Comparative Analysis of Natural and Crushed Sand

Prof.D.R.Naxine¹, Prof.S.S.Kapgate², Prof.C.N.Gawali³

¹Assistant Professor, Nagpur Institute of Technology, Nagpur

² Assistant Professor, Nagpur Institute of Technology

³ Assistant Professor, Nagpur Institute of Technology

¹drnaxine@nit.edu.in, ²kapgate.sudhir68@gmail.com, ³cngawali@gmail.com

Abstract

As the world is facing environmental crisis from last some years due to construction, so we have to find the alternative for the alternatives for cement, sand, aggregates. In concrete, Constant and abundant use of natural sand has already made it exclusive and expensive in our country. We casted Cubes of M20 grade, M30 Grade and M40 Grade respectively and test them for 7, 14 and 28 days of curing. On the basis of this collected data we will conclude whether crushed sand is suitable for 100% replacement of natural sand.

Keywords: Natural sand1, Crushed Sand1, Compressive strength1

1. Introduction

Today construction industry is at its peak due to the growing population.

Every day there is a plan or execution of constructional work throughout the globe which affect the environment. Everyone knows that the most used constructional material today which is 'Concrete''. In concrete, Constant and abundant use of natural sand has already made it exclusive and expensive in our country. Excessive removal of sand has made the rivers dry and impure which bards rural development and restricts the agricultural abilities of ours motherland. Hence we have to find new alternatives for these problems we are about to face due to this environment crisis.

2.Literature Review

<u>Sanjay Mundra</u>(2016) investigate use of crushed rock sand as alternative to Natural River sand and found that crushed stone sand can be used as available alternative to river sand and economic.

K.Kankam Bismarck (2017) done work on concrete by using quarry dust to replace sand at levels i.e. 0%, 25%, and 100% by weight and got result that concrete made used by quarry dust has better mechanical properties.

Sarbjeet Singh(2017) studied Most challenging problems of 21st century, solid waste management and stone slurry is a prime shareholder in this waste, concluded that neglecting minor variations the optimum replacement percentage for GCW and MS concrete were 25% and 15% respectively.

Farid Benmerioul(2015) done work on corete by uding Crushed dune sand and limestone filler as mineral addition in the formulation of self-compacting concrete & got result that the self-compacting concrete containing crushed dune sand shows a better behavior at the shrinkage than the Self Compacting Concrete by using limestone filler.

2. Methodology

3.1 Preliminary Testing of Material used in concrete mix design

Materials used for mix design of concrete have to be tough and durable. Along with this certain physical properties has to be known as they are vital and has to be used during the commencement of design procedure. Following properties of aggregate has to be known Sieve Analysis, Specific gravity, Dry loose bulk density (DLBD), Bulkage or Moisture content. Sieve Analysis of crushed and natural sand is done using IS sieve set starting from 10 mm sieve size to 150 micron (decreasing order). Sieve analysis is the most important part as zone of sand is determined by sieve analysis.

3.2. Specification of Materials

Aggregate / Cement Ratio to give four degree of workability by using Crushed Rock aggregate																
Degree of Worka bility	Very Low			Low		Medium			High							
Zones	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
0.4	4.5	4.1	3.8	3.5	3.5	3.5	3.2	3.0								
0.45	5.5	5.0	4.6	4.3	4.3	4.2	3.9	3.7	3.7	3.7	3.4	3.3	3.5	3.5	3.2	3.1
0.5	6.5	5.9	5.4	5.0	5.0	4.9	4.5	4.3	4.2	4.2	3.9	3.8	S	3.9	3.8	3.5
0.55	7.2	6.6	6.0	5.7	5.7	5.5	5.0	4.8	4.7	4.7	4.5	4.3		S	4.3	4.0
0.6	7.8	7.2	6.6	6.3	6.3	6.0	5.6	5.3	S	5.2	4.9	4.8			4.7	4.5

3.3 Analysisfor Natural Sand

Sieve Analysis (by IS sieve sizes mentioned below)

Type	Natural						
Source	River (Bhandara)						
IS Sieve	Weight	% Weight	Cumulative %	% Passing			
Size	Retained	Retained	Retained				
	(A) grams	(B) in %	(C)	(100-C)			
10 mm	5	0.5					
4.75 mm	25	2.5	3	97			
2.36 mm	55	5.5	8.5	91.5			
1.18 mm	295	29.5	38	62			
600 micron	360	36	74	26			
300 micron	195	19.5	93.5	6.5			
150 micron	50	5	98.5	1.5			
Pan	15	1.5	100	0			
Total	1000						

Table 2

Table 3								
Туре	Crushed							
Source		Pachga	aon (Qurrey)					
IS	Weight	% Weight	Cumulative %	% Passing				
Sieve	Retained	Retained	Retained					
Size								
	(A) grams	(B) in %	(C)	(100-C)				
10 mm	0	0	0	0				
4.75 mm	10	1	1	99				
2.36 mm	505	50.50	51.50	48.50				
1.18 mm	200	20	71.50	28.50				
600	75	7.5	88	12				
micron								
300	35	3.5	82.50	17.50				
micron								
150	20	2	84.50	15.50				
micron								
Pan	65	6.5	91	9				
Total	1000							

3.4 Provisions of Admixture

Dosage of Admixture i.e Plasticizer will be 1% to the weight of cement.

Plasticizer used is Shell Con 300, PCE Based Admixture,

For - M30 and M40 Grade of concrete

Purpose – To increase the compressive the strength and decrease the workability i.e Slump Manufacturer - Supreme Bitucem India Pvt. Ltd. (Buttibori, Nagpur)

M-20

3.5 Mix design method for concrete quantities (Modified IS method)

Concrete mix-design – M20 Grade of Concrete Concrete Specification

Characteristic Compressive Strength (Fck)

Workability: Medium		
Durability : Exposure Condition Mild		
Material properties -		
Fine Aggregate(Refer attached Sieve Analysis Report))	
Туре	Natural	Crushed
% passing 4.75 mm	97%	99%
%passing600 mic	26%	12%
%passing 600 mic	26.08%	12.12%
(Pure Sand)		
%passing 600 mic Sieve		
% passing 4.75 mm Sieve		
Zone of Sand	01	01
Specific Gravity	2.66	2.81
Dry Loose Bulk Density	1 42	2.58
Bulkage	0.20%	3 30
Coarse Aggregate	0.2070	0.00
Type	Crushed	Crushed
% passing 20 mm Sieve	91 25%	91 25
Maximum Aggregate size $-(CA I)$	20	20
% passing 4.75 mm Sieve – (CA I)	0.5%	0.5%
Specific Gravity	2.87%	2 87%
Dry Loose Bulk Density (DI BD) – CAI	1.66	2.8770
Dry Loose Bulk Density (DLDD) – CAI	1.67	1.00
Compart	1.07	1.07
A verses Strength (for the month) Em	60 mmo	60 mmo
Standard Deviation (for the month) S	0.2 mms	0.2 mms
Standard Deviation (for the month) S	0.2 mpa	0.2 mpa
Characteristic Strength of Cement (FC)	59.07 mpa	59.07 mpa
Durahility	Г	F
Durability -	MCIA	Mala
Exposure Condition	Milia 0.55	Mild 0.55
Maximum water /cement ratio	0.55	0.55
Minimum Cement Content	300 kg/m^3	300 kg/m ³
Minimum Grade of Concrete	M20	M20
Workability -		<i></i>
Slump(mm)	/5	/5
Slump (degree in workability)	Medium	Medium
larget Strength	-	-
Standard Deviation	5	5
Value of 't'	1.65	1.65
Target Mean Strength Fm	28.25	28.25
Water to Cement Ratio		
Target Mean Strength	28.25	28.25
Grade of Cement	F	F
Water to Cement Ratio (W/C)	0.54	0.54
W/c for durability 9see 3 b above)	0.55	0.55
Final Water to Cement Ratio	0.54	0.54

4.Result

Days of curing	Area of one Cube (mm ²)	Load (KN)	Characteristic strength (N/mm ²)	Average (N/mm ²)			
		Natur	al Sand				
7	22500	451.20	20.08	20.06			
7	22500	451.10	20.04	20.00			
14	22500	583.20	25.92	25.50			
14	22500	568.20	25.27	25.59			
28	22500	664.50	29.53	20.61			
28	22500	668.40	29.70	29.01			
Crushed Sand							
7	22500	393.75	17.50	17.20			
7	22500	384.75	17.10	17.50			
14	22500	542.25	24.10	22.05			
14	22500	531.10	23.60	23.83			
28	22500	610.20	27.12	27.01			
28	22500	605.25	26.90	27.01			

Results of Compression testing Machine on Cubes (M 20 Grade), Targeted strength=30

Results of Com	pression testing	Machine on	Cubes (M 30) Grade) T	argeted strength=	40
			(0 0	

Days of curing	Area of one Cube (mm ²)	Load (KN)	Characteristic strength (N/mm ²)	Average (N/mm ²)					
	Natural Sand								
7	22500	676.90	30.08	20.19					
7	22500	695.70	30.29	50.18					
14	22500	909.90	40.44	20.165					
14	22500	852.60	37.89	39.103					
28	22500	910	40.44	40.74					
28	22500	923.5	41.04	40.74					
		Crushed Sand							
7	22500	739.00	32.84	22.54					
7	22500	725.60	32.24	52.54					
14	22500	916.30	40.72	40.61					
14	22500	911.40	40.50	40.01					
28	22500	958.50	42.6	12 64					
28	22500	960.44	42.68	42.04					

Aron of

Days of curing	one Cube (mm ²)	Load (KN)	Characteristic strength (N/mm ²)	Average (N/mm ²)				
	Natural Sand							
7	22500	648.70	28.83	20.28				
7	22500	725.60	32.24	30.28				
14	22500	860.10	38.22	20.01				
14	22500	936.30	41.61	39.91				
28	22500	111.37	49.5	50.5				
28	22500	115.87	51.50	50.5				
	Crushed Sand							
7	22500	748.70	33.27	25 76				
7	22500	860.80	38.25	33.76				
14	22500	951.00	42.26	12 01				
14	22500	1021.00	45.37	43.81				
28	22500	1206	53.6	52				
28	22500	1179	52.40	55				

Results of Compression testing Machine on Cubes (M 40 Grade) Targeted strength=40

5. Conclusion

Sand requirement in concrete made with natural sand is lower than the quantity required in crushed sand. If compared with rates crushed sand cost almost 75% less than natural sand.Since the crushed sand has higher strength than natural sand, coarse aggregate of 10mm and 20mm size is relatively lower in quantity in concrete made with crushed sand. Quality control of concrete made with crushed sand can be handled better. Use of crushed sand has to controlled with adequate and balanced weight batching as a result the quality of such quantity is better than that made using natural sand.

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