stone chips.

Figure 1: Stone waste converted into stone chips

Stone chips were got from three different types of stone waste such as KotaStone, Marble and Granite in this experimental investigation.Mixture of Kotastone, Marble and Granite wastage had been taken and separate by sieve analysis and get predominant size.

Concrete is the most used construction material across the world and in concrete maximum part is coarse aggregate. Hence, if stone chips used as at least partial replace with coarse aggregate than it will reduce cost of concrete production.Stone chips are needed from the view of point of experimental preservation and effective utilization of resources.However, information about stone chips using in concrete as coarse aggregate with partial replace with basaltic aggregate is still insufficient so it will be an advisable to get more detail about the characteristics of concrete using stone chips.

PROPERTIES OF AGGREGATE:

There are various properties of aggregate which have to check before use in concrete Such as Basic properties- Specific gravity, water absorption, and mechanical properties like crushing value, Impact value, etc. must be determine before use in concrete,

these all properties directly effect on design and behaviour of concrete.

For the possibilities to use of stone chips as coarse aggregate in concrete with replace of basaltic aggregate than it should require to determine all test according to IS code and compare with Basaltic aggregate properties by such a these type of primary test.

Figure 2: Test required for aggregate

From the result of these tests it can be conclude that, stone chips will permissible to use in concrete, here the sample of stone chips including Kota stone, Marble & Granite. So these Stone chips can be used as coarse aggregate with partial replacement of basaltic replacement.

These entire as above test were done in BVM engineering collage, Vallabh Vidyanagar, Gujarat with basaltic rock and this stone chips sample which consist Kota stone, Marble, Granite.

TEST OF PROPERTIES & MATHODOLOGY

1. SIEVE ANALYSIS FOR GRADING OF COARSE AGGREGATES[IS 2368– (PART – I) 1963]

Pile-up the bulk sample received in conical form till cone flattens. Obtain the sample for screening by method of quartering so that suitable weight for sample testing is available. Air dries the sample at room temperature or by heating at 100˚C –110˚C. Weigh the air dried sample.Place the set of sieves in descending order of their sizes on pan.Place the sample in top coarse sieve and fit the lid.Shake whole assembly in all directions for not less than 2 minutes by hand movements/on shaking platform.Remove the lid and weigh the residue carefully retained on each sieve. Tabulate the results on performance.And decide grade of aggregate from Table No 2, IS 383-1970

2. FINE NESS MODULUS:

Take 1 kg. of aggregate from laboratory sample of 10 kg.Arrange the sieve in order of the size numbers.Fix them in sieve shaker with the pan at the bottom and coffer at top, find out the weight of each sieve.After this process calculate total of all % weight of retained on particular sieve and divide by 100.Hence, value ofFineness Modulus which unit is in number. Which shows the number of sieve from bottom to top and that sieve size is the maximum size of the aggregate.

3. SPECIFIC GRAVITY OF AGGREGATES[IS: 2386 – (PART – III) 1963]

Wash thoroughly two kg. of aggregate sample to remove fines, drain and then place in wire basket and immerse in water at a temperature between 22˚C to 30˚C with a cover of at least 5 cm. of water above the top of basket.Immediately after immersion, remove the entrapped air from the sample by lifting the basket containing it, 25 mm above the base of tank and allowing it to drop 25 times at about 1 drop per second.Keep the basket and aggregate completely immersed in water for a period of 2 hours afterwards.Weigh the basket and sample while suspended in water (A-1)Remove the basket and aggregate from water. Allow to drain for few minutes after which gently empty the aggregate from the basket on dry cloth. Return the empty basket to the water and weigh in water (A-2)Place the aggregate on the dry cloth and gently surface dry with the cloth and transfer it to the second dry cloth, when the first will remove no further moisture. Weigh the surface dried aggregate.(B)Place the aggregate in a shallow tray and keep it in oven for 24 hours at a temperature of 100˚C to 110˚C. Remove it from oven, cool in an air tight container and weigh **(C).**Calculate the Specific Gravity By = C/ (B-A)

Where, A=A1-A2

4. WATER ABSORPTION OF AGGREGATE[IS: 2386 – (PART – III) 1963]

Wash thoroughly @ two kg. of aggregate sample to remove fines, drain and then place in wire basket and immerse in water at a temperature between 22˚C to 30˚C with a cover of at least 5 cm. of water above the top of basket.Immediately after immersion, remove the entrapped air from the sample by lifting the basket containing it, 25 mm above the base of tank and allowing it to drop 25 times at about 1 drop per second.Keep the basket and aggregate completely immersed in water for a period of 2 hours afterwards.Weigh the basket and sample while suspended in water (A-1)Remove the basket and aggregate from water. Allow to drain for few minutes after which gently empty the aggregate from the basket on dry cloth. Return the empty basket to the water and weigh in water (A-2)Place the aggregate on the dry cloth and gently surface dry with the cloth and transfer it to the second dry cloth, when the first will remove no further moisture. Weigh the surface dried aggregate.(B)Place the aggregate in a shallow tray and keep it in oven for 24 hours at a temperature of 100˚C to 110˚C, remove it from oven, cool in an air tight container and weigh **(C).**Calculate water absorption =[100-(B-C)]/C

5. FLAKINESS AND ELONGATION INDEX OF COARSE AGGREGATE: [IS: 2368 part-1-1963]

FLAKINESS INDEX:

Take sufficient quantity of aggregate to provide at least 200 pieces of any fraction to be tested.Sieve the sample through sieve as shown in observation Tables.Separate particles retained on the prescribed the sieveTry to pass each particle through the corresponding slot of thickness gauge. The aggregate piece passing through 50 mm and retain on 40 mm should be pass from ((50 +40)/2)*0.6) =27 mm slot. If the aggregates passed through this slot than it considered as flaky. Weigh all the pieces, which pass through this slot. Calculate the flakiness index as ratio of the weight of the material passing through the thickness gauge to total weight of the sample. This ratio is to be multiplied 100 to convert in %

ELONGATION INDEX:

Sieve the sample through IS Sieve as specified In Observation table.Separate the aggregate pieces retained on sieves.Try to pass each aggregate piece through the corresponding slot of length gauge, if the length gauge. If length of the particle is ((50 +40)/2)*1.8) =81 mm, it is said to have retained on length gauge Weight all such piecesCalculate elongation Index as ratio of the weight of the material retain by the length gauge to total weight of the sample the ratio is to be multiplied by 100 to convert in %This elongation And Flaky particle should not be more than 40-45%

6. IMPACT VALUE OF AGGREGATE:[IS: 2386 part-4-1963]

Obtain sample which shall pass wholly through 12.5 mm I.S. Sieve, and retained on 10 mm sieve.Dry sample in an oven for a period of 4 hours at a temperature of 100˚C to 110˚C and allow cooling to room-temperatureFill the cylindrical metal in three equal layers, each layer being given 25 uniformly distributed strokes of the rounded end of the tamping rod.Weigh the aggregate in the measure to the nearest gram **(A).**Fix the cup firmly in position on the base of impact machine, place whole of the test sample in it and compact by single tamping of 25 strokes of the tamping rod.Allow the hammer of Impact machine to fall freely of aggregate. The test sample shall be subjected to total of 15 such blows, each being delivered at an interval of not less than one second.Remove the crushed aggregate from the cup, and sieve on the 2.36 mm IS sieve. Weigh the fraction passing to an accuracy of 0.1 gm. **(B)**Calculate Impact value = B/A *100<10% exceptionally strong 10-20% Strong 20-30% Satisfactory for road surfacing > 35% Weak for road surfacing. AS per IS: 383-1970. Cl. 3.4 -45% for concrete & 30% for wearing surface

7. CRUSHING VALUE OF COARSE AGRGREGATE:[IS: 2386 part-4-1963]

Sieve the aggregate for collecting appropriate sized sample for testing.Dry the sample for 24 hours in an oven at 100˚C to 110˚C temp. And put in desiccator in air tight tins and allow it to cool.Weigh the material **(A)**Place cylinder on level base plateFill the material to depth of 70 mm in the cylinder and tamp with tamping rod. Repeat by adding layers till depth of material in cylinder is at 200 mm; the top of plunger flange coinciding exactly with top of cylinder. Weigh the materials left over if any **(B).** Weight of sample = **(A-B)**Place apparatus in compression testing machine and apply load of 160 M.T. uniformly and gradually reaching maximum in 10 minutes. Release head, remove the apparatus and carefully remove whole of materials to be sieved through 10 mm sieve. Weigh the fraction passing through sieve **(C)** Repeat using same

weight of sample **(A-B)**Crushing Value = B/A *100As per IS: 383-1970. Cl. 3.3 -45% for concrete & 30% for wearing surface

8. **ABRASION TEST OF AGGREGATE:[IS 2386 (Part-IV) –1963]**

Sieve the aggregate for collecting appropriate sized sample for testing.Dry the sample for 24 hours in an oven at 100˚C to 100˚C temp. And put in desiccator in air tight tins and allow it to cool.Place pre-weighed **(W1)** test materials and abrasive charge in testing machine. Rotate machine at speed of 20 to 33 Revolutions /minute for 500 revolutions.After completing rotation, discharge the sample completely and sieve it on 1.70 mm sieve for preliminary separation. Sieve the finer portion later on through 1.70 mm, 1.18 m, 850 & 600 micron sieves as mentioned for crushing test.Wash coarser material > 1.70 mm, dry in oven at 105˚ C to 110˚C to constant weight and weigh accurately **(W2)**Calculate (W1-W2)/W1*100As per IS: 383-1970. Cl. 3.4,45% for concrete & 30% for wearing surface.

The result of Basaltic Aggregate and Stone Chips Aggregate are shown in Table 1. and representing graph Figure 3 to Figure 10.

TABLE NO. 1
PROPERTIES TEST RESULT OF BASALTIC AGGREGATES AND STONE CHIPS AGGREGATE

Sr. No.	Name of Test	Basaltic aggregate	Stone Chips aggregate	IS code	Permissible limit
1	Sieve analysis for Grading	Grade II	Grade II	IS:2386 part-I-1963	See IS:383-1970 Table 2
2	Fineness modulus	7.71	8.0	-	6.5-8.0
3	Specific Gravity	2.87	2.85	IS:2386 part-3-1963	2.5 to 3.0 Average value about 2.60
4	Water Absorption	0.5%	0.53%	IS:2386 part-3-1963	0.5% to 0.6%
5	Flakiness & Elongation	31.87 % 18.85 %	15.93% 19.92%	IS:2386 part-I-1963	Combine value not less than 40-45%
6	Impact value	11.47%	16.08%	IS: 2386 part-4-1963	IS: 383-1970 Cl 3.3 -45% for concrete & 30% for wearing surface
7	Crushing value	11.32%	15.38%	IS:2386(part-4)1963	IS: 383-1970 Cl 3.3 -45% for concrete & 30% for wearing surface
8	Abrasion value	11.3%	13.1%	IS:2386(part-4)1963	IS: 383-1970 Cl 3.4 -45% for concrete & 30% for wearing surface

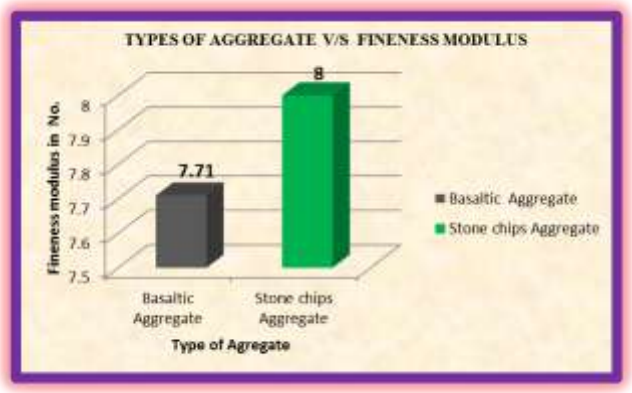

Figure 3: Types of Aggregate v/s Fineness Modulus

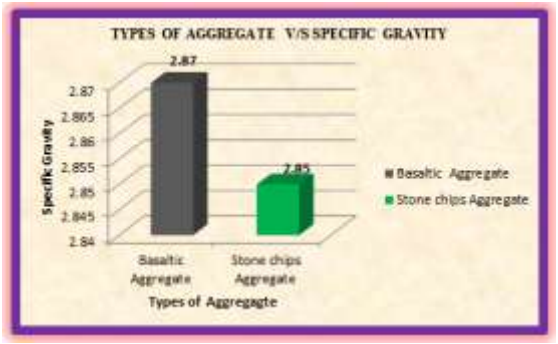

Figure 4: Types of Aggregate v/s Specific Gravity

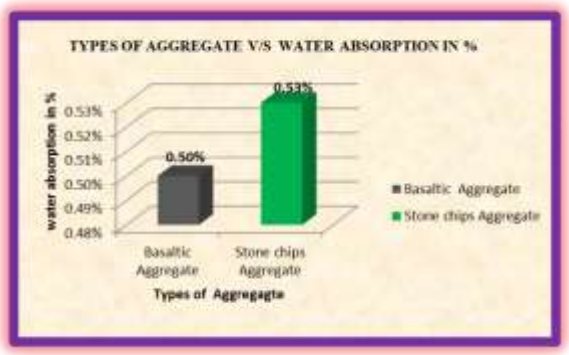

Figure 5: Types of Aggregate v/s Water Absorption in %

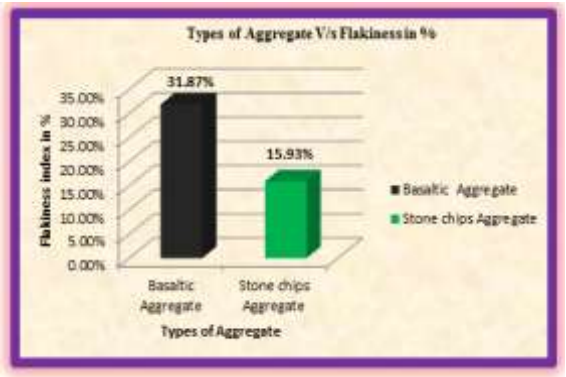

Figure 6: Types of Aggregate v/s Flakiness in %

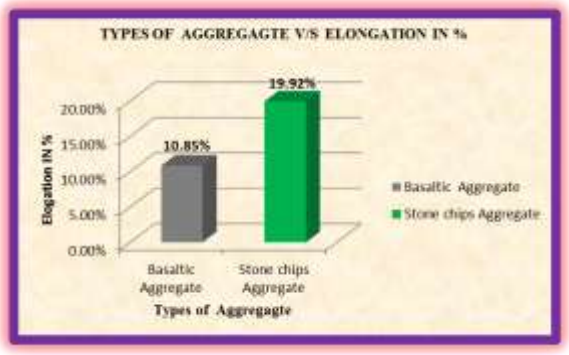

Figure 7: Types of Aggregate v/s Elongation in %

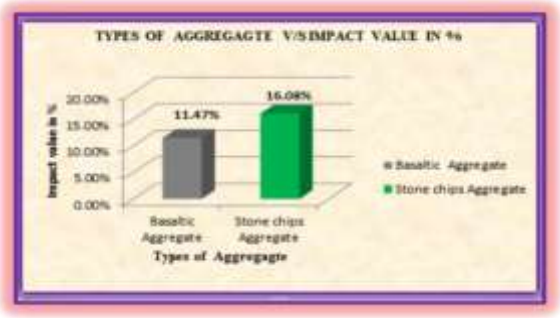

Figure 8: Types of Aggregate v/s Impact value in %

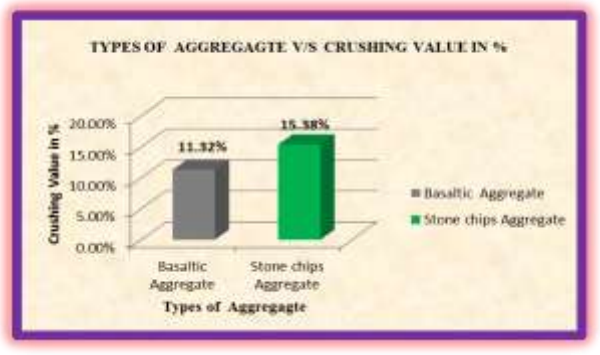

Figure 9: Type of Aggregate v/s Crushing value in%

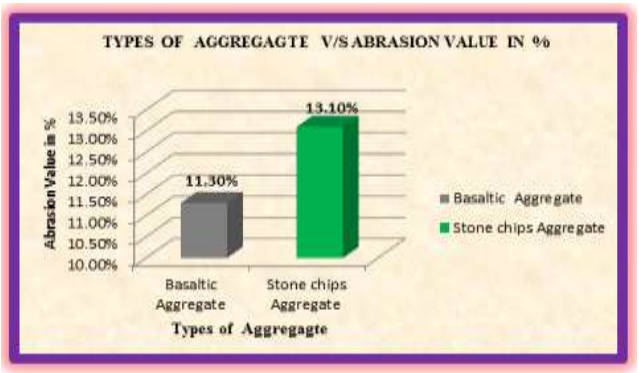

Figure 10: Type of Aggregate v/s Crushing value in%

CONCLUSIONS

Based on limited experiment Investigation of properties of aggregate, following observation can be concludes:

a) Fine ness modulus as per Is code limit is 6.5-8.0 and for Basaltic Aggregate it is 7.71and for stone chips it is 8.0. So stone chips satisfied this value
b) Specific Gravity As per IS code for max 20 mm size of aggregate 2.5-3.0 and for Basaltic Aggregate it is 2.87 and for Stone chips it is 2.85. So stone chips satisfied this value
c) Specific Gravity As per IS code for max 20 mm size of aggregate 2.5-3.0 and for Basaltic Aggregate it is 2.87 and for Stone chips it is 2.85. So stone chips satisfied this value
d) Water absorption and for Basaltic Aggregate it is 0.5 and for Stone chips it is 053. So stone chips nearer about this value
e) Flakiness and Elongation as per IS code 2386-part-1limit is 30%-45% as per and for Basaltic Aggregate it is 40%and for stone chips it is 35.85% .So stone chips satisfied this value
f) Impact value as per IS code 383-1970 limit is 33%-45% and for Basaltic Aggregate it is 11.47% and for stone chips it is 16.08%. So stone chips satisfied this value
g) Crushing value as per Iscode3831970limit is 33%-45%andforBasalticAggregate it is11.32% and for stone chips15.38 %.it is So stone chips satisfied this value

h) Abrasion value as per IS code 383-1970 limit 45%and for Basaltic Aggregate it is 11.30% and for stone chips it is 13.10%. So stone chips satisfied this value

i) Cost of Basaltic Aggregate is 0.65 rupees per kg where cost of Stone Chips is 0.20 rupees per kg so, it is cost saving material and as it is wastage of stone industries used in concrete than it can be saying as green concrete.so for sustainable development this material can be used in concrete.

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REFERENCES

[1] Ammary, B., 2007. Clean cutting stone industry. International Journal of Environment and Waste Management, 1 (2/3): 106-112.

[2] Arslan E. I Il , Aslan Sibel, Ipek Ubeyde, Altun Samet, Yazicio lu Salih, 2005, Physico-chemical treatment of marble processing wastewater and the recycling of its sludge, Waste Management & Research, 23(6): 550-559.

[3] Balasubramanian J., Sabumon C., john U. Lazar ,And ilangovanR.,1995, Reuse of textile effluent treatment plant sludge in buildingmaterials, journal of materials processing technology 48 (1-4) : 379–384.Weng, C., Lin, D. and Chiang, P., 2003. Utilization of sludge as brick materials. Advances in Environmental Research, 7 (3): 679-685

[4] Colangelo F., Marroccoli M., and Cioffi R., Properties of self-leveling concrete made with industrial wastes. Conference on use of building materials in building structures, November,2004, Barcelona , Spain

[5] Colombo A. , Tunesi A., Barberini V., Galimberti L., Cavallo A.,chemical and mineralogical characterization of cutting process sludge ,exploitation of sludge from stone working synthesis of the research,accessed 2008,http://www.aigt.ch/ download/ rapporto_INTERREGen.pdf .

[6] Dr.T.Sekar, N.Ganesan & Dr.NVN.Nampoothiri (2011),"Studies on strength characteristics on utilization of waste materials as coarse aggregate in concrete", International Journal of Engineering Science and Technology,Volume 3 No 7, 2011.

[7] G.Murali, K.R.Jayavelu, N.Jeevitha, M.Rubini and N.R.Saranya "Experimental Investigation On Concrete With Partial Replacement Of Coarse Aggregate" International Journal of Engineering Research and ApplicationsVol. 2, Issue 2,Mar-Apr 2012, pp.314-319.

[8] Hansen, T. C. and Begh, E., 'Elasticity and drying shrinkage of recycled aggregate concrete', Journal of American Concrete Institute, 82

[9] Hasaba, S., Kawamura, M., KazuyukI,T. and Kunio,T., 'Drying shrinkage and durability of concrete made from recycled concrete aggregates', Transactions of Japan Concrete Institute, Tokyo, Vol 3, 1981, pp.55-60.

[10] IS 10262:2009, recommended guidelines for concrete mix Design, BIS. New Delhi, India, 2009.

[11] IS 2386-1963 – PART I- PARTICLE SIZE AND SHAPE

[12] IS 2386-1963 –PART Ill-SPECIFIC GRAVITY, DENSITY, VOIDS'RAIO, ABSORPTlON AND BULKING

[13] IS 456-2000, Plain and Reinforced Concrete -Code of practice (fourth revision, BIS. New Delhi.

[14] IS: 383-1970, Specification for Coarse and Fine Aggregates from natural sources for concrete (Second revision).

[15] K. Muthusamy and N. A. Sabri, "cockle shell: a potential partial coarse aggregate replace ment, International Journal of Science, Environment and Technology, Vol. 1, No 4, 2012, 260 – 267

[16] M.S. Shetty. Concrete Technology, Book

[17] Mamta Rajgor, Jayeshkumar Pitroda, "Stone Sludge: Economical Solution for Manufacturing of Bricks" International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-2, Issue-5, April 2013pp. 648-652, 1985

[18] Tu T, Chen Y, Hwang C (2006). "Properties of HPC with recycled aggregates". Cem. Concr. Res., 36(5): 943–950.

[19] VeeraReddy.M (2010), "Investigations on stone dust and ceramic scrap as aggregate replacement in concrete", International journal of civil and structural engineering Volume 1, No 3,ISSN 0976 – 4399.

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