iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** III **Month of publication:** March 2019

DOI: http://doi.org/10.22214/ijraset.2019.3128

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: 6.887
Volume 7 Issue III, Mar 2019- Available at www.ijraset.com

Study of Partial Replacement of Natural Sand by Crushed Rock Powder in Concrete

Kratika Singh[1], Prof. Deepak Rastogi[2]
[1]*M.Tech. Student, Environmental Engineering, MITS, Gwalior (M.P.)*
[2]*Associate Professor, Department of Civil Engineering, MITS, Gwalior (M.P.)*

Abstract: ***Concrete is commonly used building material, which is extensively used all over the world. In India the conventional concrete is produced by using natural sand obtained from river bed as fine aggregate. But with the rapid industrialization and construction works ,the use of natural sand has also increased and as the consumption of sand has increased the required quantity of sand is not available and quarrying of sand posses the environmental problems therefore government restricted the sand quarrying operation resulting in scarcity and significant increased in its cost. This project is aimed to reduce the use of natural sand by using crushed rock powder (CRP) as a replacement for fine aggregate in concrete. Fine aggregate in concrete is replaced by 40%,50%,60%,70% and 80% Crushed rock powder. M-20 and M-25 grade of concrete is designed and their compressive strength at the ages of 7 days and 28 days is determined in the lab. The compressive strength of concrete with CRP replacement are compared with that of Normal Concrete (NC) which does not contain CRP.***
Keywords: Cement, Concrete, Compressive strength, Crushed rock powder.

I. INTRODUCTION

Concrete is a widely used construction material consisting of cementing material, fine aggregate, coarse aggregate and required quantity of water, where in the fine aggregate is usually natural sand. The use of sand in construction results in excessive sand mining which is objectionable from environment point of view. In the last 15 years it has been observed that the availability of natural sand is decreasing.

Environmental concern are also been rising against uncontrolled extraction of natural sand. The argument is mostly in regards of protecting the natural river bed against erosion and importance of having natural sand as a filter for ground water. Also, good quality sand may have to be transported from long distance, which adds to the cost of construction. In some cases, natural sand may not be of good quality.

Therefore, it is necessary to replace natural sand in concrete by an alternate material either partially or completely without compromising the quality of concrete. CRP is one such material which can be replaced sand as fine aggregate. CRP is also commonly known as QUARRY DUST .To reduce use of natural sand we are replacing CRP (40%,50%, 60%, 70% and 80%) for natural sand for producing M20 and M25 grade of concrete. The study on concrete includes determination of compressive strength and their grades of concrete.

A. Crushed Rock Powder

Crushed rock powder is a by-product which is formed in the processing of crushing stone which is broken down into a coarse aggregate of different sizes. The dust is collected from the nearest crusher site. About 20 to 25% of the total production in each crusher is left out as a waste material. The ideal percentage of replacement of natural sand with CRP is 50% in case of compressive strength. In our study CRP is obtained from DD Nagar, Gwalior crusher point and Gohad, Distt, Behind crusher point.

B. Concrete Materials And Their Properties

Coarse aggregate of 20mm maximum size is used in Reinforced cement concrete work of all types of structures. This is obtained by crushing the stone boulders of size 100 to 150mm in the stone crushers. Then it is sieved and the particles passing through 20 mm and retained on 10mm sieve known as course aggregate. The particles passing through 4.75mm sieve are called as quarry dust. The quarry dust is used to sprinkle over the newly laid bituminous road as filler between the bitumen and coarse aggregate and manufacturing of hollow blocks.

MATERIALS	PROPERTIES
Aggregate	Maximum size : 20mm Specific gravity: 2.95 Fineness modulus: 7.10
Natural River sand	Specific gravity:2.53 Fineness modulus:3.08 Density:1.63gm/cc Void ratio:0.55
CRP Crushed Rock Powder	Specific gravity:2.63 Fineness modulus:2.67
Ordinary port land cement (43 grade cement)	Specific gravity:3.05 Initial setting time:30min. Final setting time:220min. Fineness:8% residue on IS 90 micron sieve
Water	pH: 7.2 Density: 1gm/cc

C. Experimental Investigation

M-20 GRADE CONCRETE MIX	M-25 GRADE CONCRETE MIX
Water cement ratio: 0.5 Cement: 1 Sand: 1.41 Coarse Aggregate: 3.08	Water cement ratio: 0.45 Cement: 1 Sand: 1.35 Coarse Aggregate: 2.89

The required mix proportion of grade M20 and M25 is 0.5:1:1.41:3.08 and 0.45:1:1.35:2.89 respectively.

D. Sieve Analysis Of Coarse 20 MM Graded Aggregate

S.NO.	IS SIEVE SIZE	% PASSING BY WEIGHT	REMARK
1	40mm	100%	Conforming to code IS:383-1970 of table 2
2	20mm	97.5%	
3	10mm	26.8%	
4	4.75	6.5%	

E. Sieve Analysis Of Fine Aggregate (SAND)

S.NO.	IS SIEVE SIZE	% PASSING BY WEIGHT	REMARK
1	10mm	100	Conforming to grading zone II of table 4 of IS:383-1970
2	4.75mm	92	
3	2.36mm	78	
4	1.18mm	64	
5	600 micron	45	
6	300 micron	28	
7	150 micron	6	

F. Sieve Analysis Of Crushed Rock Powder (Crp)

IS Sieve size (mm)	Wt. Retained (gm)	Cumulative Wt. Retained (gm)	Cumulative % Wt. Retained	Cumulative % passing
10	0	0	0	100
4.75	0	0	0	100
2.36	0.25	0.25	25	75
1.18	0.215	0.465	46.5	53.5
600µ	0.095	0.56	56	44
300 µ	0.175	0.735	73.5	26.5
150 µ	0.235	0.97	97	3

G. Quantity Of Material For M20 Grade Concrete Mix

Sr. No.	%of crushed rock powder	Water (Kg)	Cement (Kg)	Aggregate (Kg)	Natural sand (Kg)	Crushing dust (Kg)
1	40	191.6	383	1180	436	284
2	50	191.6	383	1180	360	360
3	60	191.6	383	1180	291	429
4	70	191.6	383	1180	216	504
5	80	191.6	383	1180	147	573

H. Compressive Strentgh Of Concrete Cube For M20 Grade

Sr. No.	% replacement of fine aggregate sand: crushed rock powder	M20		
		7 days strength N/mm^2	28 days strength N/mm^2	Percentage deviation by target strength value 27.65 N/mm^2
1	100:0	21.11	27.65	0
2	60:40	21.93	27.80	0.54
3	50:50	22.00	32.20	16.45
4	40:60	20.36	29.00	4.88
5	30:70	20.00	28.33	2.45
6	20:80	19.5	26.89	-2.74

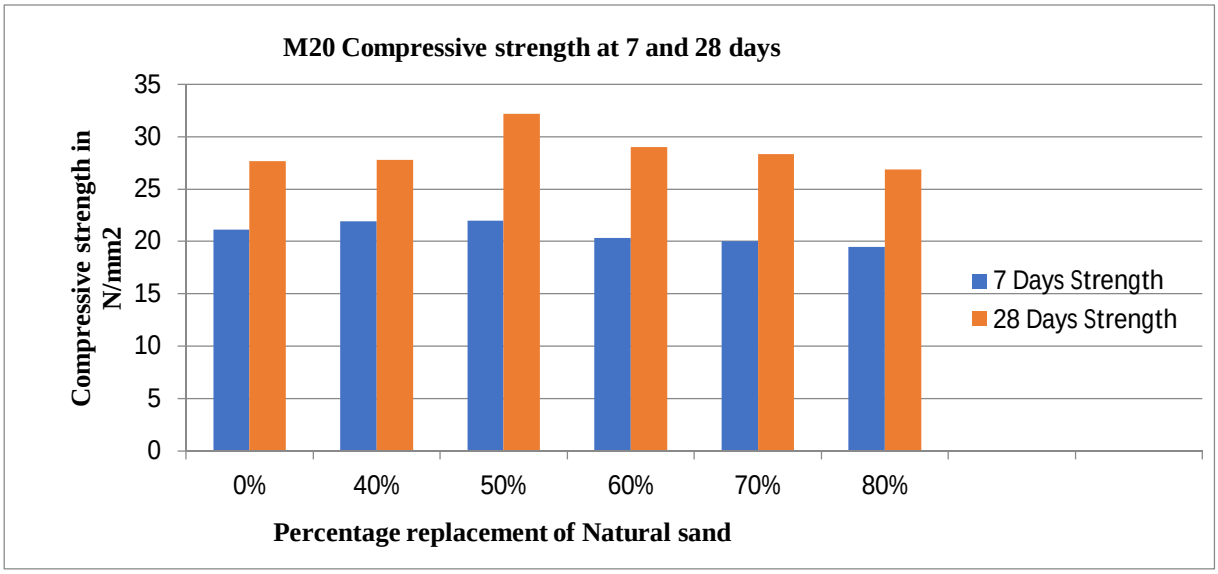


Figure: 1 Compressive strength for M-20 grade concrete cubes after 7 days and 28 days

I. Quantity Of Material For M25 Grade Concrete Mix

Sr. No.	%of crushed rock powder	Water (Kg)	Cement (Kg)	Aggregate (Kg)	Natural sand (Kg)	crushed rock (CRP)
1	40	186	413	1195	457.2	304.8
2	50	186	413	1195	381	381
3	60	186	413	1195	304.8	457.2
4	70	186	413	1195	228.6	533.4
5	80	186	413	1195	152.4	609.6

J. Compressive Strentgh Of Concrete Cube For M25 Grade

Sr. No.	% replacement of fine aggregate sand: crushed rock powder (CRP)	M25		
		7 days strength N/mm^2	28 days strength N/mm^2	Percentage deviation by target strength value 33.25
1	100:0	25.20	33.80	1.65
2	60:40	26.29	34.20	2.85
3	50:50	27.20	35.30	6.16
4	40:60	26.60	34.00	2.25
5	30:70	25.40	33.76	1.53
6	20:80	23.80	32.40	-2.55

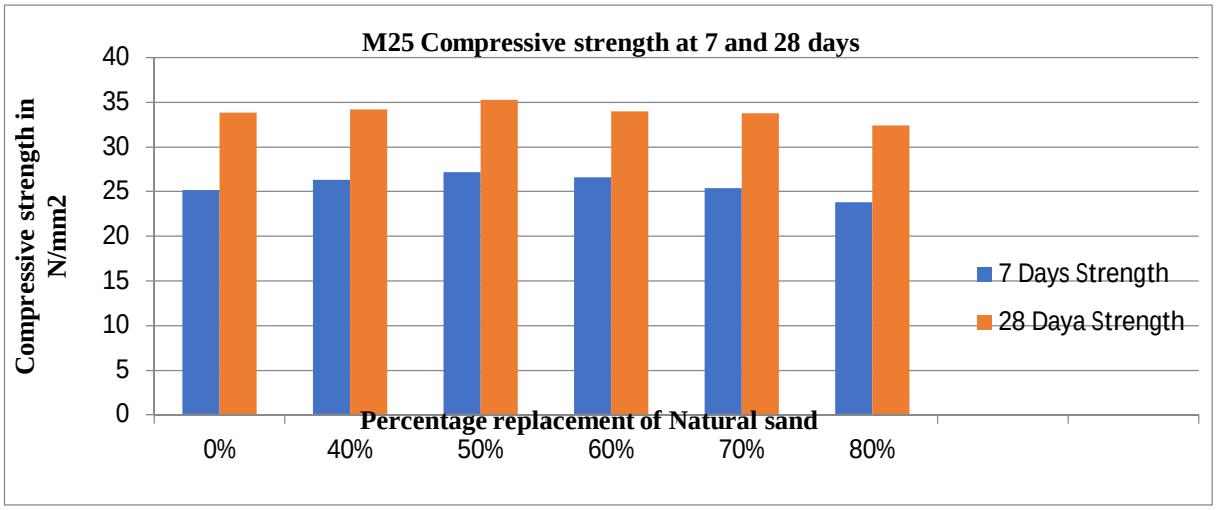


Figure: 2 Compressive strength for M-25 grade concrete cubes after 7 days and 28 days

II. CONCLUSION

Following are the conclusion drawn from the laboratory work performed further for the determination of compressive strength of concrete cubes after 7 days and 28 days of curing and replacement of natural sand by crushed rock powder 40 to 80 %.

A. The Replacement of the sand with crushed rock powder at 50% shows maximum improvement in the compressive strength of the concrete for both M-20 and M-25 grade of concrete mix.

B. The maximum variation from target strength for M-20 grade of concrete mix is found to be at 50% which is 16.45 and significant drop is observed both at increase and decrease percentage from 50%. Therefore 50% replacement of crushed rock powder is proved.

C. The maximum variation from target strength for M-25 grade of concrete mix is found to be at 50% which is 6.16 and significant drop is observed both at increase and decrease percentage from 50%. Therefore 50% replacement of crushed rock powder is proved to be determined.

REFERENCES

[1] Akshay, A.Waghmare, Akshay G.Kadao, Ayushi R. Sharma, Sunil G. Thorve, Study Of Replacement of Natural Sand by Artificial Sand In Concrete, International Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT) – 2016

[2] Anzar Hamid Mir, Improved Concrete Properties Using Quarry Dust as Replacement for Natural Sand, International Journal of Engineering Research and Development, e-ISSN: 2278-067X, p-ISSN: 2278-800X, Volume 11, Issue 03 (March 2015), PP.46-52

[3] A.Suribabu, Dr. U.Rangaraju, Dr. M.Ravindra Krishna, Behaviour of Concrete on Replacement of Sand with Quaries Stone Dust as Fine Aggregate, International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 4, Issue 1, January 2015, ISSN(Online): 2319 - 8753, ISSN (Print) :2347 - 6710

[4] Chandana Sukesh, Katakam Bala Krishna, P.Sri Lakshmi Sai Teja, S.Kanakambara Rao, Partial Replacement of Sand with Quarry Dust in Concrete, International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-2, Issue-6, May 2013

[5] G.Balamurugan, Dr.P.Perumal, Use of Quarry Dust to Replace Sand in Concrete –An Experimental Study, International Journal of Scientific and Research Publications, Volume 3, Issue 12, December 2013, ISSN 2250-3153

[6] IS456-2000 Indian standard code of practice for plain and reinforced concrete, Bureau of Indian standards, NewDelhi

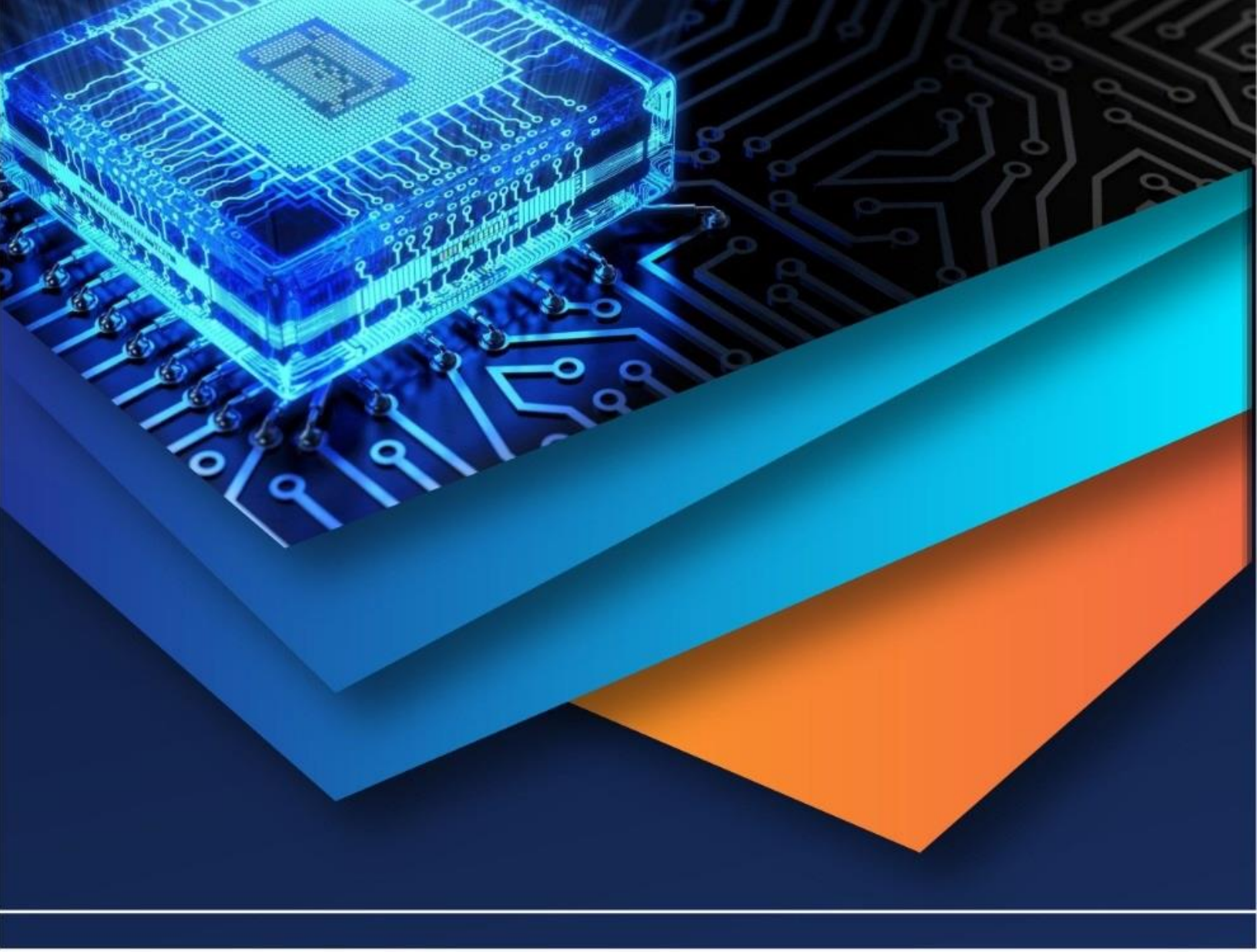
[7] K.Sai Kumar, S.Sameer Kumar, Dr.M.L.V.Prasad, Quarry Rock Dust as A Partial Replacement of Fine Aggregate - State of Art Report, Research Gate, January 2014, DOI: 10.13140/RG.2.1.3003.4403

[8] Manguriu, G.N., Karugu, C.K., Oyawa, W.O., Abuodha, S.O. And Mulu, P.U., Partial Replacement Of Natural River Sand With Crushed Rock Sand In Concrete Production, Global Engineers & Technologists Review, Vol.3 No.4 (2013)

[9] Rameshwar S. Ingalkar, Shrikant M. Harle, Replacement of Natural Sand by Crushed Sand in the Concrete, Landscape Architecture and Regional Planning 2017; 2(1): 13-22

[10] Tanweer Ahmad, Pratiksha Malviya, Vikash Kumar Singh, Experimental Study on Concrete by Partial Replacement of Fine Aggregate with Stone Dust and Cement by Glass Powder for M-30 Grades of Concrete, International Journal of Engineering Development and Research 2018 IJEDR Volume 6, Issue 1, ISSN: 2321-9939

[11] Vijaya Kumar Y.M., Bhargavi Ganesh, Arun Bhargava K.C., Kavyashree N., Dhanush B., Experimental Study on use of Crushed Rock Powder as Partial Replacement for Fine Aggregate in Concrete, International Journal for Modern Trends in Science and Technology (IJMTST) Volume: 2 | Issue: 06 | June 2016 | ISSN: 2455-3778



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY