

**REPORT ON WORKING OUT THE  
PROPORTIONS FOR COMPRESSED  
STABILIZED EARTH BLOCK (CSEB)**



**FOR  
PROPOSED NALANDA UNIVERSITY PROJECT  
AT RAJGIR, BIHAR**

**VSCEPL  
Vinod Shah Consulting Engineers Pvt. Ltd.**

# **REPORT ON WORKING OUT THE PROPORTIONS FOR CSE BLOCK (CSEB) FOR PROPOSED NALANDA UNIVERSITY PROJECT AT RAJGIR, BIHAR**

## **Back Ground:**

Proposed Nalanda University project at Rajgir-Bihar is a large project with various types of Buildings. For residential buildings it is proposed to use Compressed Stabilised Earth Block (CSEB) using soil from the site.

Dr. Jagdish, former professor of Indian Institute of Science, is an expert on CSE-Block and is consulted for advice on the same. The report describes the procedure adopted for working out the proportions and methodology for manufacturing of CSE Block.

## **Proportions for Compressed Stabilized Earth Blocks (CSEB)**

The process has been carried out in two stages:

1. Working out the proportions of different ingredients by tests carried out on cubes of (70 x 70 x 70) mm at **Mrinmayee Laboratory, Bangalore** under the guidance of Dr. Jagdish.
2. As per the suggestions given by Dr. Jagdish, CSE blocks were manufactured using fully automatic machine at **M/S Kesarjan Building Centre Pvt. Ltd, Ahmedabad** under the supervision of Mr. Keyur Sharda. To match with the quantum of CSE block required for the construction, fully automatic mode of manufacturing is necessary.

## **Detail Description Along With Results**

The blocks are proposed to have a minimum strength of 7.5 MPa. Also confirming to the limiting codal requirement for water absorption of 15%

## **PHASE-01: WORK CARRIED OUT BY Dr. Jagdish (Refer Appendix-I)**

Mrinmayee was supplied with soil samples from two different locations on the site. The grain size distribution analysis was carried out and based on that different proportions using soil, sand and fly-ash with cement as binder were tried. As the soil was having high clay content it was proposed to modify the soil using lime. The test certificates are shown in Appendix-I.

Major observations/recommendations of the report by Mrinmayee:

1. As soil is high on clay and silt content, it was recommended to add 60 to 70% sand and fly ash.
2. 2 lab testing experiment gave the results of compressive strength as 4.29 MPa and 6 MPa, for cube size of 70 x 70 x 70 mm.
3. Suggestion for moulding: Moulding mix should be prepared a day prior to moulding and the mix should include soil with lime and 50% sand.

## **PHASE-02: WORK CARRIED OUT AT “Kesarjan Building Center Pvt. Ltd.”**

Manufacturing trial samples of CSE Blocks starting with the proportions recommended by Dr. Jagdish. The purpose of preparing these samples was to confirm the proportions, when the blocks were manufactured using automatic press. The proportions recommended by Dr. Jagdish were demarcated as Mix 1 and Mix 2 and were tried along with other mixes where fly ash was replaced with Surkhi (Crushed powder of burnt clay bricks)

The different trials were carried out to fine-tune the process of mixing the ingredients.

### **First trial (23.03.15):**

#### **1. The Planning of Mix:**

The mixes here were as per Dr. Jagdish's recommendation. The details are as followed.

**Table -01 Mixes with Fly-ash**

Mixes	Soil	Sand	Fly ash	Lime	Cement
Mix-01	31 %	43 %	26 %	5 %	8 %
Mix-02	40 %	48 %	13 %	5 %	8 %
Mix-03	35 %	49 %	16 %	5 %	8 %

**Table -02 Mixes with Surkhi**

Mixes	Soil	Sand	Surkhi	Lime	Cement
Mix-04	37 %	32 %	32 %	5 %	8 %
Mix-05	35 %	-	65 %	8 %	5 %
Mix-06	35 %	-	65 %	8 %	3 %

#### **2. Method:**

- The soil received from Nalanda site was in quite moist state, so it was allowed to dry in open area.
- After proper drying, the lumps of soil were broken with help of small hammer mill. The soil was sieved with 4 mm sieve.
- One day before making CSE block the fly ash and lime were mixed together.
- The final mix was prepared in pan type mixer and blocks of 115 x 85 x 230 were moulded in fully automatic hydro-vibro press.
- Freshly moulded blocks were covered with plastic sheet.
- Blocks were stacked and cured for 14 days by sprinkling water.

#### **3. Test Results : Refer Appendix-II**

*Proportions and Results are summarised in Appendix - III*

#### **4. Observation:**

1. Required wet strength of 7.5 MPa was achieved in Mix 1 and Mix 2 recommended by Dr. Jagdish
2. Mix with Surkhi also gave encouraging results however further work on this is required.

## **Second trial (11.04.15):**

### **1. The Planning of Mix:**

The mixes here were as per Dr. Jagdish's recommendation. The details are as followed.

**Table -03 Mixes with Fly-ash**

Mixes	Soil	Sand	Fly ash	Lime	Cement
Mix-01	30 %	44 %	26 %	5 %	8 %
Mix-02	39 %	49 %	13 %	5 %	8 %
Mix-03	35 %	49 %	16 %	5 %	8 %

**Table -04 Mixes with Surkhi**

Mixes	Soil	Sand	Surkhi	Lime	Cement
Mix-04	37 %	32 %	31 %	5 %	7 %
Mix-05	34 %	-	66 %	5 %	8 %
Mix-06	41 %	-	59 %	7 %	5 %

### **2. Method :**

- The soil was crushed and sieved through 4 mm sieve.
- One day before making CSE block the lime soil and sand were mixed together
- The final mix was prepared in pan type mixer and the blocks of 115x85x230 were moulded in fully automatic hydro-vibro press.
- Freshly moulded blocks were covered with plastic sheet.
- Blocks were stacked and cured for 14 days by sprinkling water

### **3. Results : Refer Appendix-II**

### **4. Observation:**

1. Increase in strength was observed
2. The mix prepared with Surkhi gave good strength, higher than the anticipated strength of 7.5 MPa. However when sand is replaced by surkhi, the water absorption of the units have increased considerably.
3. Further refinement in the method of mixing the ingredient was done as per Dr. Jagdish's guidelines i.e using saturated soil instead of crushing and sieving of soil. The third trial was carried out based on this approach.

*Proportions and Results are summarised in Appendix - III*

### Third trial (01.07.15):

#### 1. The Planning of Mix:

1. As per Prof Jagdish's suggestion, soil was saturated with water. Saturating the soil helped in breaking and dissolving the lumps, thus avoiding the need for crushing and sieving. Another advantage of working with saturated soil is that it facilitates working in monsoon or with wet soil.
2. The saturated soil is mixed with lime and sand a day before moulding is done.

**Table -05 Mixes with Surkhi**

Mixes	Soil	Sand	Surkhi	Lime	Cement
Mix-04	33 %	35 %	33 %	5 %	7.2 %
Mix-06	41 %	-	59 %	7 %	5.4 %

3. 35% soil and 65% surkhi is giving satisfactory results of compressive strength however the water absorption values were as high as 18%. So, a new mix having 37% soil, 11% sand and 52% Surkhi was tried.

#### 2. Method:

1. The soil was saturated in a tank.
2. Lime, soil and sand were mixed together a day before the process of moulding is done.
3. The final mix was prepared in a pan type mixer and the blocks were moulded in fully automatic hydro vibro press.
4. The freshly moulded blocks were covered with plastic sheet.
5. The next day blocks were stacked and cured for 14 days by sprinkling water.

#### 3. Results : Refer Appendix-II

*Proportions and Results are summarised in Appendix - III*

#### Final Recommendations:

1. Water absorption of the SMB made with only surkhi is very high.
2. Mix No. 4 gives satisfactory results, hence is recommended. Recommended proportions are:

- Soil – 33%
- Sand – 34%
- Surkhi – 33%

Binder as percentage

- Cement – 8%
- Lime - 5%

#### Proposed process for making Blocks:

- a. Soil shall be saturated to dissolve any lumps.
- b. Soil, lime and 50% of sand to be premixed a day before the moulding is to be done.
- c. Mixing shall be done in Muller type mixer.
- d. Moulding shall be done in either vibro-hydro press or hydraulic press.
- e. Freshly moulded bricks shall be immediately covered with plastic to prevent loss of moisture from the product.
- f. CSEB shall be cured at least for 15 days.

# APPENDIX - I

**Mrinmayee**

Consultants on Mud Blocks & Building Alternatives

#65/108, Doresanipalya, Bannerghatta road, Bangalore- 560 076. Tel/Fax- 080-26582970.

Vinod Shah Consulting Engineers Pvt. Ltd.,  
Ahmedabad

## TEST CERTIFICATE

Source of soil, sand and fly ash : Supplied by the client  
Sample reference : Sl. No on Bag : 7. (Depth 0.30 m).  
Project : Construction at Nalanda University, Bihar.

### Soil properties

Sand ( $4.75\text{ mm} - 75\text{ }\mu$ ) = 12.0%; Silt ( $75\text{ }\mu - 2\text{ }\mu$ ) = 59.0 %; Clay ( $< 2\text{ }\mu$ ) = 29.0%  
Liquid Limit : 50.69%, Plastic limit : 25.25%, Plasticity Index : 22.84%.  
pH : 8.5; Free swell index : 30%

## STRENGTH TEST RESULTS

Specimen size : 70 x 70 x 70 mm.  
Modified Soil Mix : (Soil + Sand + fly ash) = (1+1.125 + 0.325) by wt.  
Stabilizer : 8 % Cement and 5 % lime by wt. of the modified soil  
Compressive  
Strength (wet) : 2.74 MPa (7 days cured); 6.0 MPa ( 28 days cured)

## RECOMMENDATION

1. The soil should be sieved through 6 mm mesh after all the soil lumps are powdered.
2. The natural soil passing 6 mm mesh should be mixed in the ratio (1 soil : 1.125 sand : 0.325 Fly ash) by weight with a stabilizer combination of 5% lime and 8 % cement by weight in the production of stabilized soil blocks.
3. The soil shall be mixed with sand (50% of the total quantity) by adding sufficient water along with the required quantity of lime. The mixing has to be thoroughly carried out and left for a day. Fly ash, ordinary portland cement along with remaining 50 % of sand shall be added to the previously prepared mix to get the final mix proportion. Now the entire material has to be mixed thoroughly.
4. Stabilized soil blocks shall be made using the above mix ensuring the water content in the mix is not more than 12% of the total quantity. Freshly prepared blocks shall have a density of not less than  $20.20\text{ KN/m}^3$ . Such blocks will give a 28 day wet strength of about 7.5 MPa (with dry density =  $18.15\text{ KN/m}^3$ ).



A.V. Pramod.

Consulting Structural Engineer.

Mrinmayee.

No 64/108, Doresanipalya, Bilekahalli,  
Bannerghatta Road, Bangalore - 560076.

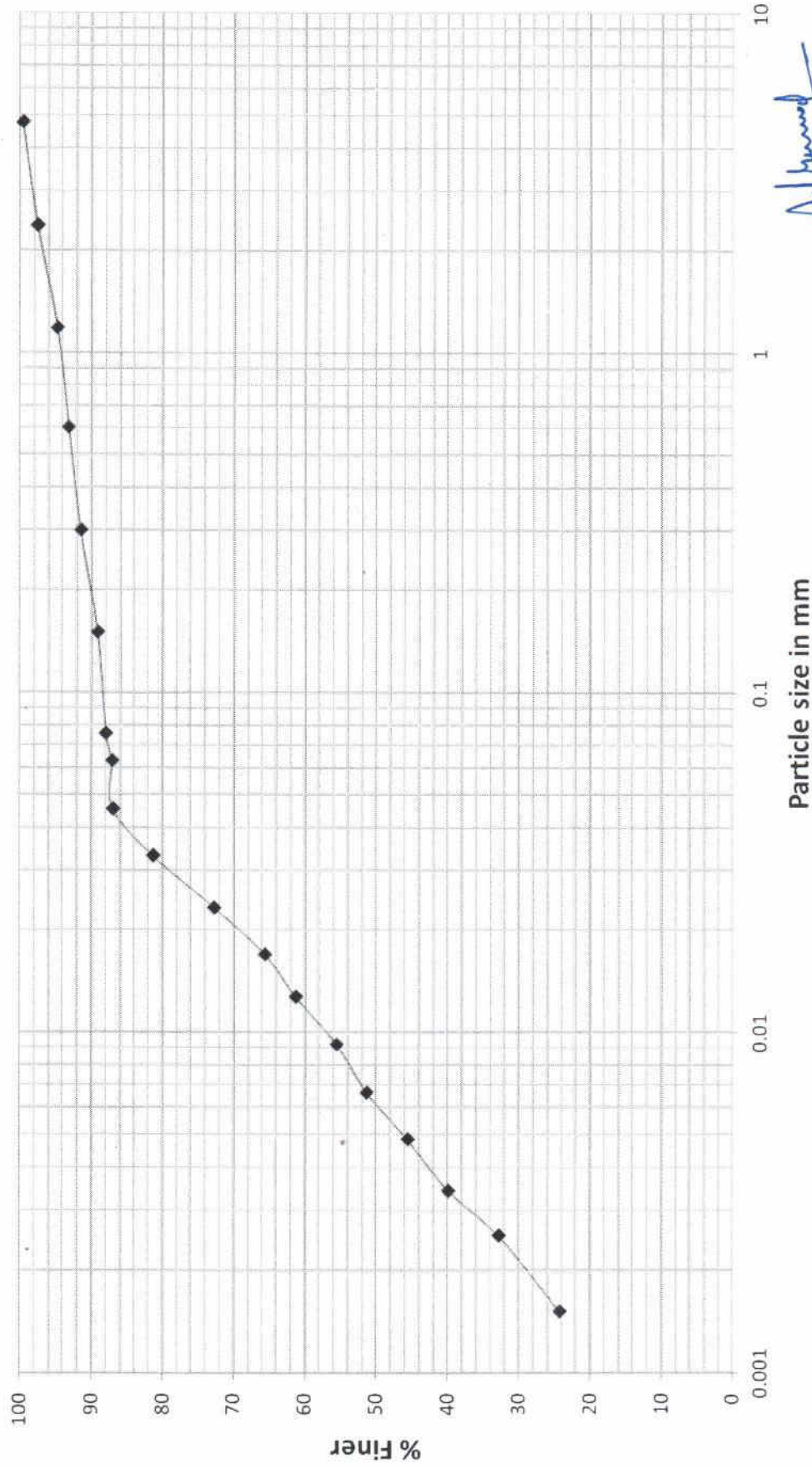
**Note :** The wet strength required should be ascertained by designing the masonry for any specific plan of the building. The density of the freshly made block shall be around  $20.20\text{ KN/m}^3$ .

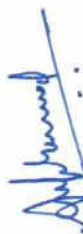
# Mrinmayee

Consultants on Mud Blocks & Building Alternatives

#65/108, Doresanipalya, Bannerghatta road, Bangalore- 560 076. Tel/Fax- 080-26582970.

Grain size distribution curve - Sl.No. on bag : 7 ( - 0.30 m )



  
A.V. Pramod.  
Consulting Structural Engineer.  
Mrinmayee.  
No 64/108, Doresanipalya, Bilekahalli,  
Bannerghatta Road, Bangalore - 560076.

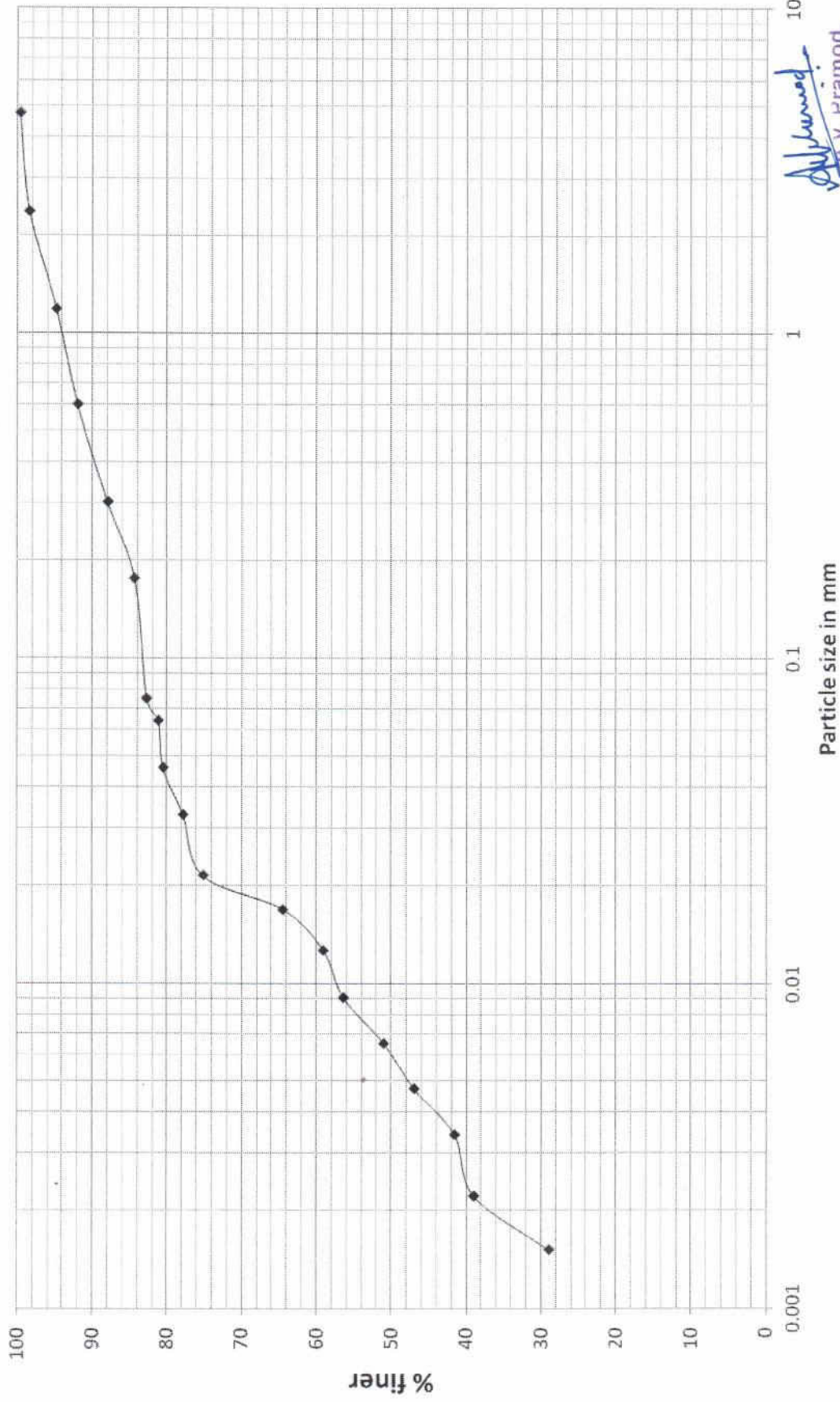


# Mrinmayee

Consultants on Mud Blocks & Building Alternatives

#65/108, Doresanipalya, Bannerghatta road, Bangalore- 560 076. Tel/Fax- 080-26582970.

Grain size analysis curve : Sl.No. on Bag : 12 ( - 1.50 m )



*A.V. Pramod*  
A.V. Pramod.  
Consulting Structural Engineer.  
Mrinmayee.  
No 64/108, Doresanipalya, Bilekahalli,  
Bannerghatta Road, Bangalore - 560076.



# Mrinmayee

Consultants on Mud Blocks & Building Alternatives

#65/108, Doresanipalya, Bannerghatta road, Bangalore- 560 076. Tel/Fax- 080-26582970.

Vinod Shah Consulting Engineers Pvt. Ltd.,  
Ahmedabad

## TEST CERTIFICATE

Source of soil sample : Supplied by the client  
Sample reference : Sl. No on Bag : 12. (Depth 1.50 m).  
Project : Construction of Nalanda University Campus.

### Soil properties

Sand ( $4.75\text{ mm} - 75\text{ }\mu$ ) : 17.2%, Silt ( $75\text{ }\mu - 2\text{ }\mu$ ) : 45.8 %, Clay ( $< 2\text{ }\mu$ ) : 37.0%  
Liquid Limit : 49.08%, Plastic limit : 19.59%, Plasticity Index : 29.49%.  
pH : 8.4; Free swell index : 30%

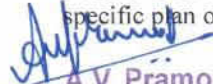
## STRENGTH TEST RESULTS

Specimen size : 70 x 70 x 70 mm.  
Soil Mix : (Soil + Sand + fly ash) = (1+1.5 + 0.83) by wt.  
Stabilizer : 8 % Cement + 5 % lime by wt. of the modified soil  
Compressive  
Strength (wet) : 2.38 MPa (7 days cured); 4.29 MPa ( 28 days cured)

## RECOMMENDATION

1. The soil should be sieved through 6 mm mesh after all the soil lumps are powdered.
2. The natural soil passing 6 mm mesh should be mixed in the ratio (1 soil : 1.5 sand : 0.83 Fly ash) by weight with a stabilizer combination of 5% lime and 8 % cement by weight in the production of stabilized soil blocks.
3. The soil shall be mixed with sand (50% of the total quantity) by adding sufficient water along with the required quantity of lime. The mixing has to be thoroughly carried out and left for a day. Fly ash, ordinary portland cement along with remaining 50 % of sand shall be added to the previously prepared mix to get the final mix proportion. Now the entire material has to be mixed thoroughly.
4. Stabilized soil blocks shall be made using the above mix ensuring the water content in the mix is not more than 12% of the total quantity. Freshly prepared blocks shall have a density of not less than  $20.20\text{ KN/m}^3$ . Such blocks will give a 28 day wet strength of about 6.0 MPa (with dry density =  $18.15\text{ KN/m}^3$ ).

**Note :** The wet strength required should be ascertained by designing the masonry for any specific plan of the building. . The density of the freshly made block shall be around  $20.11\text{ KN/m}^3$


  
A.V. Pramod.  
Consulting Structural Engineer.  
Mrinmayee.

# APPENDIX - II

## PROPORTIONS FOR TRIAL-01

		Soil	Sand	Surkhi	Fly Ash	Lime	Cement	
	Weight of Gamela	19	23	16.5	12			
MIX NO.1		1	1.5		0.83			3.33
		30%	45%		25%			
	375	112.61	168.92		93.47			
	Approx Gamela	5.93	7.34		7.79			
	Final Gamela	6	7		8	5%	8%	
	371	114	161	0	96	18.55	29.68	419.23
		31%	43%	0%	26%			
MIX NO.1		6	7		6	2	30	
MIX NO. 2		1	1.25		0.325			2.575
		39%	49%		13%			
	375	145.63	182.04		47.33			
	Approx Gamela	7.66	7.91		3.94			
	Final Gamela	8	8		4	5%	8%	
	384	152	184	0	48	19.2	30.72	433.92
		40%	48%	0%	13%			
MIX NO. 2		8	8		2	2	30	
MIX NO. 3		1	1.5		0.5			3
		33%	50%		17%			
	375	125.00	187.50		62.50			
	Approx Gamela	6.58	8.15		5.21			
	Final Gamela	7	8		5	5%	8%	
	377	133	184	0	60	18.85	30.16	426.01
		35%	49%	0%	16%			
MIX NO. 3		7	8		3	2	30	
MIX NO. 4		1	1	1				3
		33%	33%	33%	0%			
	375	125	125	125	0			
	Approx Gamela	6.58	5.43	7.58	0			
	Final Gamela	7	5	7	0	5%	8%	
	363.5	133	115	115.5	0	18.175	29.08	410.755
		37%	32%	32%	0%			
MIX NO. 4		7	5	5	0	2	30	
MIX NO. 5		1	0	2				3
		33%	0%	67%	0%			
	375	125	0	250	0			
	Approx Gamela	6.58	0.00	15.15	0			
	Final Gamela	7	0	15	0	8%	5%	
	380.5	133	0	247.5	0	30.44	19.025	429.965
		35%	0%	65%	0%			
MIX NO. 5		7	0	12	0	3	20	
MIX NO. 6		1	0	2				3
		33%	0%	67%	0%			
	375	125	0	250	0			
	Approx Gamela	6.58	0.00	15.15	0			
	Final Gamela	7	0	15	0	8%	3%	
	380.5	133	0	247.5	0	30.44	11.415	422.355
		35%	0%	65%	0%			
MIX NO. 6		7	0	12	0	3	12	

# Results of Trial - 1

<b>KBM ENGINEERING RESEARCH LABORATORY</b> H-79 PRARTHANA BUNGALOWS,VASANTNAGAR TOWN SHIP, GOTA-OGNAJ ROAD,AHMEDABAD-380060 PHONE: 02717 242373, 02717 241538 ,FAX : 02717 241538, e-mail: kbmerl@yahoo.co.in																																					
<b>LABORATORY TEST REPORT FOR STABILISED MUD BRICKS</b> (As per IS:3495)							<b>JOB.NO:</b> 15-16/034/1	<b>PAGE</b> 1 OF 1																													
							<b>DATE:</b> 29.04.2015																														
<b>Name of Project :</b> Takshashila, Bihar					Specimens Received on : 24.04.2015																																
					Reference letter No.Nil d 23.04.2015																																
<b>Name of Client :</b> Kesarjan Building Centre Pvt. Ltd. Ahmedabad					Condition of specimens on receipt : Dry																																
					Type of Specimens : Stabilised Mud Bricks																																
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;">TEST TO BE CONDUCTED</th> <th style="width: 15%;">REFERENCE</th> <th colspan="5">DATE TEST CONDUCTED</th> </tr> <tr> <th></th> <th></th> <th>(1)</th> <th>(2)</th> <th>(3)</th> <th>(4)</th> <th>(5)</th> </tr> </thead> <tbody> <tr> <td>Compressive Strength</td> <td>IS:3495 (P-1)</td> <td>29.4.15</td> <td>29.4.15</td> <td>29.4.15</td> <td>29.4.15</td> <td>29.4.15</td> </tr> <tr> <td>Water Absorption</td> <td>IS:3495 (P-2)</td> <td>28.4.15</td> <td>28.4.15</td> <td>28.4.15</td> <td>28.4.15</td> <td>28.4.15</td> </tr> </tbody> </table>										TEST TO BE CONDUCTED	REFERENCE	DATE TEST CONDUCTED							(1)	(2)	(3)	(4)	(5)	Compressive Strength	IS:3495 (P-1)	29.4.15	29.4.15	29.4.15	29.4.15	29.4.15	Water Absorption	IS:3495 (P-2)	28.4.15	28.4.15	28.4.15	28.4.15	28.4.15
TEST TO BE CONDUCTED	REFERENCE	DATE TEST CONDUCTED																																			
		(1)	(2)	(3)	(4)	(5)																															
Compressive Strength	IS:3495 (P-1)	29.4.15	29.4.15	29.4.15	29.4.15	29.4.15																															
Water Absorption	IS:3495 (P-2)	28.4.15	28.4.15	28.4.15	28.4.15	28.4.15																															
Sr. No.	Identification Mark	Dimensions of specimen Size (mm)			Cross-Sectional Area of Specimen (mm <sup>2</sup> )	Water Absorption (%)	Maximum Load (KN)	Compressive Strength (N/mm <sup>2</sup> )																													
		L	B	H																																	
1	No.1 23.3.15	229.0	110.0	75.0	25190.0	14.39	237.80	9.44																													
2	No.1 23.3.15	230.0	107.0	75.0	24610.0	17.91	179.50	7.29																													
3	No.1 23.3.15	229.5	110.0	75.0	25245.0	13.50	236.60	9.37																													
4	No.1 23.3.15	230.0	110.0	74.0	25300.0	14.28	203.70	8.05																													
5	No.1 23.3.15	229.5	108.0	75.0	24786.0	13.72	195.90	7.90																													
Average						14.76	Average		8.41																												
<b>NOTE:</b> 1) This report refers only to the specimen(s) submitted for the test. 2) This report shall not be reproduced except in full, without the written approval from this laboratory. 3) The specimens were collected by the client and supplied to the laboratory.																																					
<div style="display: flex; justify-content: space-between; align-items: center;"> <div> <p>Mihir P. Vora</p> <p><b>AUTHORISED SIGNATORY</b> For, KBM ENGINEERING RESEARCH LABORATORY</p> </div> <div>  </div> </div>																																					

# KBM ENGINEERING RESEARCH LABORATORY

H-79 PRARTHANA BUNGALOWS,VASANTNAGAR TOWN SHIP,

GOTA-OGNAJ ROAD,AHMEDABAD-380060

PHONE: 02717 242373, 02717 241538 ,FAX : 02717 241538, e-mail: kbmerl@yahoo.co.in

## LABORATORY TEST REPORT FOR STABILISED MUD BRICKS (As per IS:3495)

JOB.NO: 15-16/034/2  
PAGE 1 OF 1  
DATE: 29.04.2015

Name of Project : Takshashila, Bihar

Specimens Received on : 24.04.2015

Reference letter No.Nil d 23.04.2015

Condition of specimens on receipt : Dry

Name of Client : Kesarjan Building Centre Pvt. Ltd.  
Ahmedabad

Type of Specimens : Stabilised Mud Bricks

TEST TO BE CONDUCTED	REFERENCE	DATE TEST CONDUCTED				
		(1)	(2)	(3)	(4)	(5)
Compressive Strength	IS:3495 (P-1)	29.4.15	29.4.15	29.4.15	29.4.15	29.4.15
Water Absorption	IS:3495 (P-2)	28.4.15	28.4.15	28.4.15	28.4.15	28.4.15

Sr. No.	Identification Mark	Dimensions of specimen Size (mm)			Cross-Sectional Area of Specimen (mm <sup>2</sup> )	Water Absorption (%)	Maximum Load (KN)	Compressive Strength (N/mm <sup>2</sup> )
		L	B	H				
1	No.2 23.3.15	230.0	107.5	74.0	24725.0	17.44	175.70	7.11
2	No.2 23.3.15	229.5	108.0	74.0	24786.0	17.92	94.40	3.81
3	No.2 23.3.15	229.0	110.0	74.0	25190.0	19.37	71.20	2.83
4	No.2 23.3.15	229.5	108.5	75.0	24900.8	17.39	112.40	4.51
5	No.2 23.3.15	229.0	107.5	75.0	24617.5	12.80	247.20	10.04
Average						16.98		5.66

### NOTE:

- 1) This report refers only to the specimen(s) submitted for the test.
- 2) This report shall not be reproduced except in full, without the written approval from this laboratory.
- 3) The specimens were collected by the client and supplied to the laboratory.

Mihir P. Vora



**AUTHORISED SIGNATORY**  
For, KBM ENGINEERING RESEARCH LABORATORY

# KBM ENGINEERING RESEARCH LABORATORY

H-79 PRARTHANA BUNGALOWS,VASANTNAGAR TOWN SHIP,

GOTA-OGNAJ ROAD,AHMEDABAD-380060

PHONE: 02717 242373, 02717 241538 ,FAX : 02717 241538, e-mail: kbmerl@yahoo.co.in

## LABORATORY TEST REPORT FOR STABILISED MUD BRICKS (As per IS:3495)

JOB.NO: 15-16/034/3  
PAGE 1 OF 1  
DATE: 29.04.2015

Name of Project : Takshashila, Bihar

Specimens Received on : 24.04.2015

Reference letter No.Nil d 23.04.2015

Condition of specimens on receipt : Dry

Name of Client : Kesarjan Building Centre Pvt. Ltd.  
Ahmedabad

Type of Specimens : Stabilised Mud Bricks

TEST TO BE CONDUCTED	REFERENCE	DATE TEST CONDUCTED				
		(1)	(2)	(3)	(4)	(5)
Compressive Strength	IS:3495 (P-1)	29.4.15	29.4.15	29.4.15	29.4.15	29.4.15
Water Absorption	IS:3495 (P-2)	28.4.15	28.4.15	28.4.15	28.4.15	28.4.15

Sr. No.	Identification Mark	Dimensions of specimen Size (mm)			Cross-Sectional Area of Specimen (mm <sup>2</sup> )	Water Absorption (%)	Maximum Load (KN)	Compressive Strength (N/mm <sup>2</sup> )
		L	B	H				
1	No.3 23.3.15	230.0	110.0	74.0	25300.0	14.36	203.30	8.04
2	No.3 23.3.15	229.0	110.0	74.0	25190.0	17.66	88.30	3.51
3	No.3 23.3.15	230.0	110.0	75.0	25300.0	14.19	113.30	4.48
4	No.3 23.3.15	229.0	110.0	75.0	25190.0	14.79	180.70	7.17
5	No.3 23.3.15	230.0	110.0	74.0	25300.0	12.56	233.30	9.22
Average						14.71		Average 6.48

### NOTE:

- 1) This report refers only to the specimen(s) submitted for the test.
- 2) This report shall not be reproduced except in full, without the written approval from this laboratory.
- 3) The specimens were collected by the client and supplied to the laboratory.

Mihir P. Vora



**AUTHORISED SIGNATORY**  
For, KBM ENGINEERING RESEARCH LABORATORY

# KBM ENGINEERING RESEARCH LABORATORY

H-79 PRARTHANA BUNGALOWS,VASANTNAGAR TOWN SHIP,

GOTA-OGNAJ ROAD,AHMEDABAD-380060

PHONE: 02717 242373, 02717 241538 ,FAX : 02717 241538, e-mail: kbmerl@yahoo.co.in

## LABORATORY TEST REPORT FOR STABILISED MUD BRICKS (As per IS:3495)

JOB.NO: 15-16/034/4  
PAGE 1 OF 1  
DATE: 29.04.2015

Name of Project : Takshashila, Bihar

Specimens Received on : 24.04.2015

Reference letter No.Nil d 23.04.2015

Condition of specimens on receipt : Dry

Name of Client : Kesarjan Building Centre Pvt. Ltd.  
Ahmedabad

Type of Specimens : Stabilised Mud Bricks

TEST TO BE CONDUCTED	REFERENCE	DATE TEST CONDUCTED				
		(1)	(2)	(3)	(4)	(5)
Compressive Strength	IS:3495 (P-1)	29.4.15	29.4.15	29.4.15	29.4.15	29.4.15
Water Absorption	IS:3495 (P-2)	28.4.15	28.4.15	28.4.15	28.4.15	28.4.15

Sr. No.	Identification Mark	Dimensions of specimen Size (mm)			Cross- Sectional Area of Specimen (mm <sup>2</sup> )	Water Absorption (%)	Maximum Load (KN)	Compressive Strength (N/mm <sup>2</sup> )
		L	B	H				
1	No.4 23.3.15	230.0	110.0	74.0	25300.0	15.20	182.80	7.23
2	No.4 23.3.15	230.0	110.0	75.0	25300.0	16.09	143.30	5.66
3	No.4 23.3.15	230.0	110.0	75.0	25300.0	16.31	160.30	6.34
4	No.4 23.3.15	230.0	110.0	75.0	25300.0	13.96	208.50	8.24
5	No.4 23.3.15	230.0	110.0	76.0	25300.0	17.35	133.30	5.27
Average						15.78		Average 6.55

### NOTE:

- 1) This report refers only to the specimen(s) submitted for the test.
- 2) This report shall not be reproduced except in full, without the written approval from this laboratory.
- 3) The specimens were collected by the client and supplied to the laboratory.

Mihir P. Vora



**AUTHORISED SIGNATORY**  
For, KBM ENGINEERING RESEARCH LABORATORY



# KBM ENGINEERING RESEARCH LABORATORY

H-79 PRARTHANA BUNGALOWS,VASANTNAGAR TOWN SHIP,

GOTA-OGNAJ ROAD,AHMEDABAD-380060

PHONE: 02717 242373, 02717 241538 ,FAX : 02717 241538, e-mail: kbmerl@yahoo.co.in

## LABORATORY TEST REPORT FOR STABILISED MUD BRICKS

(As per IS:3495)

JOB.NO: 15-16/034/5

PAGE 1 OF 1

DATE: 29.04.2015

Name of Project : Takshashila, Bihar

Specimens Received on : 24.04.2015

Reference letter No.Nil d 23.04.2015

Condition of specimens on receipt : Dry

Name of Client : Kesarjan Building Centre Pvt. Ltd.  
Ahmedabad

Type of Specimens : Stabilised Mud Bricks

TEST TO BE CONDUCTED	REFERENCE	DATE TEST CONDUCTED				
		(1)	(2)	(3)	(4)	(5)
Compressive Strength	IS:3495 (P-1)	29.4.15	29.4.15	29.4.15	29.4.15	29.4.15
Water Absorption	IS:3495 (P-2)	28.4.15	28.4.15	28.4.15	28.4.15	28.4.15

Sr. No.	Identification Mark	Dimensions of specimen Size (mm)			Cross- Sectional Area of Specimen (mm <sup>2</sup> )	Water Absorption (%)	Maximum Load (KN)	Compressive Strength (N/mm <sup>2</sup> )
		L	B	H				
1	No.5 23.3.15	229.5	109.5	74.0	25130.3	17.76	151.90	6.04
2	No.5 23.3.15	229.0	107.5	75.0	24617.5	17.15	222.60	9.04
3	No.5 23.3.15	230.0	110.5	74.0	25415.0	18.33	126.90	4.99
4	No.5 23.3.15	229.0	106.5	74.0	24388.5	19.57	145.10	5.95
5	No.5 23.3.15	229.0	109.0	75.0	24961.0	19.17	164.00	6.57
Average						18.40		Average 6.52

### NOTE:

- 1) This report refers only to the specimen(s) submitted for the test.
- 2) This report shall not be reproduced except in full, without the written approval from this laboratory.
- 3) The specimens were collected by the client and supplied to the laboratory.

Mihir P. Vora



**AUTHORISED SIGNATORY**

**For, KBM ENGINEERING RESEARCH LABORATORY**

# KBM ENGINEERING RESEARCH LABORATORY

H-79 PRARTHANA BUNGALOWS,VASANTNAGAR TOWN SHIP,

GOTA-OGNAJ ROAD,AHMEDABAD-380060

PHONE: 02717 242373, 02717 241538 ,FAX : 02717 241538, e-mail: kbmerl@yahoo.co.in

## LABORATORY TEST REPORT FOR STABILISED MUD BRICKS (As per IS:3495)

JOB.NO: 15-16/034/6  
PAGE 1 OF 1  
DATE: 29.04.2015

Name of Project : Takshashila, Bihar

Specimens Received on : 24.04.2015

Reference letter No.Nil d 23.04.2015

Condition of specimens on receipt : Dry

Name of Client : Kesarjan Building Centre Pvt. Ltd.  
Ahmedabad

Type of Specimens : Stabilised Mud Bricks

TEST TO BE CONDUCTED	REFERENCE	DATE TEST CONDUCTED				
		(1)	(2)	(3)	(4)	(5)
Compressive Strength	IS:3495 (P-1)	29.4.15	29.4.15	29.4.15	29.4.15	29.4.15
Water Absorption	IS:3495 (P-2)	28.4.15	28.4.15	28.4.15	28.4.15	28.4.15

Sr. No.	Identification Mark	Dimensions of specimen Size (mm)			Cross-Sectional Area of Specimen (mm <sup>2</sup> )	Water Absorption (%)	Maximum Load (KN)	Compressive Strength (N/mm <sup>2</sup> )
		L	B	H				
1	No.6 23.3.15	230.0	110.0	74.0	25300.0	24.50	54.90	2.17
2	No.6 23.3.15	229.5	110.0	75.0	25245.0	18.65	148.20	5.87
3	No.6 23.3.15	230.0	110.0	75.0	25300.0	21.49	99.30	3.92
4	No.6 23.3.15	229.5	109.5	75.0	25130.3	19.82	132.00	5.25
5	No.6 23.3.15	229.0	110.0	75.0	25190.0	22.51	121.60	4.83
Average						21.39		4.41

### NOTE:

- 1) This report refers only to the specimen(s) submitted for the test.
- 2) This report shall not be reproduced except in full, without the written approval from this laboratory.
- 3) The specimens were collected by the client and supplied to the laboratory.

Mihir P. Vora



**AUTHORISED SIGNATORY**  
For, KBM ENGINEERING RESEARCH LABORATORY

## Results of Trial - 2

### KBM ENGINEERING RESEARCH LABORATORY

H-79 PRARTHANA BUNGALOWS,VASANTNAGAR TOWN SHIP,

GOTA-OGNAJ ROAD,AHMEDABAD-380060

PHONE: 02717 242373, 02717 241538 ,FAX : 02717 241538, e-mail: kbmerl@yahoo.co.in

**LABORATORY TEST REPORT  
FOR STABILISED MUD BRICKS**  
(As per IS:3495)

**JOB.NO:** 15-16/082/7

**PAGE** 1 OF 1

**DATE:** 4.06.2015

**Name of Project :** Takshashila, Bihar

Specimens Received on : 19.05.2015

Reference letter No.Nil d1 19.05.2015

Condition of specimens on receipt : Dry

**Name of Client :** Kesarjan Building Centre Pvt. Ltd.  
Ahmedabad

Type of Specimens : Stabilised Mud Bricks

TEST TO BE CONDUCTED	REFERENCE	DATE TEST CONDUCTED				
		(1)	(2)	(3)	(4)	(5)
Compressive Strength	IS:3495 (P-1)	3.6.15	3.6.15	3.6.15	3.6.15	3.6.15
Water Absorption	IS:3495 (P-2)	1.6.15	1.6.15	1.6.15	1.6.15	1.6.15

Sr. No.	Identification Mark	Dimensions of specimen Size (mm)			Cross-Sectional Area of Specimen (mm <sup>2</sup> )	Water Absorption (%)	Maximum Load (KN)	Compressive Strength (N/mm <sup>2</sup> )
		L	B	H				
1	M1	230.0	110.0	75.0	25300.0	16.38	346.50	13.70
2	M1	229.0	110.0	75.0	25190.0	14.17	313.40	12.44
3	M1	230.0	110.0	75.0	25300.0	17.00	156.00	6.17
4	M1	230.0	108.0	75.0	24840.0	18.23	136.80	5.51
5	M1	230.0	110.0	75.0	25300.0	14.21	274.70	10.86
						Average 16.00		Average 9.73

**NOTE:**

- 1) This report refers only to the specimen(s) submitted for the test.
- 2) This report shall not be reproduced except in full, without the written approval from this laboratory.
- 3) The specimens were collected by the client and supplied to the laboratory.

**AUTHORISED SIGNATORY**

For, KBM ENGINEERING RESEARCH LABORATORY

# KBM ENGINEERING RESEARCH LABORATORY

H-79 PRARTHANA BUNGALOWS,VASANTNAGAR TOWN SHIP,

GOTA-OGNAJ ROAD,AHMEDABAD-380060

PHONE: 02717 242373, 02717 241538 ,FAX : 02717 241538, e-mail: kbmerl@yahoo.co.in

## LABORATORY TEST REPORT FOR STABILISED MUD BRICKS (As per IS:3495)

JOB.NO: 15-16/082/8

PAGE 1 OF 1

DATE: 4.06.2015

Name of Project : Takshashila, Bihar

Specimens Received on : 19.05.2015

Reference letter No.Nil d1 19.05.2015

Condition of specimens on receipt : Dry

Name of Client : Kesarjan Building Centre Pvt. Ltd.  
Ahmedabad

Type of Specimens : Stabilised Mud Bricks

TEST TO BE CONDUCTED	REFERENCE	DATE TEST CONDUCTED				
		(1)	(2)	(3)	(4)	(5)
Compressive Strength	IS:3495 (P-1)	3.6.15	3.6.15	3.6.15	3.6.15	3.6.15
Water Absorption	IS:3495 (P-2)	1.6.15	1.6.15	1.6.15	1.6.15	1.6.15

Sr. No.	Identification Mark	Dimensions of specimen Size (mm)			Cross- Sectional Area of Specimen (mm <sup>2</sup> )	Water Absorption (%)	Maximum Load (KN)	Compressive Strength (N/mm <sup>2</sup> )
		L	B	H				
1	M2	230.0	110.0	75.0	25300.0	14.52	317.00	12.53
2	M2	230.0	110.0	75.0	25300.0	13.56	329.70	13.03
3	M2	229.5	111.0	75.0	25474.5	15.25	215.10	8.44
4	M2	230.0	110.0	75.0	25300.0	12.70	353.70	13.98
5	M2	230.0	110.0	75.0	25300.0	12.35	350.20	13.84
Average						13.68		Average 12.37

### NOTE:

- 1) This report refers only to the specimen(s) submitted for the test.
- 2) This report shall not be reproduced except in full, without the written approval from this laboratory.
- 3) The specimens were collected by the client and supplied to the laboratory.

### AUTHORISED SIGNATORY

For, KBM ENGINEERING RESEARCH LABORATORY

# KBM ENGINEERING RESEARCH LABORATORY

H-79 PRARTHANA BUNGALOWS,VASANTNAGAR TOWN SHIP,

GOTA-OGNAJ ROAD,AHMEDABAD-380060

PHONE: 02717 242373, 02717 241538 ,FAX : 02717 241538, e-mail: kbmerl@yahoo.co.in

## LABORATORY TEST REPORT FOR STABILISED MUD BRICKS (As per IS:3495)

JOB.NO: 15-16/082/3

PAGE 1 OF 1

DATE: 27.05.2015

Name of Project : Takshashila, Bihar

Specimens Received on : 19.05.2015

Reference letter No.Nil d1 19.05.2015

Condition of specimens on receipt : Dry

Name of Client : Kesarjan Building Centre Pvt. Ltd.  
Ahmedabad

Type of Specimens : Stabilised Mud Bricks

TEST TO BE CONDUCTED	REFERENCE	DATE TEST CONDUCTED				
		(1)	(2)	(3)	(4)	(5)
Compressive Strength	IS:3495 (P-1)	27.5.15	27.5.15	27.5.15	27.5.15	27.5.15
Water Absorption	IS:3495 (P-2)	23.5.15	23.5.15	23.5.15	23.5.15	23.5.15

Sr. No.	Identification Mark	Dimensions of specimen Size (mm)			Cross-Sectional Area of Specimen (mm <sup>2</sup> )	Water Absorption (%)	Maximum Load (KN)	Compressive Strength (N/mm <sup>2</sup> )
		L	B	H				
1	M3	229.5	111.5	74.0	25589.3	13.64	213.60	8.35
2	M3	229.5	112.0	75.0	25704.0	13.75	246.40	9.59
3	M3	229.0	110.5	75.0	25304.5	13.47	291.00	11.50
4	M3	229.0	109.5	75.0	25075.5	11.44	387.70	15.46
5	M3	229.0	112.0	74.0	25648.0	14.30	273.10	10.65
Average						13.32		11.11

### NOTE:

- 1) This report refers only to the specimen(s) submitted for the test.
- 2) This report shall not be reproduced except in full, without the written approval from this laboratory.
- 3) The specimens were collected by the client and supplied to the laboratory.

Mihir P. Vora



**AUTHORISED SIGNATORY**

**For, KBM ENGINEERING RESEARCH LABORATORY**

# KBM ENGINEERING RESEARCH LABORATORY

H-79 PRARTHANA BUNGALOWS,VASANTNAGAR TOWN SHIP,

GOTA-OGNAJ ROAD,AHMEDABAD-380060

PHONE: 02717 242373, 02717 241538 ,FAX : 02717 241538, e-mail: kbmerl@yahoo.co.in

## LABORATORY TEST REPORT FOR STABILISED MUD BRICKS (As per IS:3495)

JOB.NO: 15-16/082/4

PAGE 1 OF 1

DATE: 30.05.2015

Name of Project : Takshashila, Bihar

Specimens Received on : 19.05.2015

Reference letter No.Nil d1 19.05.2015

Condition of specimens on receipt : Dry

Name of Client : Kesarjan Building Centre Pvt. Ltd.  
Ahmedabad

Type of Specimens : Stabilised Mud Bricks

TEST TO BE CONDUCTED	REFERENCE	DATE TEST CONDUCTED				
		(1)	(2)	(3)	(4)	(5)
Compressive Strength	IS:3495 (P-1)	30.5.15	30.5.15	30.5.15	30.5.15	30.5.15
Water Absorption	IS:3495 (P-2)	29.5.15	29.5.15	29.5.15	29.5.15	29.5.15

Sr. No.	Identification Mark	Dimensions of specimen Size (mm)			Cross-Sectional Area of Specimen (mm <sup>2</sup> )	Water Absorption (%)	Maximum Load (KN)	Compressive Strength (N/mm <sup>2</sup> )
		L	B	H				
1	M4	230.0	110.0	75.0	25300.0	13.01	310.10	12.26
2	M4	230.0	109.5	75.0	25185.0	14.10	246.40	9.78
3	M4	229.0	110.0	75.0	25190.0	13.61	291.00	11.55
4	M4	230.0	110.0	75.0	25300.0	15.01	387.70	15.32
5	M4	230.0	110.0	75.0	25300.0	14.79	273.10	10.79
Average						14.10		Average 11.94

### NOTE:

- 1) This report refers only to the specimen(s) submitted for the test.
- 2) This report shall not be reproduced except in full, without the written approval from this laboratory.
- 3) The specimens were collected by the client and supplied to the laboratory.

### AUTHORISED SIGNATORY

For, KBM ENGINEERING RESEARCH LABORATORY



# KBM ENGINEERING RESEARCH LABORATORY

H-79 PRARTHANA BUNGALOWS,VASANTNAGAR TOWN SHIP,

GOTA-OGNAJ ROAD,AHMEDABAD-380060

PHONE: 02717 242373, 02717 241538 ,FAX : 02717 241538, e-mail: kbmerl@yahoo.co.in

## LABORATORY TEST REPORT FOR STABILISED MUD BRICKS (As per IS:3495)

JOB.NO: 15-16/082/5

PAGE 1 OF 1

DATE: 30.05.2015

Name of Project : Takshashila, Bihar

Specimens Received on : 19.05.2015

Reference letter No.Nil d1 19.05.2015

Condition of specimens on receipt : Dry

Name of Client : Kesarjan Building Centre Pvt. Ltd.  
Ahmedabad

Type of Specimens : Stabilised Mud Bricks

TEST TO BE CONDUCTED	REFERENCE	DATE TEST CONDUCTED				
		(1)	(2)	(3)	(4)	(5)
Compressive Strength	IS:3495 (P-1)	29.5.15	29.5.15	29.5.15	29.5.15	29.5.15
Water Absorption	IS:3495 (P-2)	27.5.15	27.5.15	27.5.15	27.5.15	27.5.15

Sr. No.	Identification Mark	Dimensions of specimen Size (mm)			Cross- Sectional Area of Specimen (mm <sup>2</sup> )	Water Absorption (%)	Maximum Load (KN)	Compressive Strength (N/mm <sup>2</sup> )
		L	B	H				
1	M5	230.0	111.0	75.0	25530.0	27.53	222.30	8.71
2	M5	229.5	110.0	75.0	25245.0	18.46	270.80	10.73
3	M5	230.0	110.0	75.0	25300.0	19.19	250.60	9.91
4	M5	230.0	110.0	75.0	25300.0	18.26	272.30	10.76
5	M5	230.0	110.0	75.0	25300.0	19.59	232.00	9.17
Average						20.61		Average 9.85

### NOTE:

- 1) This report refers only to the specimen(s) submitted for the test.
- 2) This report shall not be reproduced except in full, without the written approval from this laboratory.
- 3) The specimens were collected by the client and supplied to the laboratory.

### AUTHORISED SIGNATORY

For, KBM ENGINEERING RESEARCH LABORATORY

# KBM ENGINEERING RESEARCH LABORATORY

H-79 PRARTHANA BUNGALOWS,VASANTNAGAR TOWN SHIP,

GOTA-OGNAJ ROAD,AHMEDABAD-380060

PHONE: 02717 242373, 02717 241538 ,FAX : 02717 241538, e-mail: kbmerl@yahoo.co.in

## LABORATORY TEST REPORT FOR STABILISED MUD BRICKS (As per IS:3495)

JOB.NO: 15-16/082/1

PAGE 1 OF 1

DATE: 27.05.2015

Name of Project : Takshashila, Bihar

Specimens Received on : 19.05.2015

Reference letter No.Nil d1 19.05.2015

Condition of specimens on receipt : Dry

Name of Client : Kesarjan Building Centre Pvt. Ltd.  
Ahmedabad

Type of Specimens : Stabilised Mud Bricks

TEST TO BE CONDUCTED	REFERENCE	DATE TEST CONDUCTED				
		(1)	(2)	(3)	(4)	(5)
Compressive Strength	IS:3495 (P-1)	26.5.15	26.5.15	26.5.15	26.5.15	26.5.15
Water Absorption	IS:3495 (P-2)	23.5.15	23.5.15	23.5.15	23.5.15	23.5.15

Sr. No.	Identification Mark	Dimensions of specimen Size (mm)			Cross- Sectional Area of Specimen (mm <sup>2</sup> )	Water Absorption (%)	Maximum Load (KN)	Compressive Strength (N/mm <sup>2</sup> )
		L	B	H				
1	M6	229.5	110.0	75.0	25245.0	18.72	242.50	9.61
2	M6	230.0	110.0	75.0	25300.0	18.67	247.40	9.78
3	M6	230.0	110.0	75.0	25300.0	14.68	375.20	14.83
4	M6	230.0	111.0	74.0	25530.0	18.63	236.50	9.26
5	M6	230.0	110.0	75.0	25300.0	18.97	216.00	8.54
Average						17.94		Average 10.40

### NOTE:

- 1) This report refers only to the specimen(s) submitted for the test.
- 2) This report shall not be reproduced except in full, without the written approval from this laboratory.
- 3) The specimens were collected by the client and supplied to the laboratory.

Mihir P. Vora



**AUTHORISED SIGNATORY**

**For, KBM ENGINEERING RESEARCH LABORATORY**

## Results of Trial -3

### KBM ENGINEERING RESEARCH LABORATORY

H-79 PRARTHANA BUNGALOWS,VASANTNAGAR TOWN SHIP,

GOTA-OGNAJ ROAD,AHMEDABAD-380060

PHONE: 02717 242373, 02717 241538 ,FAX : 02717 241538, e-mail: kbmerl@yahoo.co.in

#### LABORATORY TEST REPORT FOR STABILISED MUD BRICKS

(As per IS:3495)

#### FINAL REPORT

**JOB.NO:** 15-16/258/1

**PAGE** 2 OF 2

**DATE:** 11.8.2015

**Name of Project :** Nalanda, Bihar

Specimens Received on : 5.8.2015

Reference letter No.Nil dt 4.8.2015

Condition of specimens on receipt : Dry

**Name of Client :** Kesarjan Building Centre Pvt. Ltd.  
Ahmedabad

Type of Specimens : Stabilised Mud Bricks  
(Wet soil Mix-4 Mfg 1/7/15)

TEST TO BE CONDUCTED	REFERENCE	DATE TEST CONDUCTED				
		(1)	(2)	(3)	(4)	(5)
Compressive Strength	IS:3495 (P-1)	10.8.15	10.8.15	10.8.15	10.8.15	10.8.15
Water Absorption	IS:3495 (P-2)	7.8.15	7.8.15	7.8.15	7.8.15	7.8.15

Sr. No.	Identification Mark	Dimensions of specimen Size (mm)			Cross-Sectional Area of Specimen (mm <sup>2</sup> )	Oven Dried Wt. of Specimen (gms)	Saturated Wt. of Specimen (gms)	Water Absorption (%)	Maximum Load (KN)	Compressive Strength (N/mm <sup>2</sup> )
		L	B	H						
6	Mix-4 1/7/15	230.0	109.0	74.0	25070.0	3152.0	3616.0	14.72	224.20	8.94
7	Mix-4 1/7/15	230.0	109.0	75.0	25070.0	3366.0	3800.0	12.89	467.10	18.63
8	Mix-4 1/7/15	229.5	109.0	75.0	25015.5	3222.0	3694.0	14.65	311.00	12.43
9	Mix-4 1/7/15	230.0	108.0	75.0	24840.0	3162.0	3640.0	15.12	321.20	12.93
10	Mix-4 1/7/15	230.0	109.0	75.0	25070.0	3246.0	3702.0	15.90	326.10	13.01
Average								14.66		13.19

#### NOTE:

- 1) This report refers only to the specimen(s) submitted for the test.
- 2) This report shall not be reproduced except in full, without the written approval from this laboratory.
- 3) The specimens were collected by the client and supplied to the laboratory.

# KBM ENGINEERING RESEARCH LABORATORY

H-79 PRARTHANA BUNGALOWS,VASANTNAGAR TOWN SHIP,

GOTA-OGNAJ ROAD,AHMEDABAD-380060

PHONE: 02717 242373, 02717 241538 ,FAX : 02717 241538, e-mail: kbmerl@yahoo.co.in

## LABORATORY TEST REPORT FOR STABILISED MUD BRICKS

(As per IS:3495)

### FINAL REPORT

JOB.NO: 15-16/258/1

PAGE 1 OF 2

DATE: 11.8.2015

Name of Project : Nalanda, Bihar

Specimens Received on : 5.8.2015

Reference letter No.Nil dt 4.8.2015

Name of Client : Kesarjan Building Centre Pvt. Ltd.  
Ahmedabad

Condition of specimens on receipt : Dry

Type of Specimens : Stabilised Mud Bricks  
(Wet soil Mix-4 Mfg 1/7/15)

TEST TO BE CONDUCTED	REFERENCE	DATE TEST CONDUCTED				
		(1)	(2)	(3)	(4)	(5)
Compressive Strength	IS:3495 (P-1)	10.8.15	10.8.15	10.8.15	10.8.15	10.8.15
Water Absorption	IS:3495 (P-2)	7.8.15	7.8.15	7.8.15	7.8.15	7.8.15

Sr. No.	Identification Mark	Dimensions of specimen Size (mm)			Cross- Sectional Area of Specimen (mm <sup>2</sup> )	Oven Dried Wt. of Specimen (gms)	Saturated Wt. of Specimen (gms)	Water Absorption (%)	Maximum Load (KN)	Compressive Strength (N/mm <sup>2</sup> )
		L	B	H						
1	Mix-4 1/7/15	230.0	109.0	75.0	25070.0	3300.0	3712.0	12.48	366.80	14.63
2	Mix-4 1/7/15	230.0	110.0	75.0	25300.0	3294.0	3752.0	13.90	400.90	15.85
3	Mix-4 1/7/15	230.0	108.0	75.0	24840.0	3222.0	3676.0	14.09	359.80	14.48
4	Mix-4 1/7/15	230.0	109.0	75.0	25070.0	3116.0	3606.0	15.73	259.90	10.37
5	Mix-4 1/7/15	230.0	108.0	75.0	24840.0	3016.0	3518.0	16.64	236.80	9.53
Average								14.57		12.97

### NOTE:

- 1) This report refers only to the specimen(s) submitted for the test.
- 2) This report shall not be reproduced except in full, without the written approval from this laboratory.
- 3) The specimens were collected by the client and supplied to the laboratory.

# APPENDIX - III

Trial No.	Method of Mix Prepared		Soil	Sand	Surkhi	Fly Ash	Lime	Cement
First Trial	Fly Ash lime mix	MIX NO. 1 - 23.3.15	1	1.5		0.83	% of total mix	
			31%	43%	0%	26%	5%	8%
		Avg. Compressive Strength		8.41	N/mm <sup>2</sup>			
		SD		0.95				
		Average Water Absorption		14.76%				
		SD		1.80				
Second Trial	Modified Soil Mix with Lime and Sand	MIX NO. 1 - 11.4.15	1	1.47		0.87		
			30%	44%	0%	26%	5%	8%
		Avg. Compressive Strength		9.73	N/mm <sup>2</sup>			
		SD		3.70				
		Average Water Absorption		16.00%				
		SD		1.78				

## RESULTS

Results of First trail	Water absorption	Compressive Strength
	14.39	9.44
	17.91	7.29
	13.5	9.37
	14.28	8.05
	13.72	7.9
Average	14.76	8.41
Standard Deviation	1.79993	0.95218

Results of Second trail	Water absorption	Compressive Strength
	16.38	13.7
	14.17	12.44
	17	6.17
	18.23	5.51
	14.21	10.86
Average	15.998	9.736
Standard Deviation	1.78	3.70

### Comments

- 1 The mix was used as per advice of Prof. Jagdish. Where clay and silt content is balanced by addition of sand and fly ash.
- 2 There is certain improvement of average properties of the SMB; however standard deviation is also high with soil modified on prior date.
- 3 Overall results are satisfactory however due to greyish tint not considering the option.





**KESARJAN**  
BUILDING CENTRE  
PVT. LTD.

Trial No.	Method of Mix Prepared		Soil	Sand	Surkhi	Fly Ash	Lime	Cement
First Trial	Fly Ash lime mix	MIX NO. 2 - 23.3.15	1	1.25		0.325	% of total mix	
			40%	48%	0%	13%	5%	8%
		Avg. Compressive Strength		5.66	N/mm <sup>2</sup>	SD		
				SD	2.92			
		Average Water Absorption		16.98%		SD		
				SD	2.47			
Second Trial	Modified Soil Mix with Lime and Sand	MIX NO. 2 - 11.4.15	39%	49%	0%	13%	5%	8.0%
		Avg. Compressive Strength		12.37	N/mm <sup>2</sup>			
				SD	12.36			
		Average Water Absorption		13.68%				
				SD	2.27			

**RESULTS**

Results of First trail	Water absorption	Compressive Strength
	17.44	7.11
	17.92	3.81
	19.37	2.83
	17.39	4.51
	12.8	10.04
Average	16.984	5.66
Standard Deviation	2.472231785	2.917224709

Results of Second trail	Water absorption	Compressive Strength
	14.52	12.53
	13.56	13.03
	15.25	8.44
	12.7	13.98
	12.35	13.84
Average	13.676	12.364
Standard Deviation	1.22	2.27

**Comments**

- 1 This mix is also proposed by Prof. Jagdish. Compare to mix one fly ash has been reduced and soil has been increased with minor increase in sand also.
- 2 There is definite increase in strength by prior day modification of soil. The minimum results are exceeds minimum expected strength (7.5 Mpa) however standard deviation is high too.
- 3 Here too we are not considering the mix because of colour.







**KESARJAN**  
BUILDING CENTRE  
PVT. LTD.

Trial No.	Method of Mix Prepared		Soil	Sand	Surkhi	Fly Ash	Lime	Cement
First Trial	Fly Ash lime mix	MIX NO. 3 - 23.3.15	1	1.5		0.5	% of total mix	
			35%	49%	0%	16%	5%	8%
		Avg Compressive Stregnth		6.48	N/mm <sup>2</sup>			
		SD		2.41				
		Average Water Absorption		14.71%				
		SD		1.85				
Second Trial	Modified Soil Mix with Lime and Sand	MIX NO. 3 - 11.4.15	35%	49%	0%	16%	5%	8.0%
		Avg Compressive Stregnth		11.11	N/mm2			
		SD		2.70				
		Average Water Absorption		13.32%				
		SD		1.10				

**RESULTS**

Results of First trail	Water absorption	Compressive Stregnth
	14.36	8.04
	17.66	3.51
	14.19	4.48
	14.79	7.17
	12.56	9.22
Average	14.712	6.484
Standard Deviation	1.85	2.41

Results of Second trail	Water absorption	Compressive Strength
	13.64	8.35
	13.75	9.59
	13.47	11.5
	11.44	15.46
	14.3	10.65
Average	13.32	11.11
Standard Deviation	1.10	2.70

**Comments**

- 1 This is moderate mix of prior 2 mix.
- 2 For second trial results has improved considerably and acceptable.
- 3 Here too we are not considering the mix because of colour.





# KESARJAN

BUILDING CENTRE  
PVT. LTD.

Trial No.	Method of Mix Prepared		Soil	Sand	Surkhi	Fly Ash	Lime	Cement
First Trial	Fly Ash lime mix	MIX NO. 4 - 23.3.15	1	1	1			% of total mix
			37%	32%	32%	0%	5%	8%
			Avg Compressive Strength		6.55	N/mm <sup>2</sup>		
			SD		1.20			
			Average Water Absorption		15.78%			
			SD		1.27			
Second Trial	Modified Soil Mix with Lime and Sand	MIX NO. 4 - 11.4.15	37%	32%	31%	0%	5%	7.0%
			Avg Compressive Strength		11.94	N/mm <sup>2</sup>		
			SD		2.10			
			Average Water Absorption		14.10%			
			SD		1.634			
Third Trial	Wet Soil - Modified with Lime and Sand	MIX NO. 4 - 1.7.15	33%	35%	33%	0%	5%	7.2%
				LOT - 1	LOT - 2			
			Avg Compressive Strength		12.97	13.19	N/mm <sup>2</sup>	
			SD		2.83	3.48		
			Average Water Absorption		14.57%	14.68%		
			SD		1.6339	1.1052		

## RESULTS

Results of First trail	Water absorption	Compressive Strength
	15.2	7.23
	18.09	5.66
	16.31	6.34
	13.95	8.24
	17.35	5.27
Average	15.782	6.548
Standard Deviation	1.27	1.20

Results of Second trail	Water absorption	Compressive Strength
	13.01	12.26
	14.1	9.78
	13.81	11.55
	15.01	15.32
	14.79	10.79
Average	14.104	11.94
Standard Deviation	0.83	2.10

Results of Third (Lot-01)	Water absorption	Compressive Strength
	12.48	14.63
	13.9	15.85
	14.09	14.48
	15.73	10.37
	16.54	9.53
Average	14.57	12.97
Standard Deviation	1.63	2.83

Results of Third (Lot-02)	Water absorption	Compressive Strength
	14.72	8.94
	12.89	16.63
	14.65	12.43
	15.12	12.93
	16.9	13.01
Average	14.659	13.188
Standard Deviation	1.105	3.476

## Comments

- 1 Here the fly ash has been replaced by Surkhi. Considering coarseness of surkhi it was considered for part replacement of sand also. Thus all three ingredients were kept in equal proportion by weight.
- 2 As this was more promising by way of color as well as properties, it was further explored. Earlier the
- 3 This is properly vise most acceptable mix however colour is dull pink.



Trial No.	Method of Mix Prepared		Soil	Sand	Surkhi	Fly Ash	Lime	Cement
First Trial	Fly Ash lime mix	MIX NO. 5 - 23.3.15	1	0	2		% of total mix	
			35%	0%	65%	0%	8%	5%
		Avg. Compressive Stregnth		6.52	N/mm <sup>2</sup>			
		SD		1.52				
		Average Water Absorption		18.40%				
		SD		0.99				
Second Trial	Modified Soil Mix with Lime and Sand	MIX NO. 5 - 11.4.15	34%	0%	66%	0%	5%	8.0%
		Avg. Compressive Stregnth		9.85	N/mm <sup>2</sup>			
		SD		0.92				
		Average Water Absorption		20.61%				
		SD		3.89				

#### RESULTS

Results of First trail	Water absorption	Compressive Stregnth
	17.76	6.04
	17.15	9.04
	18.33	4.99
	19.57	5.95
	19.17	6.57
Average	18.396	6.518
Standard Deviation	0.9923	1.5206

Results of First trail	Water absorption	Compressive Stregnth
	27.53	8.71
	18.46	10.73
	19.19	9.91
	18.26	10.76
	19.9	9.17
Average	20.668	9.856
Standard Deviation	3.89	0.92

#### Comments

- 1 This was Soil and Surkhi mix with one third soil and two third Surkhi.
- 2 Very constant stregnth however high water absorption.
- 3 Here the water absorption level prohibits the acceptance of mix.







# KESARJAN

BUILDING CENTRE  
PVT. LTD.

Trial No.	Method of Mix Prepared		Soil	Sand	Surkhi	Fly Ash	Lime	Cement
First Trial	Fly Ash lime mix	MIX NO. 6 23.3.15	1	0	2			% of total mix
			35%	0%	65%	0%	8%	3%
		Avg. Compressive Strength		4.41	N/mm <sup>2</sup>			
		SD		1.44				
		Average Water Absorption		21.39%				
		SD		2.286314				
Second Trial	Modified Soil Mix with Lime and Sand	MIX NO. 6 - 11.4.15	41%	0%	59%	0%	7%	5%
		Avg. Compressive Strength		10.40	N/mm <sup>2</sup>			
		SD		3.98				
		Average Water Absorption		17.94%				
		SD		1.82				
Third Trial	Wet Soil - Modified with Lime and Sand	MIX NO. 6 - 1.7.15	41%	0%	59%	0%	7%	5.4%
				LOT - 1	LOT - 2			
		Avg. Compressive Strength		8.94	9.95	N/mm <sup>2</sup>		
		SD		3.98	3.02			
		Average Water Absorption		17.66%	17.05%			
		SD		4.35	3.63			

## RESULTS

Results of First trial	Water absorption	Compressive Strength
	24.5	2.17
	18.65	5.87
	21.49	3.92
	19.82	5.25
	22.51	4.83
Average	21.394	4.408
Standard Deviation	2.286	1.438

Results of Second trial	Water absorption	Compressive Strength
	18.72	9.61
	18.67	9.78
	14.68	14.83
	18.63	9.26
	18.97	8.54
Average	17.934	10.804
Standard Deviation	1.82	2.52

Results of Third (Lot-01)	Water absorption	Compressive Strength
	18.32	7.39
	18.1	7.11
	19.81	7.14
	10.32	16.06
	21.74	6.99
Average	17.658	8.938
Standard Deviation	4.352	3.984

Results of Third (Lot-02)	Water absorption	Compressive Strength
	14.47	8.88
	20.16	8.44
	11.99	15.34
	18.82	8.62
	19.83	8.49
Average	17.054	9.954
Standard Deviation	3.633	3.016

## Comments

- 1 This was Soil and Surkhi mix with 40% soil and 60% Surkhi. Here the lime is also kept high at 7%
- 2 Strength is low and some time deviation is very high.
- 3 One of the most explored mix but doubtful because of water absorption and strength.

