TO EVALUATE MECHANICAL PROPERITIES OF LIGHTWEIGHT CONCRETE BLOCKS MASONRY

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Abstract—In an age when there is a growing demand for high strength but light in weight, lightweight concrete blocks masonry has become an important aspect in reducing the dead load of a structure. As for the earthquake damage is concerned the dead load of the multistory buildings made up of lightweight concrete blocks masonry have half weight than that made of normal concrete blocks masonry.

So the masonry of lightweight concrete block gives us better results. Using lightweight concrete blocks masonry proves to save money and man power. Experimental program was carried out on Lightweight Concrete Blocks Masonry. All the results met very favorably with the ASTM specifications for structural concrete. Because of its lightweight property, Lightweight Concrete Blocks Masonry is proved to be used for multi-story buildings in the areas where the soil bearing capacity is weak. This research contains many experimentally proved properties of lightweight concrete blocks masonry. And also the comparison of lightweight concrete blocks masonry & normal weight concrete blocks masonry is given with the experimental proofs.

Index Terms— Minimum 7 keywords are mandatory, Keywords should closely reflect the topic and should optimally characterize the paper. Use about four key words or phrases in alphabetical order, separated by commas.

1 Introduction

Lightweight concrete blocks are made up of lightweight aggregate, cement and sand in proper ratios with water. The lightweight aggregate may be obtained from vermiculite, slate, shale, expanded clay and pumice etc. The one we used among them was slate because it is easily available in P. C .S .1 .R Lab. Peshawar. The Slate has further distinct advantages over the other sources of aggregates.

As for the sand is concerned, many types of sand are available but the best we chose was of Nizampoor sand. Similarly various types of cement are available in the market i-eKohat cement, Lucky cement etc. the best we chose among them was Kohat cement on the basis of its distinct characteristics over the other types of cement. And also the water used for the mixture was in proper ratios. As for the blocks formation, curing and transportation is concerned, they all were carried out in proper way and taken the weather conditions into account.

2 Methodology

2.1 Study and Data Collection

The relevant literature will be collected from books, research papers, and internet and through face to face meetings with different experts. It will help in understanding and explaining the use of slate, pumice, shale etc.

2.2 Lab Activities

It is a very essential stage in this project to test material to be used in the project. Different types of will be carried out in order to complete this project.

- Moisture content test
- Determination of specific gravity
- Absorption test of fine and coarse aggregate
- Sieve analysis of fine and coarse aggregate
- Cement consistency Test

2.3 Mix Designing

Different tests have been performed to find out suitable ratios for different components to design proper concrete sample. Then we use 1:4:8 which give us better results

2.4 Casting and curing of blocks

The mixture is placed in a vibrator machine which have the dimension 6″ 9″ 12″ and compressing the mixture upto 1″ and blocks were formed with the dimension of 6″8″12″ .with proper curing after 28 days the blocks were tested in Civil Dept. UET Peshawar. Mixture of 1:6 of mortar were prepared and other three masonry samples, each having four blocks were formed. After 28 days these samples were tested for compressive and shear Strength.

3 Test on materials

- Sieve analysis of fine aggregate
- Bulk density of fine aggregate

ISSN 2229-5518

- Specific gravity & moisture absorption capacity of fine aggregate

Table 1 Sieve analysis for sand

Sieve #	Retainedweight ofsand ineach sieve(gm)	Percent retained on each sieve	Percent passing each	Percentage retained cumulative
4	2.50	0.54	99.46	0.54
8	23.60	5.10	94.36	5.64
16	39.00	8.40	85.96	14.04
30	129.00	27.65	58.31	41.69
50	193.20	41.4	16.91	83.09
100	79.20	16.90	0	100.09
Total	466.50	0	0	245.09

4 ANALYSIS AND RESULTS

4.1 Compressive Strength

The two blocks used after 14 days for compressive strength tests which give us 974.2psi and 969.2 psi compressive strength respectively. And the other three samples of masonry gave us strength i.e 16.8u>ns, 17.4tons, 14.4 tons respectively

The compressive strength test result is analyzed through the following formulas and calculation data in the table. The stress Vs strain curves for all the three samples in compressive strength have been shown in fig.3-1,3-2 and 3-3, and corresponding data in tables 3-2,3-3 and 3-4. For stress the formula is a = P/A where P is load and A is surface area of block. The formula for strain is G = A/ (gage length) where A is the deformation. As for each sample there are two faces

So there is a separate gage length and deformation for each face. Dividing each face deformation by its own gage length and taking average of deformation of each face we got average strain. Then stress Vs avg. strain curves were plotted for each three samples. On each curve, at stress 01 which is obtained as omax/20, was plotted and corresponding strain Gl. and other stress at omax/3 that is **02** and its corresponding strain G2, Then to find modulus of elasticity which is denoted by E.

So E = **(02** -O1) **/ (G2** -Gi). Also on curve we plotted omax and its corresponding Gamax. The cross on the curve shows the cracking stress corresponding its strain. All the plotting on the curve is according to ASTM 1314. The above steps are performed for other two samples too.

Table 3-1 Data for stress Vs strain Curve

Sample #	Cracking stress (MPa)	Cracking strain (10-6)	Ultimate stress (MPa)	Strain at Ultimate stress
1	2.75	1648	3.06	2142
2	2.65	1192	2.73	1512
3	2.27	1450	2.38	3597

Figure 3.4: Compressive strength test of sample

Table 3-2, Stress Vs strain data for sample # 1

Gauge Length-1 (mm) = 457.2

Gauge Length-2 (mm) = 444.5

Specimen Area (mm2) = 61935

S. No.	Measured Deformation, (mm)		Measured Load (kN)	Strain x 10"6 (mm/mm)			Stress, (MPa)
	Gauge-1	Gauge-2		Gauge-1	Gauge-2	Average	
1	0	0	0.00	0	0	0	0.00
2	0.04	0.03	19.62	87	67	77	0.32
3	0.09	0.06	39.24	197	135	166	0.63
4	0.14	0.11	58.86	306	247	277	0.95

ISSN 2229-5518

5	0.19	0.16	78.48	416	360	388	1.27
6	0.24	0.2	98.10	525	450	487	1.58
7	0.31	0.31	117.72	678	697	688	1.90
8	0.41	0.47	137.39	897	1057	977	2.22
9	0.57	0.67	156.96	1247	1507	1377	2.53
10	0.63	0.72	162.25	1378	1620	1499	2.62
11	0.67	0.75	166.77	1465	1687	1576	2.69
12	0.72	0.79	171.68	1575	1777	1676	2.77
13	0.78	0.86	176.58	1706	1935	1820	2.85
14	0.85	0.95	180.50	1859	2137	1998	2.91
15	0.92	1.01	189.62	2012	2272	2142	3.06
16	0.95	1.05	186.39	2078	2362	2220	3.01
17	1.2	1.4	176.58	2625	3150	2887	2.85
18	1.45	1.51	147.15	3171	3397	3284	2.38
19	1.64	1.54	137.34	3587	3465	3526	2.22
20	1.98	1.59	127.53	4331	3577	3954	2.06
21	5.3	1.62	98.10	11592	3645	7618	1.58

Table 3-3, Stress Vs strain data for sample # 2

Gauge Length-1 (mm) = 431.8

Gauge Length-2 (mm) = 444.5

Specimen Area (mm^2) = 61935

s. No.	Measured Deformation, (mm)		Measured Load (kN)	Strain x 10^{-6} (mm/mm)			Stress, (MPa)
	Gauge-1	Gauge-2		Gauge-1	Gauge-2	Average	
1	0	0	0.00	0	0	0	0.00
2	0.08	0	19.62	185	0	93	0.32

3	0.13	0	39.24	301	0	151	0.63
4	0.17	0	58.86	394	0	197	0.95
5	0.21	0.05	78.48	486	112	299	1.27
6	0.25	0.1	98.10	579	225	402	1.58
7	0.3	0.15	117.72	695	337	516	1.90
8	0.37	0.21	137.34	857	472	665	2.22
9	0.56	0.37	156.96	1297	832	1065	2.53
10	0.71	0.37	166.77	1644	832	1238	2.69
11	0.78	0.43	166.77	1806	967	1387	2.69
12	0.83	0.49	169.20	1922	1102	1512	2.73
13	0.9	0.56	166.77	2084	1260	1672	2.69
14	0.93	0.56	161.80	2154	1260	1707	2.61
15	1.81	0.8	117.72	4192	1800	2996	1.90
16	2.62	1	88.29	6068	2250	4159	1.43
17	3.02	1.29	78.48	6994	2902	4948	1.27
18	3.74	1.89	68.67	8661	4252	6457	1.11
19	4.35	2.16	58.86	10074	4859	7467	0.95

Table 3-4, Stress Vs strain data for sample # 2

Gauge Length-1 (mm) = 419.1

Gauge Length-2 (mm) = 438.2

Specimen Area (mm2) = 61935

S. No.	Measured Deformation, (mm)		Measured Load (kN)	Strain x *10** (mm/mm)			Stress, (MPa)
	Gauge-1	Gauge-2		Gauge-1	Gauge-2	Average	
1	0	0	0.00	0	0	0	0.00
2	0.05	0	19.62	119	0	60	0.32
3	0.1	0.03	39.24	239	68	154	0.63

4	0.15	0.08	58.86	358	183	270	0.95
5	0.21	0.11	78.48	501	251	376	1.27
6	0.28	0.18	98.10	668	411	539	1.58
7	0.36	0.25	117.72	859	571	715	1.90
8	0.57	0.39	137.34	1360	890	1125	2.22
9	0.69	0.46	140.28	1646	1050	1348	2.26
10	2.03	1.03	147.15	4844	2351	3597	2.38
11	2.65	2.21	137.34	6323	5043	5683	2.22
12	3.05	4.25	117.72	7277	9699	8488	1.90

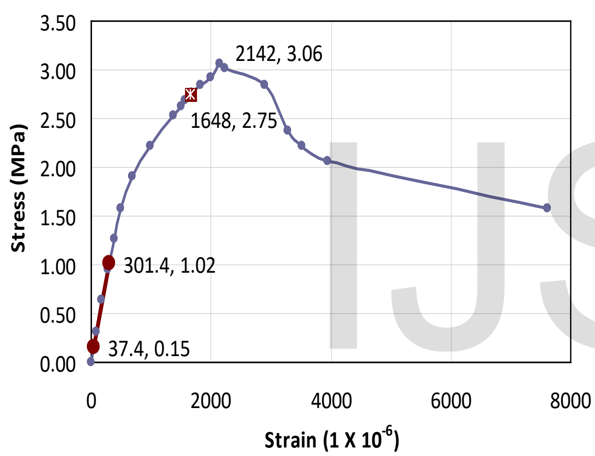

Figure 3-1, Stress strain curve for sample # 1

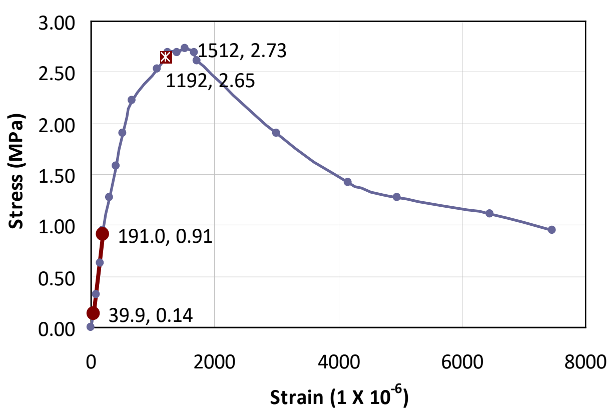

Figure 3-2, Stress strain curve for sample # 2

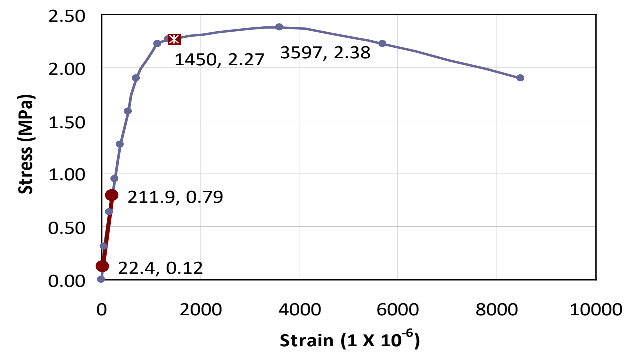

Figure 3-3, Stress Vs strain curve for sample #3

4.2 Shear Strength Test

- For different ultimate loads (Pu) of the three samples we got the following shear strength as shown in table 3-5. Using the formula **(ru** = Pu/2*Av) for all the three samples to find shear strength.

- Shear strength of concrete is taken approximately equal to 20 % its compressive strength.

- Three samples, each having three blocks masonry were tested .The samples were placed vertically in a way that two pieces of wood at the bottom of side blocks and one piece at the top end of middle one, was used. And then loads were applied on each three samples respectively. They gave us strength 0.66 tons, o.86 tons, 0.74 tons. [According to our supervisor instructions]

Table 3-5, Shear strength test data

Sample #	Load(Pu in pounds)	Shear Area(Av)	ShearStrength (ruin psi)
1	1454.6	96"	15.15
2	1895.4	96"	19.74
3	1630.96	96"	16.98

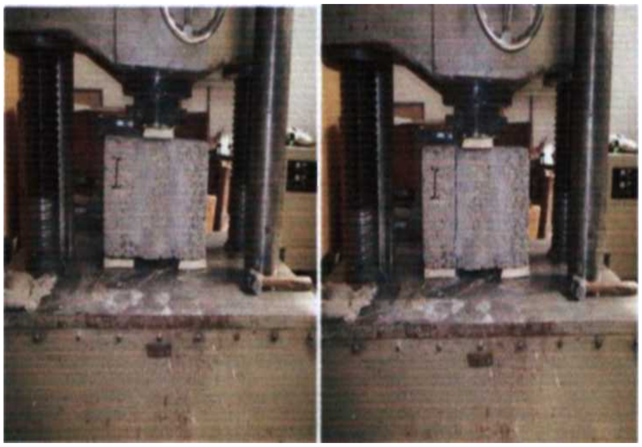

Figure 3-4**,** Shear Strength Test

4 Conclusion

- Two blocks after testing for compressive test gave us 6.70 MPa and 6.68 MPa strength. Normally compressive strength ranges from 3-7 MPa.
- The three blocks masonry samples, after testing for compressive test, gave us cracking stresses as 2.75 MPa, 2.65 MPa and 2.27 MPa and modulus of elasticity for these samples were, 2878 MPa, 4052 Mpa, 3177 Mpa respectively, while the normal range for modulus of elasticity is 1500-2000 Mpa for brick masonry in Pakistan.
- The shear strength for block masonry samples was, 0.10 MPa, 0.13 MPa and 0.11 MPa while the normal range is 0.05-0.15 MPa for common brick masonry in Pakistan.

Acknowledgment

The authors wish to thank A, B, C. This work was supported in part by a grant from XYZ.

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