International Journal of Civil and Structural Engineering Research ISSN 2348-7607 (Online)
Vol. 2, Issue 2, pp: (166-171), Month: October 2014 - March 2015, Available at: www.researchpublish.com

Decorative Concrete Using Recycled Glass Aggregate

[1]Aswathy KM, [2]Prathibha V, [3]Rinu Issac, [4]Rita Rose Jacob

[1234]Under Graduate Students, Mar Athanasius College of Engineering, Kothamangalam, India

Abstract: **The increasing awareness of glass recycling speeds up inspections on the use of waste glass with different forms in various fields. One of its significant contributions is to the construction field where the waste glass was reused for value-added concrete production. By adding glass aggregate we can reduce the waste and lower the construction cost and helping the environment. When adding colour to the concrete, the concrete gets an aesthetic appearance and also further finishing works likes painting can be avoided. Through this project we are aiming to make a garden chair using coloured concrete with glass aggregate.**

Keywords: **Mix design, Recycled glass, Compressive strength, Colour pigment.**

I. INTRODUCTION

Decorative concrete is the use of concrete as not simply a utilitarian medium for construction but as an aesthetic enhancement to a structure, while still serving its function as an integral part of the building itself such as floors, walls, and driveways .The transformation of concrete into decorative concrete is achieved through the use of a variety of materials that may be applied during the pouring process or after the concrete is cured. The increasing awareness of glass recycling speeds up inspections on the use of waste glass with different forms in various fields. One of its significant contributions is to the construction field where the waste glass was reused for value-added concrete production.

II. LITERATURE REVIEW

In more recent years, the use of recycled glass in aggregate is an excellent initiative to promote sustainable practices. Despite some minor difficulties with stockpiling and crushing, the product is a feasible replacement to virgin aggregate at the current specification levels (5%). To date the insitu performance of pavements of moderate traffic volumes where recycled glass base course has been used is identical to the performance of similar pavements where 100% virgin aggregate has been used. The environmental preference of reducing carbon emissions resulting from transporting the glass long distances (eg Nelson to Auckland for recycling, or to increasingly more isolated landfill site's) is clear. However, it is the extension of the life of both landfills and quarries that really make this sustainability initiative worthy of raising one's glass. .

The accurate estimation of mineral pigment contents is very important to reduce the cost of production of the coloured mortars, especially taking into account that small discrete changes in composition do not always produce noticeable colour changes by the human eye.Coloured mortars and concrete have become popular among engineers and architects for such applications as facades, side walks, driveways, floors and other architectural uses. Now a day sand in antiquity, the number of mineral pigments is very high, for example, hematite (reddish, orange, purple, and brown), goethite (yellow), lepidocrocite (brown), calcite (white), dolomite (white),celadonite (green), malachite (green), and quartz (translucent and white). Others pigments have been produced by synthesis in the laboratory: litharge (reddish), massicot (yellow), red lead (orange),\chromium oxide (green), black of coal, and Egyptian blue . One very important aspect is to get permanent colors without producing adverse effects on mortars and concrete. It is imperative that the coloring agents can be used in a confident and safe manner.

Dave Blasdel, owner of Blazes Concrete Impressions, Kalispell, Mont., says that he uses colored glass aggregates for concrete countertop and floor construction. He places them integrally for countertop construction and seeds them for floor work. For seeded work he takes the added step of soaking them over night in polymer to increase the bond to concrete.

Before the placement he removes the glass from the polymer and lets it dry to the point where it still feels a little sticky. He broadcasts the aggregate from planks to achieve the most even broadcast. If he can't do that he places the aggregate every 10 lineal feet during the concrete placement. He typically uses a pea gravel mix when he does glass aggregate work and some of these stones are revealed in the exposing process, adding a nice look to the finish.

Glen Roman, senior technical representative for Brickform, Rancho Cucamonga, Calif., sandblasted a stencil logo graphic for an automobile dealer. The concrete contractor for the project seeded black glass aggregate and finished the slab so that no aggregate showed on the surface. After a month Roman adhered stencil patterns to the concrete and using slag as the blast medium (which hits harder than silica sand), blasted a fairly deep reveal, showing a nice contrast between smooth finished concrete and exposed aggregate. Glass aggregate increasingly is being mixed with epoxy binders for terrazzo floors too.

III. MATERIALS AND METHODS

A. *Testing Of Materials*

Various tests were done for finding the properties of cement and aggregates for mix design of M30. The results are as follows :

Initial setting time of cement	**50 min**
Specific gravity of cement	2.8
Standard consistency of cement	34%
Specific gravity of fine aggregate	2.7
Specific gravity of coarse aggregate	2.75
Aggregate crushing value	26%
Bulking of fine aggregate	28%
Sieve analysis	
Uniformity coefficient of fine aggregate	9
Uniformity coefficient of coarse aggregate	1.4

B. *Mix Design M30*

1. STIPULATIONS FOR PROPORTIONING

a) Grade designation =M30
b) Type of cement =PPC supergrade
c) Maximum nominal size of aggregate=20 mm
d) Minimum cement content =320kg/m^3
e) Maximum water cement ratio=0.45
f) Workability=75 mm (slump)
g) Exposure condition=severe (for reinforced concrete)
h) Degree of supervision=good
i) Chemical admixture type=superplasticizer

2. TEST DATA FOR MATERIALS

a) Specific gravity of cement=2.8
b) Specific gravity of fine aggregate=2.7
c) Specific gravity of coarse aggregate=2.8

d) Sieve analysis-Fine aggregate

Sieve opening (micron)	% passing
4750	97.3
2360	72.9
1180	54.4
600	40
300	20
150	10

e) Sieve analysis - coarse aggregate

Sieve opening (micron)	% passing
25000	100
20000	81.2
12500	8.5
10000	0
4750	0

3. STRENGTH OF MIX PROPORTIONING

$f'_{ck} = f_{ck} + 1.65 \times s$
$= 30 + 1.65 \times 5$
$= 38.25\ N/mm^2$

4. SELECTION OF WATER-CEMENT RATIO

As per IS, maximum water cement=0.45
But adopt 0.39 as maximum water cement ratio
0.39 < 0.45 hence ok.

5. SELECTION OF WATER CONTENT

From table 2, Maximum water content= 186 L
For 75 mm slump= 186+(.03 x 186)=192 L
As superplasticizer is used, water content can be reducedupto 20%.
Amount of water content=192 x 0.8=154 L

6. CALCULATION OF CEMENT CONTENT

Water cement ratio= .39
Cement content= 154/.39 = 395kg/m3
As per IS456 minimum cement content= 320kg/m3
395> 320kg/m3
Hence ok.

7. PROPORTIONS OF VOLUME OF COARSE AGGREGATE AND FINE AGGREGATE

FROM TABLE 3, Volume of coarse aggregate corresponding to 20mm aggregate size (zone1)
For water cement ratio of .5 =.60
As water cement ratio is lower by.11 ,the proportion of volume of coarse aggregate increased by .07

Concrete proportion of volume of coarse aggregate for water cement ratio of .40= .67

8. MIX CALCULATIONS

a) Volume of concrete=1m3
b) Volume of cement=395/(3.95x1000)=.134m3
c) Volume of water=154/1000= .154m3
d) Volume of all in aggregate=1-(.134+.154)=.712m3
e) Mass of coarse aggregate= .712x.67x2.85x1000= 1359.56kg
f) Mass of fine aggregate= .712x(1-.67)x 2.85x1000= 669.6kg

C. *Mix Proportions*

CEMENT	395kg/m3
FINE AGGREGATE	670kg/m3
COARSE AGGREGATE	1369kg/cm3
WATER CEMENTT RATIO	.39
SUPER PLASTICIZERS	20 ml

IV. CASTING OF M30 SPECIMEN BY REPLACING COARSE AGGREGATE BY GLASS

Waste glass was collected from a glass house. The glass was then converted into the required size by broken it manually. The glass pieces which passed through 20mm and retained on 12.5mm were taken for the replacement of coarse aggregate. After that the concrete cubes were cast by replacing coarse aggregate with 10%,15%,20% and 25% glass and after the curing of 28 days tested the concrete cubes and found out their strength.

TEST RESULTS OF M30 CUBES BY REPLACING AGGREGATES

SL NO	% REPLACEMNT	STRENGTH	STRESS (N/MM^2)
1	25	53.5 t	23.7
2	20	51.5 t	22.8
3	15	47 t	20.8
4	10	54.5 t	24.2

V. CASTING OF MORTAR CUBES WITH DIFFERENT COLOUR

Mortar cubes were cast by adding different percentage of different colours as a replacement of cement. The colour pigments used are red , yellow and black. After 7 days curing test the mortar cubes and found out the strength variation.

TEST RESULTS OF MORTAR CUBES

Sl no	% replacement of cement	strength	Stress(N/mm^2)
1	2% yellow	7.1 t	18.2
2	4% yellow	6.4 t	18.8
3	6% yellow	10.5 t	21
4	8% yellow	9.4 t	12.8
5	10% yellow	9.1 t	14.2
6	1% black	5.5 t	11
7	2% black	8.9 t	17.8
8	4% black	6 t	12
9	2% red	6.3 t	12.6

10	4% red	6.4 t	12.8
11	6% red	3.2 t	6.4

The optimum strength obtained at 6% replacement of cement by colour (yellow) and 10% replacement of coarse aggregate by glass from the compression test. A garden chair was constructed using these optimum conditions.

IV. GARDEN CHAIR

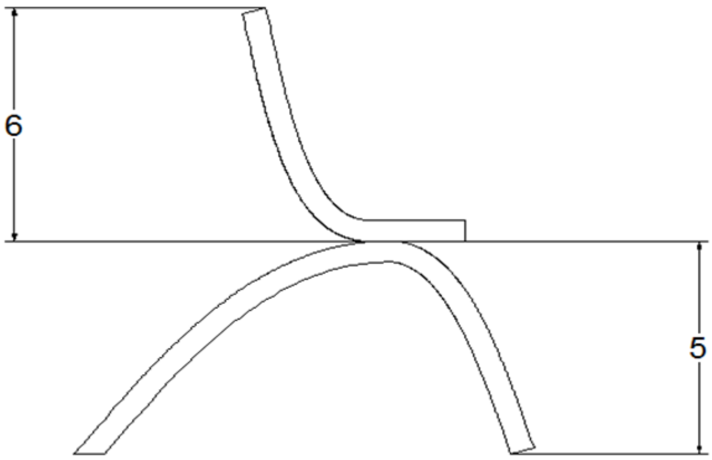
A garden chair is a very demanding garden furniture item in outdoor furniture industry. It is typically made of weather – resistant materials. The most commonly used materials for outdoor furniture are wood, aluminium, metal, stone, plastic, reinforced concrete, self compacting concrete.

An arch behaves much like a hanging cable . Because the cable is unable to resist bending moments and it takes a form that will result purely in tensile forces under an applied load. An efficient arch follows the same principle; inverting this shape to result in pure compression. Unreinforced masonry and concrete are very weak in tension, and therefore are able to withstand only minimal bending moments under loading. A well defined arch will be shaped such that the majority of force is carried by compressive forces in the arch.

VII. MODELLING OF GARDEN CHAIR USING AUTOCAD

The model is drawn according to yhe dimensions fixed on the basis of ergonomic design. The fixed dimensions are:

backrest height = 60 cm
backrest width = 50 cm
seat width = 50 cm
seat length = 50 cm
seat height = 50 cm
thickness = 5 cm



VIII. ANALYSIS OF GARDEN CHAIR

The design of garden chair model was done using ANSYS 14.5 (FEA Software). In recent years advances in technology has allowed finite element analysis t o become an increasingly viable resource , allowing the user to model the structure to a degree not possible with conventional design methods . ANSYS as a finite element software can support a 3D model by viewing the stress and displacement outputs and the structural integrity can be determined . After this the structure can then be altered in a variety of different ways for instance modifying materials properties, thickness and shape.

IX. CONCLUSION

Concrete cubes were cast by replacing coarse aggregate with 10%,15%,20% and 25% of glass and tested the cubes. Also mortar cubes with different percentage of red, yellow and black colours were cast and tested it. The results obtained from testing of concrete and mortar cubes shows that optimum dosage attained at 10% glass aggregate and 6% yellow colour. A garden chair having an arch shape which has designed and analysed using ANSYS software and the garden chair was constructed with concrete mix using the optimum conditions.

REFERENCES

[1] Enviros. Recycled Glass Market Study & Standards Review. *The Waste & Resources Action Programme*, 2004.

Use of waste glass as aggregate in concrete

[2] Liang, Hong1; Zhu, Huiying2; Byars, Ewan A.3 1 the University of Edinburgh, UK; h.liang@ed.ac.uk 2 Deputy General Engineer at GuangXi Research & Design Institute of Building Science, China 3 the University of Sheffield, UK

[3] M.C. Zurita Ares a, E. Villa González b, A.I. Torres Gómez c, J.M. Fernández b,c, ReviewAn easy method to estimate the concentration of mineral pigments colored mortars

[4] Ordinary Portland cement , 53 grade specification IS 12269 (2013), Methods of test for aggregates for concrete part – I particle size and shape , IS 2386 part – I (1963)