

Feasibility Study of Basalt Stone Tile a Case Study

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Abstract— In this paper studied the properties of the basalt stone to fusibility of the basalt stone tile. Tests on basalt available in Kerli Tal: Panahala Dist.: Kolhapur of western Maharashtra will be done to convent range of properties suitable for stone tile manufacturing. In which Compressive (Crushing) Strength Test, Flexural (transverse) Strength Test, Density and Porosity Test, Water Absorption Tests do for now the raw material properties of basalt stone.

Study the various properties of basalt stone tile for its suitability in construction as construction material. Its properties also compare with other nature stone tile (i.e. marble, granite.) with respect to water absorption test, density and porosity test, abrasion test, flexural (transverse) strength test

Index Terms—Abrasion Test, Apprent Specific Gravity, Compressive Strength Test, Flexural Strength Test, Porosity Test, Water Absorption

1 INTRODUCTION

Stone is a naturally available building material which has been used from the early age of civilization. It is available in the form of rocks, which is cut to required size and shape and used as building blocks. Basalt stone has been used to construct small residential building to large palace and temples in Maharashtra. It is also used as construction material for fort, temple, monuments, rajwadars, palaces and bridges etc. In modern construction industry use of basalt stone is being limited for crushed stones, for the following uses.

- As a basic inert material in concrete.
- For making artificial stones and building block.
- As railway ballast.

Availability of basalt is large in Maharashtra. The Deccan basalt province covers an area of about 5, 00,000 sq. km's in western and central India.

Due to various applications of basalt stone as construction material if processed and converted in appropriate building material, say as tiles for cladding, flooring and paving will save lot of cost.

2 Raw Material Testing

Testing of rock is important for finding out properties of rock. The properties of rock are important in deciding its construction purpose. To ascertain the required properties of basalt stone the following test were conducted.

1. Compressive (Crushing) Strength Test
2. Flexural (Transverse) Strength Test
3. Density and Porosity Test
4. Water Absorption Test

For the sample selection, physical properties of rock should be examined, damaged rock (due to blasting) should not be considered for testing.

2.1 Water Absorption, Apparent Specific Gravity and Porosity Test

TABLE 1
OBSERVATION TABLE OF WATER ABSORPTION, APPARENT SPECIFIC GRAVITY AND POROSITY TEST FOR KERLI STONE SAMPLE

Sample	A=Weight of oven - dry test piece in g.	B = Weight of saturated surface-dry test pieces in g.	C = Quantity of water added in 1000 ml jar containing the test piece in g.	Apprent specific gravity = $A / (1000 - C)$	Water Absorption = $((B - A) / A) \times 100$ in %	Porosity = $((B - A) / (1000 - C)) \times 100$ in %
1	509	515	832.5	3.04	1.18	3.58
2	510	517	834	3.07	1.37	4.22
3	508	513	832	3.02	0.98	2.98
Average				3.04	1.18	3.59

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2.2 COMPRESSIVE STRENGTH TEST

Where,

W = the maximum load in kg supported by the test piece before failure

A = area of bearing face of the specimen in cm².

C = compressive strength.

A) Saturated Condition

TABLE 2

OBSERVATIONTABLE OF COMPRESSIVE STRENGTH FOR KERLI STONE
SAMPLE AT SATURATED CONDITION

Sample	W	A	C
1	25000	60.84	410.91
2	32000	60.84	525.97
3	45000	60.84	739.64
Avg.			558.84

B) Dry Condition

TABLE 3

OBSERVATIONTABLE OF COMPRESSIVE STRENGTH FOR KERLI STONE
SAMPLE AT DRY CONDITION

Sample	W	A	C
1	42000	60.84	690.34
2	50000	60.84	821.83
3	78000	60.84	1282.05
Avg.			931.40

2.3 FLEXURAL STRENGTH TEST

A) Saturated Condition

TABLE 4

OBSERVATION TABLE OF FLEXURAL STRENGTH OF KERLI STONE
SAMPLE AT SATURATED CONDITION

Sample	Length in cm (L)	Central breaking load in kg (W)	Average width in cm (b)	Average depth in cm (d)	$R=(3WL)/(2bd*d)$ in kg/sq.cm	Average in kg/sq.cm
1	20.4	1610	5.13	5.21	353.80	338.55
2	20.4	1550	5.24	5.37	313.89	
3	20.3	1560	5.01	5.22	347.96	

B) Saturated Condition

TABLE 5
OBSERVATION TABLE OF FLEXURAL STRENGTH OF KERLI STONE
SAMPLE AT SATURATED CONDITION

Sample	Length in cm (L)	Central breaking load in kg (W)	Average width in cm (b)	Average depth in cm (d)	$R=(3WL)/(2bd*d)$ in kg/sq.cm	Average in kg/sq.cm
1	20.4	1250	5.25	5.19	270.48	291.71
2	20.4	1200	5.07	5.12	276.28	
3	20.5	1450	5.18	5.12	328.35	

3. TEST ON TILE

To ascertain the required properties of basalt stone tile the following test can be conducted.

1. Water Absorption Test
2. Density and Porosity Test
3. Abrasion Test
4. Flexural (Transverse) Strength Test

3.1 WATER ABSORPTION, APPRENT SPECIFIC GRAVITY AND POROSITY TEST

TABLE 8

OBSERVATION TABLE OF WATER ABSORPTION, APPARENT SPECIFIC GRAVITY AND POROSITY TEST FOR KERLI BASALT STONE TILE SAMPLE

Sample	A=Weight of oven - dry test piece in g.	B = Weight of saturated surface-dry test pieces in g.	C = Quantity of water added in 1000 ml jar containing the test piece in g.	Apprent specific gravity = $A / (1000 - C)$	Water Absorption = $((B-A)/A) \times 100$ in %	Porosity = $((B-A)/(1000-C)) \times 100$ in %
1	509	515	832.5	3.04	1.18	3.58
2	510	517	834	3.07	1.37	4.22
3	508	513	832	3.02	0.98	2.98
Average				3.04	1.18	3.59

3.2 ABRASION TEST

TABLE 9

OBSERVATION TABLE FOR ABRASION TEST OF BASALT STONE TILE

Sr. No	Initial t1 mm	Final t2 mm	Wear from thickness $t_v = t_2 - t_1$	Initial W1 gm	Final W2 gm	tw mm
1	18.04	17.26	0.78	263.99	249.96	0.96
2	15.54	15	0.54	229.33	217.25	0.82
3	15.12	15.02	0.1	227.97	225.38	0.17
4	16.9	16.64	0.26	246.53	237.12	0.65
5	15.4	15.22	0.18	226.31	216.99	0.63
6	15.74	15.46	0.28	227.47	218.63	0.61
Avg.			0.36	Avg.		0.64
Max.			0.78	Max.		0.96

3.3 FLEXURAL STRENGTH TEST

A) Saturated Condition

TABLE 10

OBSERVATION TABLE FOR FLEXURAL STRENGTH SAMPLE OF BASALT STONE TILE AT SATURATED CONDITION

Sample	Length in cm (L)	Central breaking load in kg (W)	Average width in cm (b)	Average depth in cm (d)	$R = (3WL)/(2bd*d)$ in kg/sq.cm	Average in kg/sq.cm
1	20.4	13.505	5.19	1.6	31.10	34.88
2	20.7	14.305	5.13	1.6	33.82	
3	20.3	15.7	5.21	1.52	39.72	

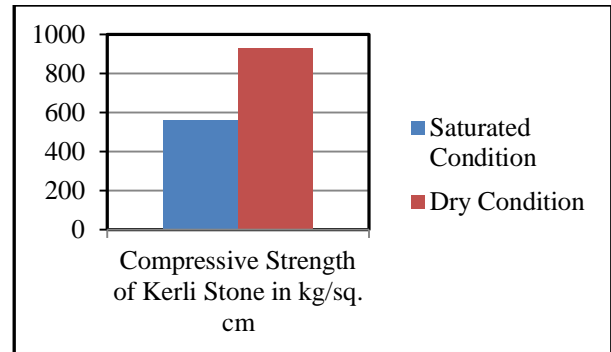


Fig. 2 Compressive Strength of Kerli Stone

B) Dry Condition

TABLE 10

OBSERVATION TABLE FOR FLEXURAL STRENGTH SAMPLE OF BASALT STONE TILE AT DRY CONDITION

Sample	Length in cm (L)	Central breaking load in kg (W)	Average width in cm (b)	Average depth in cm (d)	$R = (3WL)/(2bd*d)$ in kg/sq.cm	Average in kg/sq.cm
1	20.2	15.71	5.24	1.57	36.85	35.39
2	20.5	16.03	5.24	1.62	35.84	
3	20.7	15.345	5.23	1.65	33.46	

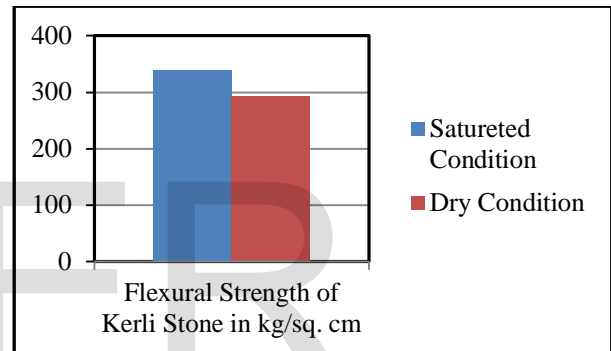


Fig. 3 Flexural Strength of Kerli Stone

4. RESULTS

4.1 RAW MATERIAL TESTING

1. The apparent specific gravity of Kerli stone is 3.04
2. The water absorption of Kerli stone is 1.18 %
3. The apparent porosity of Kerli stone is 3.59%

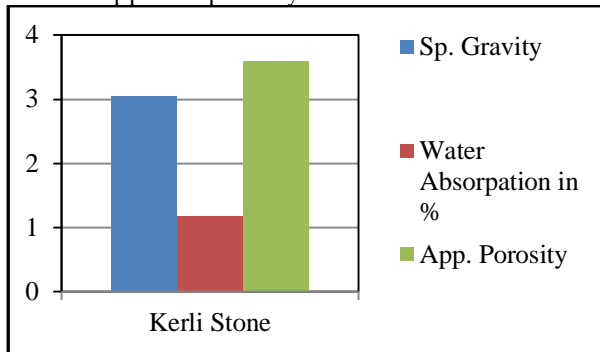


Fig. 1 Apparent Sp. Gravity, Water Absorption, App. Porosity of Kerli Stone

4. The compressive strength of the saturated specimen tested is 558.84 kg/ cm².
5. The compressive strength of the dry specimen tested is 931.40 kg/ cm².

4.2 BASALT STONE TILE TESTING

1. The apparent specific gravity of tile is 3.05
2. The water absorption of tile is 0.89 %
3. The apparent porosity of tile is 2.44 %

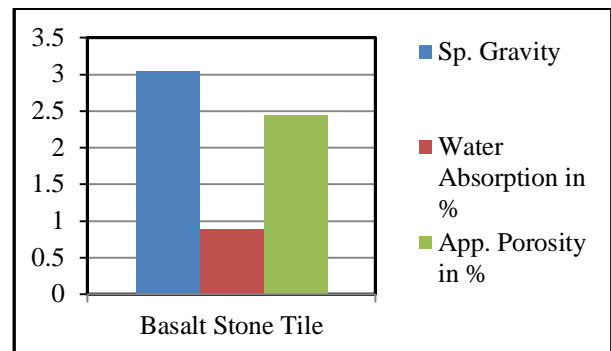


Fig. 4 Apparent Sp. Gravity, Water Absorption, App. Porosity of Basalt Stone Tile

4. Average wears i.e. loss of thickness t_v is 0.36 mm. Or t_w is 0.64 mm.
5. Max. Wear on individual tile t_v is 0.78 mm.

Or tw is 0.96mm.

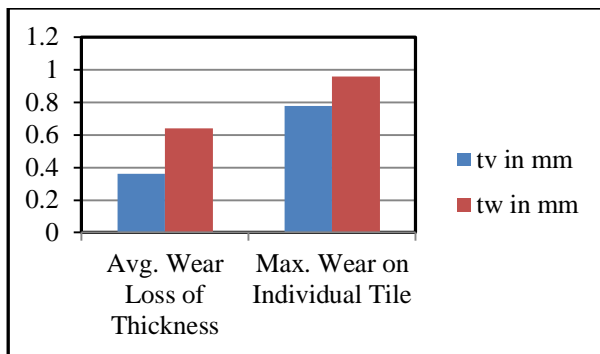


Fig. 5 Abrasion of Basalt Stone Tile

6. The flexural strength of the saturated specimen tested = 34.88 kg/ cm².

7. The flexural strength of the dry specimen tested = 35.39 kg/ cm². Max. Wear on individual tile tv is 0.78 mm.

Or tw is 0.96mm.

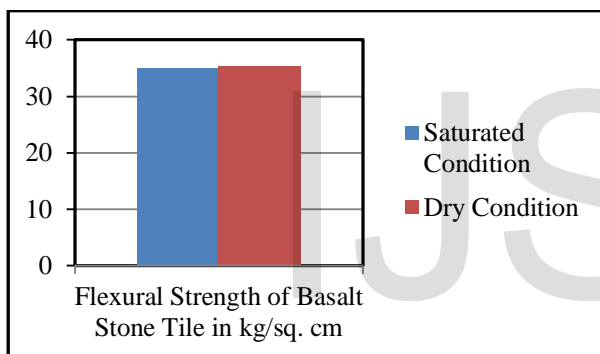


Fig. 6 Flexural Strength of Basalt Stone Tile

5 CONCLUSIONS

1. Stone from Kerli Tal.: Panhala, Dist.: Kolhapur is having specific gravity 3.04 slightly higher (2.6 - 3), water absorption is 1.18 % also higher (0 - 1 %), and porosity is 3.59 % very high (0.1 - 1 %) than stated in IS 1123 - 1973, compression and flexural strength of the stone is in the limit.
2. The apparent specific gravity of tile is 3.05 which is slightly higher than the required. Average specific gravity of tested sample of basalt stone tile is 3.05 but is in (2.6 - 3). Water absorption of basalt stone tile is 0.89 % which is in the limits (0 - 1 %). The apparent porosity of basalt stone tile is 2.44 % is below the limits (2.6 - 3 %).
3. Average wear i.e. loss of thickness tv is 0.36 mm limit for the loss of thickness (wear) of basalt stone tile is 2 mm for heavy duty tile average wear therefore the tile is good.
4. Average wear i.e. loss of thickness (wear) found out from loss of weight tw is 0.64 mm limit for the loss of thickness (wear) found out from loss of weight of basalt stone tile is 2

mm for heavy duty tile average wear therefore the tile is good.
5. Max. Wear on individual tile specimen loss of thickness (wear) of tested sample tv is 0.78 mm limit for the loss of thickness (wear) of individual basalt stone tile was 2.5 mm for heavy duty tiles wear on individual tile specimen therefore the tile is good.

6. Max. Wear on individual tile specimen loss of thickness (wear) found out from loss of weight of tested sample tw is 0.96 mm limit for the loss of thickness (wear) of individual basalt stone tile was 2.5 mm for heavy duty tiles wear on individual tile specimen therefore the tile is good.

7. The flexural strength of the saturated specimen tested basalt stone tile 34.88 kg/ cm². Comparatively basalt stone tile is lower flexural strength than granite stone tile 40.48 kg/ cm² and higher flexural strength than marble stone tile 18.32 kg/ cm² at saturated condition.

8. The flexural strength of the dry specimen tested basalt stone tile 35.39 kg/ cm². Comparatively basalt stone tile is lower flexural strength than the granite stone tile 39.31 kg/ cm² and higher flexural strength than marble stone tile 31.39 kg/ cm² at dry condition.

9. As the rocks is available in plenty and have good physical and mechanical properties, the stone selected from the case study site (Kerli) is suitable for tile manufacturing.

6 REFERENCES

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