International Journal of Research in Engineering, Science and Management
Volume 5, Issue 1, January 2022
https://www.ijresm.com | ISSN (Online): 2581-5792

To Design and Study the Physical Properties of Green Concrete by using Demolished Concrete

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***Abstract*: Green concrete is a changing topic in the history of the concrete industry. It's a way of the concept of environmental considerations in concrete thinking is considered all aspects such as materials, production, design mix, structure, construction and service life. In this project we will try to design green concrete by using demolished concrete i.e. friendly concrete debris. After designing us will study the physical properties of green concrete and the general concrete used in construction. We will look at whether the proposed concrete is likely to perform construction work and finally we will compare the performance and strength of ordinary and green concrete concrete. The current investigation will focus on rehabilitating demolished debris building materials to reduce construction costs and solve housing problems they face low-income communities in the world. Demolished concrete debris is separated by sieving to determine the required sizes of the composite, several tests were performed determine the composite structures before re-use in new concrete. This exploratory research aims to use crushed concrete debris as an alternative to good adhesion to a mixture of mud. A typical mud mixture would be likened to concrete debris a mixture of the same proportions.**

***Keywords*: Composite, construction, debris, demolished, design mix, green concrete, production, re-use, strength.**

1. Introduction

The concrete which is made with eco-friendly concrete wastes is known as Green concrete. The other name for green concrete is resource saving structures with reduced environmental impact for e.g. Energy saving, CO2 emissions, waste water. Green concrete is a revolutionary topic in the history of concrete industry. Concrete is one of the world's most widely used structural construction material. Most people associate GREEN concrete with concrete that is color with pigment. However, it is also referred which has not yet hardened. But in the context of this topic, green concrete is taken to mean environmentally friendly concrete. This means concrete that uses less energy in its production & produces less carbon dioxide than normal concrete is green concrete.

Concrete is one of the world's most widely used structural construction material. High quality concrete that meets specification requires a new standard of process control and materials optimization. Increasingly, concrete is being recognized for its strong environmental benefits in support of creative and effective sustainable development. Concrete has substantial sustainability benefits.

A. Motivation

With the scarcity of space for land filling and due to its ever increasing cost, waste utilization has become an attractive alternative to disposal. The use of waste products in concrete not only makes it economical, but also helps in reducing disposal problems. The reuse of that demolished debris is a good solution to the problem of an excess of waste material. The use of demolished waste material as the basic material of new construction is more economic and eco-friendly.

B. Problem Statement

1. Scarcity of space for land filling
2. Increase in municipal waste management cost
3. Increase in CO2 emission, thus increases rate of global warming.
4. Adverse effect of environment on concrete

C. Objectives

The specific objectives of this project are therefore:

- To Prepare a concrete mix design by IS 10262:2009.
- To study physical properties of conventional concrete and green concrete.
- To reuse the aggregate in new construction.
- To reduce the cost of construction.

2. Report on Present Investigation

A. Features of Green Concrete

Cement production accounts for more than 6% of all CO2 emission which is a major factor in the world global warming (Greenhouse gas). India is the third largest cement producer in the World and one of the largest consumers of cement per capita in the world. Rough figures are that India consumes about 1.2 Ton/year/capita, while as World average is 0.6 Ton/year/capita.

There have been a number of efforts about reducing the CO2 emissions from concrete primarily through the use of lower amounts of cement and higher amounts of supplementary cementitious material (SCM) such as fly ash, blast furnace slag etc. CO2 emissions from 1 ton of concrete produced vary between 0.05 to 0.13 tons. 95% of all CO2 emissions from a cubic meter of concrete is from cement manufacturing. It is important to reduce CO2 emissions through the greater use of SCM.

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B. *Materials for Green Concrete*

Green construction materials are composed of renewable, rather than non-renewable resources. Green materials are environmentally responsible because impacts are considered over the life of the product. Depending upon project-specific goals, green materials may involve an evaluation of one or more of the following criteria.

- Locally available: Construction materials, components, and systems found locally or regionally, saving energy and resources in transportation to the project site.
- Salvaged, re-furnished, or re-manufactured: Includes saving a material from disposal and renovating, repairing, restoring, or generally improving the appearance, performance, quality, functionality, or value of a product.
- Reusable or recyclable: Select materials that can be easily dismantled and reused or recycled at the end of their useful life.

Recycled materials that the Industry has found to perform favorably as substitutes for conventional materials include: fly ash, granulated blast furnace slag, recycled concrete, demolition waste, micro silica, etc. Generation and use of recycled materials varies from place to place and from time to time depending on the location and construction activity as well as type of construction projects at a given site. Following materials can be considered in this category and are discussed here. a. Recycled Demolition Waste Aggregate b. Recycled Concrete Aggregate c. Blast furnace Slag d. Manufactured Sand e. Glass Aggregate f. Fly ash They are divided in cement, cementitious material, coarse and fine aggregate.

C. *Environmental Benefits to using Green Concrete*

Green concrete is part of a movement to create construction materials that have a reduced impact on the environment. It is made from a combination of an inorganic polymer and 25 to 100 per cent industrial waste. Here is a list of 4 benefits to using green concrete for your next project.

1) Lasts Longer

Green concrete gains strength faster and has a lower rate of shrinkage than concrete made only from Portland Cement. Structures built using green concrete have a better chance of surviving a fire (it can withstand temperatures of up to 2400 degrees on the Fahrenheit scale). It also has a greater resistance to corrosion which is important with the effect pollution has had on the environment (acid rain greatly reduces the longevity of traditional building materials). All of those factors add up to a building that will last much longer than one made with ordinary concrete. Similar concrete mixtures have been found in ancient Roman structures and this material was also used in the Ukraine in the 1950s and 1960s.

Instead of a 100 percent Portland cement mixture, green concrete uses anywhere from 25 to 100 percent fly ash. Fly ash is a by-product of coal combustion and is gathered from the chimneys of industrial plants (such as power plants) that use coal as a power source. There are copious amounts of this industrial waste product. Hundreds of thousands of acres of land are used to dispose of fly ash. A large increase in the use of green concrete in construction will provide a way to use up

Table 1
Sieve analysis test on fine aggregates

IS Sieve Size	Weight Retained (g)	Cumulative Weight Retained (g)	% of Cumulative Weight Retained	% of Cumulative Weight Passing	IS-383:1970, % passing for Grading Zone-I
10 mm	0	0	0	100	100
4.75 mm	55	55	5.5	94.5	90-100
2.36 mm	292	347	34.7	65.3	60-95
1.18 mm	227	574	57.4	42.6	30-70
600 μ	152	726	72.6	27.4	15-34
300 μ	109	835	83.5	16.5	5-30
150 μ	74	909	90.9	9.1	0-10
Pan	91	1000	100	0	-

Table 2
Sieve analysis test on coarse aggregates

IS Sieve Size	Weight Retained (g)	Cumulative Weight Retained (g)	% of Cumulative Weight Retained	% of Cumulative Weight Passing
80 mm	0	0	0	100
63 mm	0	0	0	100
40 mm	0	0	0	100
20 mm	310	310	15.5	84.5
16 mm	1120	1430	56	28.5
12.5 mm	460	1890	23	5.5
10 mm	80	1970	4	1.5
4.75 mm	30	2000	1.5	0
pan	0	0	0	0

Table 3
Test result in tabular format

Property	Cement	Crushed Sand	Coarse Aggregate
Consistency Test	32%	-	-
Fineness Test	Percentage retained: - 7 %	-	-
IST and FST Test	IST = 30minutes FST=600minutes	-	-
Specific gravity	-	2.68	2.68
Water absorption	-	1.17	0.98%

fly ash and hopefully free many acres of land.

2) Reduces Energy Consumption

If you use less Portland cement and more fly ash when mixing concrete, then you will use less energy. The materials that are used in Portland cement require huge amounts of coal or natural gas to heat it up to the appropriate temperature to turn them into Portland cement. Fly ash already exists as a by-product of another industrial process so you are not expending much more energy to use it to create green concrete.

Another way that green concrete reduces energy consumption is that a building constructed from it is more resistant to temperature changes. An architect can use this and design a green concrete building to use energy for heating and cooling more efficiently.

3. Result and Discussion

A. Mix Design

Concrete Mix Design for M 25 Grade *by = IS 10262-2009*

1) Stipulations for proportioning

a) Grade Designation: M25
b) Type of Cement: OPC 53 grade Conforming to IS. 8112.
c) Max Nominal Size of aggregate: 20 mm
d) Max content of cement: 310 kg/m^3
e) Max w/c ratio: 0.45
f) Workability: 100 mm
g) Exposure condition: Normal
h) Degree of supervision: Good
i) Type of aggregate: crushed angular aggregate
j) Max cement: 540 kg/m^3
k) Chemical admixture: nil

2) Test data for materials

a) Cement used: OPC 53 grade
b) Specific gravity cement: 3.15
c) Chemical admixture: nil
d) Specific gravity of
(1) fine agg. : 2.68
(2) 20 mm : 2.82
e) Water absorption
(1) fine agg. : 1.18%
(2) 20 mm : 0.98%
f) Free (surface)
(1) coarse agg. : nil
g) Sieve Analysis:
1) Coarse agg.: Confirming to IS. 383.
2) Fine Agg.: Confirming to grading Zone I of Table 4 of IS.383

3) Target strength for mix proportion

f'ck=fck-1.65 s
f'ck=25-1.65*4
f'ck=31.6 N/mm^2
Standard deviation for M24= 4
Hence targeted strength at 28th day = 31.6 N/mm^2

4) Selection of water cement ratio

From table 5 of IS 456
Max WC ratio =0.45

5) Selection of water content

For 20mm aggregate =186 lit (for 25mm to 50mm slump)
Estimate WC for 100mm slump= 186+6/100*186 =197 liters

6) Calculation of cement content

WC Ratio= 0.45
Cement content=197/0.45 =492.5 kg/m^3 from table 5 of IS 456
For normal condition = 280 kg/m^3
492.5kg/m^3>280kg/m^3, Hence ok

7) Proportion for volume of coarse aggregate and fine aggregate

volume of coarse aggregate corresponding to20mm size aggregate and fine aggregate (zone-1) = 0.6

In present case WC ratio = 0.45 Volume of coarse aggregate as per 3 of IS456=62%

Adopt volume of fine aggregate =1-0.62=0.38%

Mix calculation:

a) Volume of concrete = 1m^3
b) Volume of cement =
Mass of cement/Specific gravity *1/1000
= 495/3.15*0.001
= 0.157m^3
c) Volume of water =
Mass of water/Sp.gr of water*0.001
= 39.4/1*0.001
d) Volume of all in aggregate = [A-(B+C+D)]
=1-(0.157+0.197) = 0.646m^3
e) Mass of Coarse Aggregate:
= E*Volume of C.A.* Sp.gr. of Course Aggregate *1000
= 0.646*0.62*2.82*1000
= 1129.47 Kg
e) Mass of Fine Aggregate:
= E*volume of fine aggregate* Sp.gr*1000
= 0.12*2.68*0.38*1000
= 657.9 kg

Mix Design Proportion: 1:1.4:2.3
If 50%-50% of 10 mm & 20 mm
Aggregate used = 63.935 kg each.

Table 4
Mix design result

Water	Cement content	Fine Aggregate	Coarse Aggregate
197 Kg /m^3	495 Kg /m^3	657.9 Kg /m^3	1129.47 Kg /m^3
For 1 bag	Cement		
19.7 lit	50 kg	75.59 kg	127.87 kg

Table 5
Quantities of material used for casting cubes

Material	Cement (kg)	Crushed sand (kg)	Powder dust (kg)	Metal 2 (kg)	Metal 1 (kg)	Water (lit)
Quantity	4.95	7.559	0	6.367	6.367	1.97

B. *Compression Test Results*

Table 6
Normal concrete cubes of 7 days testing

Spec. No.	Dimensions (mm X mm X mm)	Weight (Kg.)	Density (KN/m^3)	Load (KN)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
1	150X150X150	8.315	24.16	411	18.26	18.65
2	150X150X150	8.130	23.63	421	18.71	
3	150X150X150	8.380	24.35	427	18.98	

Table 7
Normal concrete cubes of 28 days testing

Spec. No.	Dimensions (mm X mm X mm)	Weight (Kg.)	Density (KN/m^3)	Load (KN)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
1	150X150X150	8.35	24.27	745	33.11	34.2
2	150X150X150	8.40	24.41	796	34.37	
3	150X150X150	8.40	24.41	813	35.13	

Table 8
100% demolished concrete cubes of 7 days testing

Spec. No.	Dimensions (mm X mm X mm)	Weight (Kg.)	Density (KN/m^3)	Load (KN)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
1	150X150X150	8.37	24.32	415	18.31	16.51
2	150X150X150	7.85	22.81	359	15.95	
3	150X150X150	7.96	23.13	344	15.28	

Table 9
100% demolished concrete cubes of 28 days testing

Spec. No.	Dimensions (mm X mm X mm)	Weight (Kg.)	Density (KN/m^3)	Load (KN)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
1	150X150X150	7.94	23.07	628	27.11	25.86
2	150X150X150	7.73	22.46	564	25.06	
3	150X150X150	7.93	23.09	572	25.42	

Table 10
80% demolished concrete cubes of 7 days testing

Spec. No.	Dimensions (mm X mm X mm)	Weight (Kg.)	Density (KN/m^3)	Load (KN)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
1	150X150X150	8.11	23.57	473	21.02	21.03
2	150X150X150	8.22	23.89	471	20.93	
3	150X150X150	8.17	23.74	476	21.15	

Table 11
80% demolished concrete cubes of 7 days testing

Spec. No.	Dimensions (mm X mm X mm)	Weight (Kg.)	Density (KN/m^3)	Load (KN)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
1	150X150X150	8.15	23.68	781	34.71	34.5
2	150X150X150	8.11	23.57	824	36.62	
3	150X150X150	8.01	23.28	724	32.17	

C. *Split Tensile Test Results*

Table 12
Normal concrete cylinder of 28 days testing

Spec. No.	Dimensions (mm X mm X mm)	Weight (Kg.)	Density (KN/m^3)	Load (KN)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
1	150X150X300	13.20	24.42	252	14.26	12.97
2	150X150X300	12.95	23.96	208	11.77	
3	150X150X300	12.75	23.59	228	12.90	

Table 13
100% demolished concrete cylinder of 28 days testing

Spec. No.	Dimensions (mm X mm X mm)	Weight (Kg.)	Density (KN/m^3)	Load (KN)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
1	150X150X300	11.73	21.07	173	9.81	10.01
2	150X150X300	12.45	23.03	179	10.142	
3	150X150X300	12.45	23.03	178	10.07	

Table 14
80% demolished concrete cylinder of 28 days testing

Spec. No.	Dimensions (mm X mm X mm)	Weight (Kg.)	Density (KN/m^3)	Load (KN)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
1	150X150X300	12.41	22.96	184	10.41	11.37
2	150X150X300	12.36	22.87	226	12.78	
3	150X150X300	12.61	23.33	193	12.92	

4. Conclusion

Thus, we have done testing of 100% & 80% demolished aggregate concrete. From the results, we get to know that the strength of 100% & 80% demolished aggregate concrete is same or more than the conventional concrete. It means we can use demolished aggregate as a replacement for conventional aggregate. We got maximum result using 80% demolished aggregate. The idea of reusing the waste material is very exciting and encouraging specially when it will be helpful in minimizing destruction to earth's crust and green forest cover by virtue of reduced mining. Protection of environment from the demolition concrete waste. Compressive strength of the demolished concrete is getting greater than normal concrete. The tensile strength is also high. This method in the construction filed is very effective.

References

[1] M. S. Shetty, Concrete Technology, S. Chand Publication.

[2] A. M. Neville and J. J. Brooks, Concrete Technology, Pearson Publications.

[3] Da Silva, F. M., Gachet Barbosa, L. A., Lintz, R. C. C. & Jacintho, A. E. P. G. A. 2015. Investigation on the properties of concrete tactile paving blocks made with recycled tire rubber. Construction and Building Materials, 91, 71-79.

[4] Glavind, M. & Jepsen, M.T. (2002). "Evaluation of Green Concrete Types". Proceedings of the XVIII Symposium on Nordic Concrete Research. Helsinger, June.

[5] Mehta, P. K. (2010). "Sustainable Cements and Concrete for the Climate Change Era – A Review". Proc. 2nd International Conference on Sustainable Construction Materials and Technologies. Ancona, Italy, June 28-30.

[6] The Institution Recycling Network Mark Lennon "Recycling Construction and Demolition Wastes" A Guide for Architects and Contractors, April 2005.

[7] Dewanshu Ahlawat, L. G. Kalurkar, 2014, "Coconut Shell as Partial Replacement of Coarse Aggregate in Concrete," International Conference on Advances in Engineering & Technology.

[8] Suhendro, B. 2014. Toward Green Concrete for Better Sustainable Environment. Procedia Engineering, 95, 305-320.

[9] Wang, H. Y., Zeng, H. H. & Wu, J. Y. 2014. A study on the macro and micro properties of concrete with LCD glass. Construction and Building Materials, 50, 664-670.

[10] Zhao, H., Sun, W., Wu, X. & Gao, B. 2015. The properties of the self-compacting concrete with fly ash and ground granulated blast furnace slag mineral admixtures. Journal of Cleaner Production, 95, 66-74.

[11] Weimin Wanga, Radu Zmeureanua, Hugues Rivard, Applying multi-objective genetic algorithms in green building design optimizations, Building & Environment 40 (2005) 1512-1525.

[12] Blomsma, F.; Brennan, G. The Emergence of Circular Economy: A New Framing Around Prolonging Resource Productivity. J. Ind. Ecol. 2017, 21, 603–614.

[13] Shailendra Tiwari et al 2015, "Development of Green Concrete and Assessment of its Strength Parameters", International Journal of Engineering and Technical Research, Volume 3, Issue 5, May 2015.

[14] Chirag Garg & Aakash Jain 2014, "Green Concrete: Efficient and Eco-friendly Construction Materials", International Journal of Research in Engineering and Technology, Volume 2, Issue 2, Feb- 2014.

[15] Tommy Y. Lo and H. Z. Cui, Properties of Green Lightweight Aggregate Concrete, International Workshop on sustainable Development & concrete technology Hong Kong, 2002.

[16] E. S. Bakhoum and D. C. Brown, "Developed sustainable scoring system for structural materials evaluation," Journal of Construction Engineering and Management, vol. 138, no. 1, pp. 110–119, 2012.

[17] N. K. Amudhavalli & Jeena Mathew, "Effect of Silica Fume On a Strength & Durability Parameters of Concrete", International Journal of Engineering Sciences & Emerging Technologies, 2012.