ANALYSIS OF STRENGTH OF MASONRY BLOCKS MANUFACTURED BY PARTIAL REPLACEMENT OF M-SAND BY M-SAND DUST

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Abstract - *For good strength bricks w are using m-sand and cement,, but in this we used m-sand dust as an extra material which will help to reduce the amount of m-sand. M-sand dust is waste material which is easily available in m-sand plants.*

1.INTRODUCTION

In this project we are going to study about the strength variation of masonry blocks using m-sand, m-sand dust and cement.

In our country bricks are known as one of the most important building material and brick manufacturing industry is one of the most traditional industry normally related to rural areas.

1.1 Methodology

- Collection of materials as m-sand, m-sand dust, water and cement.
- Calculation of ingredients quantities.
- Mixing of ingredients
- Placing mortar in moulds
- Curing of bricks
- Testing of bricks

NOTE

- In this report we are using some notations which are explained as below
- D 1:3 – 1 unit of cement, 3 units of m-sand dust.
- D 1:4 – 1 unit of cement, 4 units of m-sand dust.
- D 1:2 – 1 unit of cement, 2 units of m-sand dust.
- S 1:4 or S 1:2:2 – 1 unit of cement, 2 units of m-sand, 2 units of m-sand dust.
- S 1:3 or S 1:1.5:1.5 – 1 unit of cement, 1.5 unit of m-sand, 1.5 unit of m-sand dust.
- S 1:2 or S 1:1:1 – 1 unit of cement, 1 unit of m-sand, 1 unit of m-sand dust.

2 ABOUT BRICKS AND MATERIALS

2.1 Bricks

. Bricks are nothing but a masonry blocks which helps in the construction of walls, compound walls, sometimes it also used for the construction of columns. Bricks are normally of rectangular shapes which will helps to laying the bricks, so that the load will get transferred in the structure. Most of the bricks are made by the clay and are kiln fired ones, but in this project we are going try it for M-sand dust and m-sand as a material for bricks.

Water Absorption of S 1:3 proportion brick,

$$= \frac{4240-4130}{34304130} \times 100 = 2.663\ \%$$

Tests on Cement

SL No.	Property of cement	Test results
1	Consistency of cement	31%
2	Initial Setting Time	133 Minutes
3	Final Setting Time	210 Minutes
4	Soundness	0.4 mm
5	Sieve Analysis	2% (retained on 90 mm sieve)
6	Specific Gravity	2.85

Tests on M-sand dust

Fineness Modulus of M-sand dust is = $\frac{459.5}{100}$ = **4.595**

Specific gravity of m-sand dust = $\frac{1170-645}{(1170-645)-(1775-1530)}$ = **1.857**

Moisture content of M-Sand dust = $\frac{29.52-27.48}{27.48} \times 100$ = **7.423 %**

Tests on M-sand

Specific gravity of m-sand = $\frac{1105-645}{(1105-645)-(1905-1530)}$ = **2.645**

Moisture content of M-Sand = $\frac{64.37-54.35}{54.35} \times 100$

= **18.436 %**

2.2 Cement

The cement should be clean and free from voids, passing through 90 mm sieve, fresh (not more than 3 months from manufactured date),it should be dry and it is kept a place which is free from water, placing in no moisture content place.

2.3 M-sand dust

- Free from stone pieces and clean
- Powdered type material and should not be wet form.
- Should be easily available from manufacturing place.

2.4 M-sand

- It should be clean, easily available, properties should be good as specific gravity etc.
- Should not contain any water content in it because it will results in variation in the strength.

4.1.4 Water

Clean and free from external materials which are not required, transparent water means it will not include any colours in it, not using any waste water.

3. CALCULATION OF MATERIALS

3.1 For 1 : 3 proportions (S 1:3)

SL. No	Materials	Quantity for 1 cube	Quantity for 3 cubes
1	Cement	210 gms	630 gms
2	Dust	630 gms	945 gms
3	M-Sand	315 gms	945 gms
4	Water	91 ml	273 ml

Table 1 Materials required for mortar cubes for S 1:3 proportion

3.2 For 1 : 2 : 2 proportions (S 1:4)

SL. No	Materials	Quantity for 1 cube	Quantity for 3 cubes
1	Cement	168 gms	504 gms
2	Dust	336 gms	1008 gms
3	M-Sand	336 gms	1008 gms
4	Water	91 ml	273 ml

Table 2 Materials required for mortar cubes for S 1:4 proportion

3.3 For 1:1.5:1.5 proportions (S 1:3)

SL. No	Materials	Quantity for 1 Brick
1	Cement	1162 gms
2	Dust	1743 gms
3	M-Sand	1743 gms
4	Water	500 ml

Table 3 Materials required for 1 brick for S 1:3 proportion

3.4 For 1:2:2 proportions (S 1:4)

SL. No	Materials	Quantity for 1 Brick
1	Cement	930 gms

2	Dust	1860 gms
3	M-Sand	1860 gms
4	Water	500 ml

Table 4 Materials required for 1 brick for S 1:4 proportion

3.5 Water content variation

The water content varied because the mix is not fully wet, by seeing the mix of cement mortar it should require some water content. Because of this water content the strength will also varied, So that we are going to vary the water content incrementally, hence we can get the highest strength of brick from the tests. The water is going to vary by 10%, 20%, 30%,…….. like this and the required amount of water is listed below.

SL NO.	% Variation (By Water Content) (in %)	Total Water Content (for 1 brick) (in ml)	Total Water Content (for 12 bricks) (in ml)
1	10	550	6600
2	20	600	7200
3	30	650	7800
4	40	700	8400
5	50	750	9000
6	60	800	9600
7	70	850	10200
8	80	900	10800
9	90	950	11400
10	100	1000	12000
11	110	1050	12600
12	120	1100	13200
13	130	1150	13800
14	140	1200	14400
15	150	1250	15000
16	160	1300	15600

Table 5 Amount of Water content for bricks

4. RESULTS AND ANALYSIS OF RESULTS

4.1 Bricks of S 1:3 and S 1:4 Proportion with Normal Mix

	SL NO.	7 days in N/mm²	28 days in N/mm²
S 1:3	1	14.462	16.528
	2	14.049	17.355
	3	13.636	16.117
	4	14.049	16.942
		14.049	16.735

Table 6 Strength of bricks of S 1:3 proportion

	SL NO.	7 days in N/mm²	28 days in N/mm²
S 1:4	1	12.396	14.876
	2	13.223	14.049
	3	13.223	14.462
	4	12.809	14.462
		12.912	14.462

Table 7 Strength of bricks of S 1:4 proportion

5.268 N/mm² is the strength at 7 days for S 1:4 (D 1:2:2) and strength at 28 days will be 6.818 N/mm² about 30% increment in strength from 7 to 28 days strength and comparing with D 1:3 proportion strength is very low about 80% strength reduces and if compared with DL 1:3 there is decrease in strength. The strength reduction from D 1:3 to D 1:4 proportion is because of m-sand dust material, so from this we come to know that as m-sand dust content increasing the strength goes on reducing and the dust loses the bonding strength of bricks. From the values of brick strength it shows the 4 brick showing different strength and the average value taken but it it seems no large variation in strength from 7 to 28 days strength which is occurred in SL bricks, there occurs a large variation of strength of bricks from 7 to 28 days. Here

we mixed only dust with cement and as dust is consists of smaller particles which is absorbing water content so because of this we are going to test bricks by varying water content in further.

Coming to the S 1:3 (SD 1:1.5:1.5 or S 1:1.5:1.5) 7 days strength got as 14.049 N/mm^2 and 28 days as 16.735 N/mm^2 as nearly 20% of increment in strength from 7 to 28 days, in case of SL mix the strength 50% low compared from S 1:3 at 7 days and 15% low strength at 28 days, from these results we come to know that the latex is reacting with m-sand and the strength will be increasing as m-sand percentage is increases the strength and bonding capacity also increases. But in latex polymer is lowering the strength as compared from normal mixes S 1:3, hence the strength should be increased by increasing the m-sand content only, and for 1.5% latex the strength reduced by 35% at 7 and 15% reduces at 28 days, taking the consideration of D 1:3 mix there is an increase of strength about 40% at 7 and 35% at 28 days from D 1:3 to S 1:3 proportions and 180% increase in strength at 7 days and 160% increase in strength at 28 days as compared from D 1:4 by S 1:3. From these results there is an large variation is occurring and also variation in bonding strength of bricks also appears, as the m-sand content is added to the mix the strength suddenly increasing as seen by above variation of strength in percentages, so the m-sand material is very effective in brick strength variation. Hence if the strength of brick is to be increased and also the bonding capacity of bricks, there should be an increase in the amount of m-sand material. From these results we can conclude that if the bricks are made from m-sand and cement mix not using the m-sand dust as an ingredient, the strength we are getting is very high, but our project is to use m-sand dust which is a waste in m-sand industry.

For S 1:4 there is a decrease in strength as compared to S 1:3 proportion bricks and the strength of increased value as compared to D 1:3 and D 1:4 proportions. So according to this S 1:4 is having good strength and it can helpful in bricks made with economical because we required minimum strength for bricks as 5 N/mm^2 so all these tests results in preliminary for normal proportions the strength obtained is good.

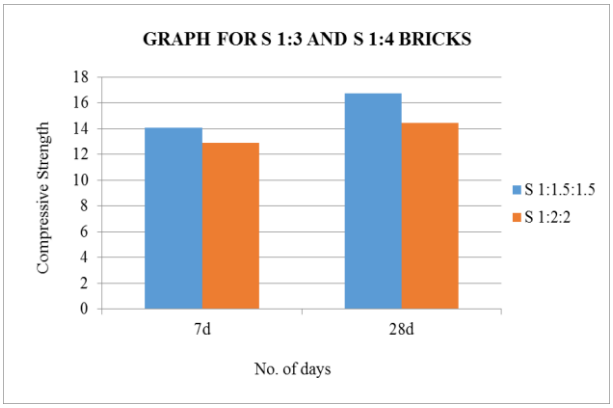

Figure 1 Comparison of strength of S 1:3 and S 1:4 proportion bricks

4.2 Bricks of S 1:3 Proportion with Variation of Water Content

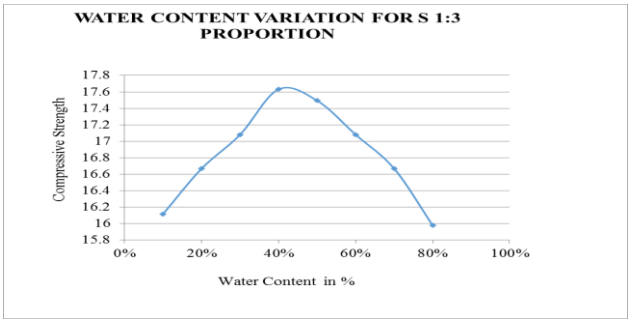

Figure 2 Impact of water substance on strength of S 1:3 proportional bricks

This represents the bricks of proportions 1:1.5:1.5 where 1.5 unit is m-sand and dust and it is

also written as S 1:3 and somewhere it is written as S 1:1.5:1.5 and the above graph shows variation of compressive strength for the proportion of S 1:3 bricks. As the graph shows like a parabolic variation in which it includes a higher value of strength with respect to water content variation, in this water content variation will be as 10%, 20%,…..80%, this is like because the m-sand having less water absorption capacity as compared to dust and in this process we are using 50% of m-sand instead of m-sand dust.

At first the strength will be 16.115 N/mm^2 at 10% addition of water content then at 20% water content there is increase in strength by 3% and again addition of water results increase in strength of brick, at 40% water content it shows a higher value of compressive strength of brick which is 17.630 N/mm^2 and it is nearly 10% more strength than the strength at 10% water content. So by this the strength will be more byaddition of water content and by increasing the water content to certain value.

After the maximum value of strength at 40% again increase in water content shows a decrease in strength of bricks which is lowers with respect to increase in water content.

SL No.	Percentage of Water Content	Average Compressive strength in N/mm^2
1	10%	16.115
2	20%	16.667
3	30%	17.079
4	40%	17.630
5	50%	17.493
6	60%	17.079
7	70%	16.666
8	80%	15.977

Table 8 Strength of S 1:3 proportional bricks with varying water content

4.3 Bricks of S 1:4 Proportion with Variation of Water Content

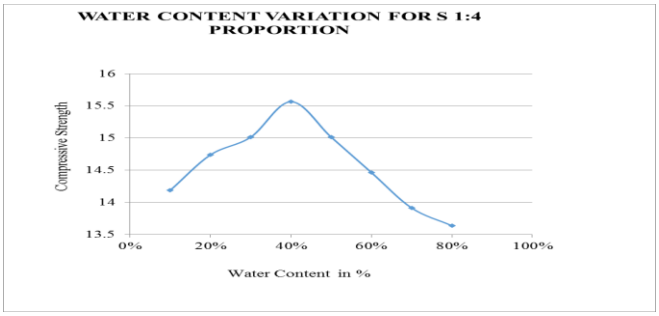

Figure 3 Impact of water substance on strength of S 1:4 proportional bricks

In this it is plotted variation of water content and compressive strength of bricks, as it shows at 40% water content the value is 15.564 N/mm^2 and it is 10% higher value than compared to value of strength at 10% water content, so by this the addition of water content results increase in the compressive strength of bricks, because it contains contents of m-sand and m-sand dust where dust having more absorption of water and it increases the bond in bricks if more water is added to it.

14.187 N/mm^2 is the strength at 10% water content again addition of more water content as 20%, 30% results increase in strength by 2% and 3% and after the it reaching a maximum value at 40% water percentage after that again increase in water content results lowering of strength in bricks.

SL No.	Percentage of Water Content	Average Compressive strength in N/mm^2
1	10%	14.187
2	20%	14.738
3	30%	15.013
4	40%	15.564
5	50%	15.013
6	60%	14.462
7	70%	13.911
8	80%	13.636

Table 9 Strength of S 1:4 proportional bricks with varying water content

5. ESTIMATION OF BRICKS

5.1 Cost of 1 Brick for S 1:3 Proportion

SL. No	Materials	Cost (in Rs)
1	Cement + Labour cost	8
2	Dust	Nil
3	M-Sand	2.5
4	Water	Nil
	Total Amount	10.5

Table 10 Estimation of 1 brick for S 1:3 proportion

5.2 Cost of 1 Brick for S 1:4 Proportion

SL. No	Materials	Cost (in Rs)
1	Cement + Labour cost	7
2	Dust	Nil
3	M-Sand	2.5
4	Water	Nil
	Total Amount	9.5

Table 11 Estimation of 1 brick for S 1:4 proportion

6. SCOPE OF STUDY

- Easily available to the construction site.
- Production can be done anywhere and anytime.
- High strength bricks can be used in thermal power plants and nuclear power plants in lower cost because the bricks for wall construction in power plants are of high cost.
- Dust is having higher fire resistance capacity than natural sand and bricks made from this also results as fire resistant bricks so can be used in power plants.
- These bricks reduce sound pollution.
- Bricks can be manufactured for artificial purpose.

7. CONCLUSION

- S 1:3 (1 unit cement, 1.5 units dust, 1.5 units m-sand) and S 1:4 (1 unit cement, 2 units dust, 2 units m-sand) bricks having more strength as compared with all proportions and these can be used in load bearing structures because the strength are 16.735 N/mm^2 and 14.462 N/mm^2 for S 1:3 and S 1:4 at 28 days and the strength at 7 days are 14.049 N/mm^2 and 12.912 N/mm^2 respectively, so these bricks can be used in wall construction of load bearing structures.
- The strength of the bricks can be increased by varying the water content and by this it gives the correct water content for different proportional bricks as the strength for brick S 1:3 at 40% water is 17.630 N/mm^2 and S 1:4 at 40% water is 15.564 N/mm^2 which all are shows10 to 20% more strength as compared with normal mixes, so by this we can conclude that water plays a main role in strength of bricks.
- Bricks by use of m-sand dust as partial replacement which helps to reduce the amount of m-sand material.
- By using m-sand and m-sand dust, bricks will get more strength.
- It will reduce the use of clay bricks and cement blocks which will helps to maintain environmental equality.
- These bricks are of low cost.
- Bricks which are made from this project are of more strength.

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