

# Comparative Study on Natural Sand and Crushed Stone Sand

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**Abstract**— India has a large road network covering an area of about 4 lakh million square kilometers including all types of pavements in urban as well as in rural areas [1]. The availability of conventional material is becoming a challenge for engineers in construction of pavements. In this concern requirement of good materials for construction is there. In order to provide good alternative materials for construction of pavement layers, crushed stone sand may be used as a replacement for conventional sand. In order to preserve the various natural resources the various types of wastes should have given keen attention in order to use them in the various road construction processes as a base and sub-base material. The utilization of the alternative material based on the industrial waste is the need of hour. This work is done in order to give utilization of crushed stone sand or M-sand by analyzing various characteristics of the pavement material by using the crushed stone sand in their construction processes. The main aim of the research is to strengthen the WBM course as well as the surface layer of the rigid pavement. In this work, gradation of particles, moisture content, specific gravity and workability is determined in order to compare the various characteristics of natural sand and crushed stone sand

**Keywords**— *Crushed stone sand, natural sand, physical properties.*

## I. INTRODUCTION

Crushed stone sand is a common by-product of mining and quarrying. Rather than being discarded it as a waste material it can be utilized in various construction processes of the pavements. The crusher dust is also known as the M-sand. The cost of crushed stone sand is relatively low compared to other conventional materials. The price of M-sand ranges from Rs. 500 per ton as compared to natural sand which is Rs. 830 per ton. Crushed stone sand use less water than other alternatives and have excellent load bearing capabilities and durability. Rather than being discarded it as a waste material it can be utilized in various construction processes of the pavements. For this work various tests will be performed and by analyzing various properties the characteristics of crushed stone sand as a pavement material are analyzed. The objective of my work is to replace the conventional materials of construction by making the use of crushed stone sand in the various pavement construction processes.

The basic mix chosen for the analysis is M20. The crushed stone sand is added for the replacement of the aggregates

partially or fully. Test results indicate that fine aggregate should be replaced with the utilization of crushed stone sand.

## II. MATERIALS

### A. Crushed Stone Sand (CSS)

The material is collected from the local crusher, Ganpati Stone Crusher, Hatipura, Garh, Bassi, Rajasthan, 30 kms from Jaipur city. The crusher dust is also known as the M-sand. Crushed stone sand is a common by-product of mining and quarrying. Rather than being discarded it as a waste material it can be utilized in various construction processes of the pavements

### B. Natural Sand

The material is collected from the Banas River, Tonk, Jaipur, Rajasthan, 100kms from Jaipur city. It is a naturally occurring granular material composed of finely divided rock and mineral particles.

## III. EXPERIMENTAL PROGRAMME

In order to determine the gradation of the crushed stone sand and natural sand sieve analysis test were performed as per IS code. In present investigation the moisture content test was performed by oven dry method, specific gravity was determined by pycnometer method as per IS: 2720 (Part III)-1980 and the workability was determined by compaction factor test as per IS 1199 [3].

## IV. RESULTS AND DISCUSSION

### A. Gradation of Particles

The gradation of the particles of crushed stone sand and natural sand was determined by the sieve analysis of fine aggregates. In this analysis 200 grams of the sample were taken and sieved for the period of 10 minutes. The test results were expressed in the tubular form.

Type of Sieve analysis: Dry (passing 4.75mm sieve)

Total weight of crushed stone sand = 200g

Weight of dish = 2888g

Table 1: Sieve analysis of crushed stone sand

IS Sieve Opening, mm, $\mu$	Wt. of dish, g	Wt. of (dish + CSD) retained, g	Wt. of CSD retained, g	Cum. wt. retained, g	Cum. % retained	Cum. % finer
4.75	375	376	1	1	0.5	99.50
2.36	311	313	2	3	1.5	98.50
1	397	482	85	88	44	56.00
600	415	438	23	111	55.50	44.50
300	373	398	25	136	68.00	32.00
150	352	368	16	152	76.00	24.00
75	336	352	16	168	84.00	16.00
Pan	327	363				

Type of Sieve analysis: Dry (passing 4.75mm sieve)

Total weight of natural sand = 200g

Weight of dish = 2888g

Table 2: Sieve analysis of natural sand

IS Sieve Opening, mm, $\mu$	Wt. of dish, g	Wt. of (dish + sand) retained, g	Wt. of sand retained, g	Cum. wt. retained, g	Cum. % retained	Cum. % finer
4.75	375	375	0	0	0	0
2.36	311	312	1	1	0.50	99.50
1	397	414	17	18	9.00	91.00
600	415	438	23	41	20.00	80.00
300	373	456	83	123	61.50	38.50
150	352	412	60	183	91.50	8.50
75	336	351	15	198	99	1.00
Pan	327	330				

The gradation of the practices in the natural sand and crushed stone sand are comparable therefore the fine aggregates in concrete should be replaced by utilizing the crushed stone sand.

#### B. Moisture Content

Moisture content of crushed stone sand was determined by oven dry method. The weight of the sample of crushed stone sand and natural sand was taken as 30 grams by determining the moisture content of the crushed stone sand and natural sand at certain intervals, behavior of the crushed stone sand and natural sand with respect to water content can be analyzed.

Table 3: Moisture content of crushed stone sand

Sample no.	Wt. of empty container, g	Wt. of (container + sample), $W_1$ g	Oven dried Wt., g	% moisture content
$W_1$	44	74	73.92	0.125
$W_2$	44	74	73.80	0.313
$W_3$	43	73	72.65	0.558
AVERAGE				0.332

The moisture content of the crushed stone sand determined by the oven dry method is 0.332%.

Moisture content of natural sand by oven dry method

Table 4: Moisture Content of natural sand

Sample no.	Wt. of empty container, g	Wt. of (container + sample), $W_1$ g	Oven dried Wt., g	% moisture content
$W_1$	44	74	73	1.36
$W_2$	44	74	73	1.36
$W_3$	43	73	72	1.38
AVERAGE				1.36

The moisture content of crushed stone sand is comparatively less than that of the natural sand.

#### C. Specific Gravity

This test was performed by the pycnometer method. The specific gravity of the crushed stone sand is 2.81 whereas the specific gravity of the natural sand is 2.40. Therefore crushed stone sand has higher specific gravity as compared to natural sand which results in higher density. Due to the higher density, higher degree of compaction is achieved.

#### D. Workability

The workability of the concrete remains unaffected at addition of 5% of crushed stone sand while increasing the amount of crushed stone sand, workability decreases.

### V. CONCLUSIONS

Due to the comparable gradation of the particles, crushed stone sand can be utilized as a partial replacement of the fine aggregate in concrete.

Due to the higher specific gravity, density increases which results in higher degree of compaction.

Due to the increase of percentage of crushed stone sand workability decrease.

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