

# Evaluation of Compressive Strength of Mortars Containing Stone dust as partially replacement with fine aggregate

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**Abstract** - The paper presents the experimental investigation on compressive strength of mortar using sand stone dust as partially replacement with river sand. The cement mortar mixes in proportion of 1:3 and 1:6 (cement: sand), which are the mixes usually adopted in various construction activities. The water/cement ratio (W/C) and sand ratio were kept constant for all mixes. The basic material testing was carried out before casting of cubes. Sand was replaced by sand stone dust of 0%, 25%, and 50% by weight of sand. The compressive strength of mortar checked at 3, 7, and 28 days of interval. The result showed that the partially replacement of SSD with Sand up to 50% replacement of SSD give reliable result for compressive strength.

**Key Words:** Mortar, Sand stone dust, strength of mortar, replacement.

## 1. INTRODUCTION

Mortar is produced composed of binder material and sand as fine aggregate. Moreover, mortar is used to hold together of bricks or stone and also used in other construction activities.

Due to rapid growth of construction activity, the available source of natural sand are getting exhausted and the day by day rate of sand will also increase. On the other hand, there are lots of stone mines in Saurashtra region which produce stone dust in large quantity while cutting the stone. The sand stone dust creates disposal problem, environmental problem due to its non-fertile properties and causing health hazards.

This study was carried out to overcome the above problems and to check the feasibility of replacement of sand stone dust with river sand in mortar with various proportions. An alternative material of sand is mitigating the increasing demand of sand.

In industrial advanced contrary, utilization of stone dust like marble powder, stone slurry etc. has been accepted as replacement of fine aggregate and concluded that the replacement give batter results in properties of mortar. In this present work the main objective is to determine the possibility of sand stone dust as replacement with fine aggregate in mortar in respect to the compressive strength. This study ensures that the sand stone dust is

used as alternative of sand in respect to compressive strength.

## 2. MATERIALS

The basic material for mortar is cement, sand and/or sand stone dust, and water.

### 2.1 CEMENT

In this study, ordinary Portland cement of 53 grade satisfying all the required specification of Indian standard IS 1489 part I(1991) was used.

### 2.2 SAND AND STONE DUST

The sand is used for make the mortar was well graded sand. Sand stone dust collected from Stone dust site in Una, Saurashtra region. The various properties of sand and Sand stone dust are showing below.

Table-1: - Chemical properties of Sand and Stone dust

CHEMICAL COMPONENT	SANDSTONE DUST	RIVER SAND
SiO <sub>2</sub>	1.17%	62.25%
Al <sub>2</sub> O <sub>3</sub>	1.60%	18.41%
Fe <sub>2</sub> O <sub>3</sub>	1.88 %	0%
CaO	48.94%	2.11%
K <sub>2</sub> O	0%	2.41%
MgO	2.07%	2.68%
Chloride	0.009%	0%
FeO	0%	10.84%
LOI	42.13%	0.46%

Table-2: - sieve analysis data

Sieve size	River sand		Sand Stone dust	
	Cumulati ve mass retained (g)	Cumulative present (%) retained	Cumulative mass retained (g)	Cumulative present (%) retained
4.75 mm	58.5	5.86	0	0
2.36 mm	122	12.237	5.56	1.12

1.18 mm	278.5	27.934	59.12	11.92
600 µm	412	41.324	128.47	25.90
300 µm	782	78.435	289.22	58.32
150 µm	980.5	98.345	416.46	83.98
Pan	1000	100	498.5	100

Table-3: -properties of sand and stone dust

Properties	Value of river sand	Value of SSD
<b>Bulk Density (Loose)</b>	1510.23 kg/m <sup>3</sup>	1348.35 kg/m <sup>3</sup>
<b>Bulk Density (Dense)</b>	1632.58 kg/m <sup>3</sup>	1545.93 kg/m <sup>3</sup>
<b>Fineness Modulus</b>	2.64	1.92
<b>Grading zone</b>	II	III
<b>Specific Gravity</b>	2.65	2.71
<b>Water absorption</b>	1.52%	3.12%

### 2.3 Water

Normal bore well water was used for making mortar.

### 3. SPECIMEN PREPARATION AND CURING

Cubes moulds of 70x70x70 mm are used as per the specification of Indian standards. The cement mortar mixes in proportion of 1:3 and 1:6 (cement: sand) and W/C = 0.60 was constant throughout the experiment. Three mortar cube were casted for each proportion with and the tested at 3, 7 and 28 days. Three sets of mortar cubes were casted as mention below:

1. Three sets of conventional mortar cube (0% replacement)
2. Three sets of Mortar cube made with 25% replacement of sand by stone dust
3. Three sets of Mortar cube made with 50% replacement of sand by stone dust

Cube moulds were cleaned, oiled and bolted properly before pouring of mortar. Mortar prepare in cleaned plastic tub by properly hand mixing. For hand mixing for preparing mortar, first off all the cement, sand and/or stone dusts are properly mixed in dry condition and then required quantity of water is added and again mixing up to the thoroughly same colour mixed.



Fig. 1: Casting of Cube specimen

After properly mixing of the mortar, Mortar was placed in to moulds in sequentially in three layer and each layer are well compacted. After that cubes were demoulded after 24 hours and cured in the curing tank. Cubes were cured at 3 days, 7 days and 28 days in curing tank. These cubes were tested on the universal testing machine for their compressive strength as per IS 2250-1981.



Fig. 2: Curing of Cube specimen

### 4. RESULTS AND DISCUSSIONS

The compressive strength of mortar cubes were tested at 3, 7 and 28 days after curing was properly done. The compressive strength of mortar cube of proportion of (cement: sand/stone dust) 1:3 and 1:6 with 0%, 25% and 50% replacement at 3 days, 7 days and 28 days is shown in figure.

Compressive strength of control mixed 1:3 obtained at 3, 7 and 28 days is 10.48 MPa, 14.06MPa, and 22.27 MPa. For 25% replacement of SSD with sand, compressive strength of cube at 3, 7 and 28 days is 10.27 MPa, 12.73MPa, and 21.47 MPa and For 50% replacement of SSD with sand, compressive strength of cube at 3, 7 and 28 days is 10.07 MPa, 12.46MPa, and 23 MPa.

Compressive strength of control mixed 1:6 obtained at 3, 7 and 28 days is 4.15 MPa, 4.6MPa, and 7.99 MPa. For 25% replacement of SSD with sand, compressive strength of cube at 3, 7 and 28 days is 4.01 MPa, 3.93MPa, and 7.46 MPa and For 50% replacement of SSD with sand, compressive strength of cube at 3, 7 and 28 days is 3.81 MPa, 3.47MPa, and 7.27 MPa.

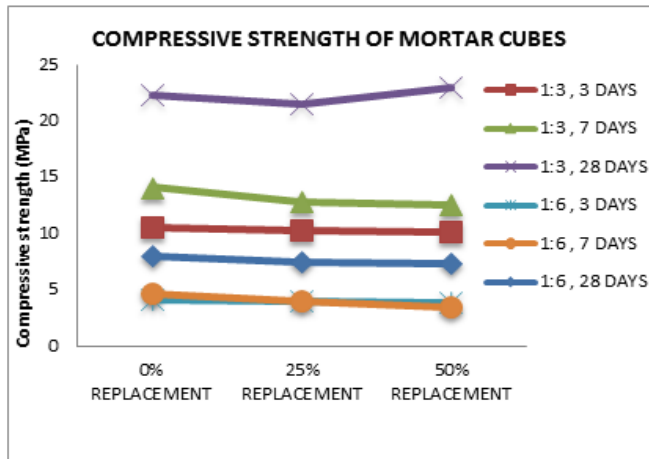


Chart -1: Compressive strength of mortar cube

## 5. CONCLUSIONS

- After the testing of cubes, it was concluded that for mortar cube 1:3 and 1:6 (cement: sand) the compressive strength at 3, 7 and 28 days strength is almost same with increasing the replacement percentage of sand stone dust.
- The value of compressive strength of mortar is satisfied the criteria of IS 2250-1981 i.e. minimum compressive strength for 1:3 and 1:6 mortar cube at age of 28 days is 7.5 MPa and 3 MPa respectively.
- From this experimental work, it was concluded that the replacement of Sand stone dust with river sand is possible in mortar. So, use of favourable stone dust is helps to make best use of waste material.

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