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COMPRESSIVE STRENGTH OF CONCRETE MASONRY UNIT MADE BY PARTIAL REPLACEMENT OF FINE SAND WITH LOCAL SAND

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ABSTRACT

Use of construction masonry unit has got wide acceptance in construction industry to deal with the numerous issues associated with burnt clay bricks. Normally cement, fine sand and crush are used as the ingredients of CMU. However unavailability of fine sand in the locality makes the resulting product expensive. To this end use of alternative material in place of fine sand remained active area of research since long. This research work studies the partial replacement of fine sand with local sand. 0% - 70% (with 10% increment) replacement of fine sand with local sand is used. Local sand is washed in purpose made tank with # 200 sieve at outlet. Eight batches of concrete masonry units are prepared. Each batch contains 6 specimen. The size of all specimen is 4" x 8" x 12". 1:4:8 concrete mix with water cement ratio of 0.45 is used in preparation of the CMU. Local sand is obtained from the vicinity of Nawabshah region. Specimen are prepared in concrete masonry unit making machine. Curing of the specimen is done for 7 and 28 days. Finally compressive strength of all specimen is evaluated using universal load testing machine both in horizontal and vertical position.

Based on the results it is observed that compressive strength of concrete masonry unit cured for 7 days and tested in horizontal position is recorded as 720 psi (minimum) for 70% replacement and 1385 psi (maximum) for 40% replacement. Minimum and maximum compressive strength results recorded for vertical position are 500 psi for 70% and 1206 psi for 40% respectively. On the other hand 28 day cured CMU tested in horizontal position gave 747 psi for 70% and 1511 psi for 40% as minimum and maximum compressive strength values. The same for vertical position are recorded as 554 psi for 70% and 1315 psi for 70% respectively.

Based on the results it is concluded that utilization of local sand as replacement of fine sand has positive effect on compressive strength and is found that 40% replacement of the fine sand with local sand gives better results.

KEYWORDS: Concrete Masonry Unit, Local Sand, Fine Sand, Compressive Strength.

INTRODUCTION

Evolution took out man of stone ages from caves to grass land for need of food and thus changed their living styles from caves to primitive shelters, advancement also continued in shape of requirement of dwellers with time and need, from stone to wood then burnt bricks and concrete blocks. Traces of old civilization of Moen-jo-daro, Harappa, pyramid of Egypt, thousands of forts around the world are witness of history of masonry construction.

Masonry is considered as integral part of construction, oldest form of constructing houses/buildings even after development of hydraulic cement in nineteenth century which changed entire mode of construction from load bearing to frame structures. Bricks or block masonry is still in vogue even in frame structures despite of many substitute introduced.

Concrete masonry construction (CMU) is based on thousands of years' experience in building structures of stone, mud, clay and burnt bricks. Concrete blocks introduced successfully in masonry construction in place of bricks according to requirement such as demand supply, economy, strength, load, environmental issues etc., but could not become popular due to massive self-weight. Solid blocks were first made in United States with molded mixture of

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quicklime and moist sand cured by steam, further development occurred in England, where powdered lime, fine aggregates and boiling water was used to give rapid set until the unpopularity of concrete block converted to popularity when molding of hollow block technique developed in 1866.

CMU or concrete block is by product of lean concrete, it is a mixture of concrete with a relatively low cement content containing fine and coarse aggregates. Since lean concrete is already low grade concrete hence further compromise on compressive strength of CMU as lean product, would be disaster for structure where it will be used. Different materials are tested and used as aggregates in form of local alternatives for the production of CMU without compromising on compressive strength. Since ingredients used in concrete blocks are not found locally in many areas therefore transported from far-flung plants and pits thus making them high-priced. Number of studies had been carried out to overcome this problem by mixing locally available plentiful material without compromise on strength. The experiments were carried out using glass as quartzite, glass in form of culets, ash, marble powder, factory residuals, bloated particles of burnt clay, local sand etc as aggregate in the production of CMU depending upon their availability in surroundings varying from place to place. However a wide scatter in the results is observed which keeps the door of research open on the topic.

In this experimental work partial replacement of fine aggregates with locally available sand in vicinity of Nawabshah is used for the production of CMU and to get optimum percentage of replacement of fine sand without making any compromise on compressive strength. Fine sand is replacement in 10%, 20%, 30%, 40%, 50%, 60% and 70% with local sand. Local sand is washed in purpose made tank with # 200 sieve at outlet. Altogether eight batches of CMU are prepared with one batch containing 0% local sand and termed as reference specimen. The results are compared with this batch. Each batch contains 6 specimen out of which 50% is cured for 7 days and 50% for 28 days. The size of all specimen is kept 4" x 8" x 12". 1:4:8 mix with 0.45 water cement ratio is used for the preparation of CMU. After curing blocks the blocks are then cut from center making a dimension of 4" x 8" x 6" each, suitable for application in universal load testing machine. Finally compressive strength both in horizontal and vertical positions is evaluated. The obtained results are presented in tabular and graphical format and are discussed in relevant section.

Based on the results it is observed that use of local sand in manufacture of concrete masonry unit has promising effect on compressive strength, also it can be concluded that 40% replacement of fine sand with local sand gives better results.

LITERATURE REVIEW

Concrete Masonry Unit has been recognized as standard material after 1882 when the first concrete block was molded. Extensive manufacture of concrete blocks began in the early 1900s, and their popularity grew rapidly, concrete block structures got fame due to number of its advantages such as economy, fire-resistance, energy efficient, and minimal maintenance. Generally CMU is known as concrete block, cement block known in United States, cinder blocks (fly ash or bottom ash) in Canada and New Zealand, breeze blocks (breeze is a synonym of ash) in the UK, hollow blocks in the Philippines, baser blocks or bricks in Australia and blocks in Pakistan.

High density Concrete blocks are made from normal concrete, and for lower density blocks industrial wastes as aggregate are used. Use of CMU in building work is not novel in our country though it is new in our locality, reason may be same as mentioned above i.e. hike in price of bricks, unavailability of bricks due to huge rain as no soil available for bricks to be molded, environmental issues etc. CMU in this region are generally produced with a mixture of cement, sand, and crushed stone, or lightweight aggregate. All ingredients in CMU used are not available locally and are transported from distant factories and quarries which results in increased cost of blocks. On the other hand replacement (partially or fully) of standard ingredient with alternative materials has remained active research area since long. In the following summary of research related to the topic is presented.

Number of studies had been carried out to use various available abundant material such as glass, glass in form of cullet, glass as quartzite, ash, marble powder, factory residuals, bloated particles of burnt clay, local sand, etc as aggregate replacement in production of CMU depending upon their availability in surroundings which varies from place to place.

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In a study by Joshua and Lawal[1] for searching a way in which lateritic soil could be used in the production of hollow sandcrete blocks in Ota, Ogun State of Nigeria without compromising on strength and ensuring economy. Sand was replaced from 10% to 60% with lateritic soil in making blocks. After curing the blocks for 28 days compressive strength was evaluated and compared with reference blocks. The author concluded that blocks formed by their technique confirm the requirements of BS 882:19982 for fine aggregate. 20% replacement of fine aggregates with lateritic soil gives 2.0 N/mm2 and saves 11.89%. More economy can be achieved by if manufacturing is done on mass scale.

An experimental study was carried out by Shanmugapriya and Uma[2] to check compressive and flexural strength of high performance concrete (HPC) in concrete mixes when partially replaced with manufactured sand by natural sand and silica fume with ordinary portland cement. They used four proportions (i.e. 10%, 30%, 50%, and 70%) natural sand with manufactured sand & silica fume by 1.5%, 2.5 %, and 5%, resulting increase in the compressive and flexural strength of HPC nearly 20% but addition of more than 50% of manufactured sand caused reduction in the strength. It was discovered in the study that 50% replacement by manufacture sand and 5% replacement of cement with silica fume is optimum. Improvement in compressive strength of 18.88% and 13.2% increase in flexure strength could be obtained with 50% replacement and 28 days curing.

Glass is the industrial product of sand since quartz sand (silica) is the main raw material in commercial glass production. Cullet (broken glasses) has been taken as object for its possible use as a material for manufacturing hollow non-load bearing concrete masonry units by Tomas[3]. He investigated the advantages of using recycled window glass, in combination with sand as fine aggregate for hollow blocks production and came to know that by using 1:2:4 cement-recycled glass-sand ratio highest compressive strength can be achieved, the load bearing blocks has capability of finely crushed glass to manifest its pozzolanic effect and its low moisture content characteristics, unit weight of concrete decreases, utilization of recycled clear flat window glass lowers the value of modulus of elasticity but not recommended for structural members such as columns, beams and suspended slabs.

An attempt was made by Neithalath and Schwarz[4], to test the potential use of waste glass powder from economic and environmental point of view in concrete, with possible reduction of cement content in concrete compressive strength, heat of hydration of modified cement paste, degree of hydration test been carried out to get optimal dosages. The glass powder showed potential to reduce the expansion due to alkali-silica reaction, modified block mixtures achieved same strength as control mix in 14-days curing with slightly lower at very early ages. Study established that without compromising concrete performance in 10% cement replacement with glass powder, in cast-in place concrete as well as in concrete blocks from mechanical and durability aspects gives higher compressive strengths of the blocks. Thus it can be treated as fine substitute material where it is in abundance locally.

Korte and Brouwers[5] were of belief that contaminated soil needs to be remediated as per Dutch law, & feasible, financial, technical and environmental criteria fulfilling concrete blocks with proportion of contaminated soil could be designed. They used two binder combinations, i.e. slag cement with hemi-hydrate and slag cement with quicklime. In their study they observed that 10% hemihydrates in combination with 90% blast furnace cement concrete mix proved best, cost effective, suitable for production of immobilizes on large scale when wet soil used in mix design instead of dried within the normalconcrete production at laboratory level.

Finding an appropriate way of overcoming the expected unfavorable influence of alkalis reaction between glass and cement on compressive strength, flexural strength, expansion, and visible surface deterioration up to an age of one year, 34 different concrete mixes samples are tested by Johnston[6].They used crushed glass of size 3/4"(19mm) as coarse aggregate and six reference mixes made with gravel of the same size with cement having alkali equivalent to 0.58 and 1.13 (ASTM C 150-72). He came to know that sample mix yield regression remarkably and expansion due to alkali aggregate reaction. With 25 to 30 percent by weight of the cement replacement of whether low or high alkali performance is found satisfactory.

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To cope with threatening environmental problem & wastage of natural resource in shape of quantities of waste glass from dumping in Korea, Park et al[7] worked on concrete mixtures. In their study the observed that both slump and compacting factors are decreased. Moreover, when use of waste glass exceeds 30%, it gives negative results of compressive, tensile and flexural strengths. The content is only practical when waste glasses is used below 30% with 10% SBR latex (admixture), compulsory to attain workability and air content.

Topcu and Canbaz[8] also carried out a study to ascertain dumping of waste glass posing an environmental problem and its remedy in shape of its proportional use in concrete with no extra cost or energy. Crushed waste glass 4-16 mm in proportions of 0-60% is used in production blocks with PKC/B 32.5/R type cement. The results showed major effect upon the workability of the concrete and only slight reduction of its strength when compared with fresh concrete.

Turgut and Yahlizade[9]experimented on fine glass (FG) and coarse glass (CG) as substitute with fine aggregate (FA) to study physical and mechanical properties of paving blocks. They investigated strength of paving block using different parameters such as compressive strength, flexural strength, splitting tensile strength and abrasion resistance with the control sample and observed that 20% by weight replacement of fine aggregate with FG provide compressive strength equals to 69%, flexural strength equals to 90%, the splitting tensile strength equals to 47%, and abrasion resistance equals to 15% of reference blocks. They found paving blocks impending for the production with a room to confirm the durability properties.

Dirk[10] were of belief that secondary aggregates are becoming substitute of natural aggregates (gravels) in concrete for production of block because of scarcity, economy and need of time to lessen the waste produced by industries. Keeping in view the author initiated investigation on use of Ferromolybdenum slag (FeMo-slag) as partial replacement of aggregates. Ferromolybdenum slag is a hazardless waste-product formed in the production of carbon ferromolybdenum as iron alloys. Textural, mechanical and other technical aspects were taken into consideration to get the optimum mix compositions for successful production of concrete blocks. The test results meet the European and Belgian standards with minor loss of strength.

Aerated concrete block, a precast manufactured technique by mixing all ingredients in addition with suitable aerating agent to entrap air voids in the mortar is not new in India as mentioned by Prakash et al[11].They investigated its feasibility with respect to physical and elastic properties by adopting procedure of density test, compressive strength, stress-strain characteristics, flexural strength and water absorption test. They come up with finding that aerated concrete block has least density when compared with other masonry units thus is light in weight resulting low cost structure, minimum requirement meet with least compressive strength in contrast with high modulus of elasticity. Flexural strength of the blocks is favorable, durability suffers due to high water absorption rate. They analyzed solid concrete blocks and hollow blocks as well.

LECA (light weight extended concrete) consists of small, lightweight, bloated particles of burnt clay having strength and thermal insulation properties. An innovative approach made by Sousa et al[12] to design sound insulated LECA concrete masonry unit. Trials were done on different designed geometrical blocks with acoustical, physical and mechanical properties and deduced that an optimal sound insulation could be achieved by special designed LECA concrete block more economical as compare to traditional Portuguese brick double wall.

A new thought has been given regarding production of concrete blocks as per requirement i.e. contractors select block which are readily available, architect demand shapes and face designs, Engineer`s concern over structural and volumetric stability, instead of traditional demand of color and shape of blocks. John[13] & [14] discussed these things in detail along with procedure such as raw materials storing, batching, mixing, molding, curing, cubing and storing and slump for proposed blocks.

Alan and Karl[15]in their detailed report discussed proper use of engineering controls in dusty construction work by examining work of hand-held abrasive cutter and tuck pointing grinder with local exhaust ventilation (LEV) control and a water spray control. They observed significant difference in reduction of both quartz and respirable dust

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exposures by using LEV controls in cutting concrete blocks. Report established the fact that use of engineering controls resulted in considerable and major cutback in exposures to reparable dust and quartz.

Warnock[16] examined different types of block walls to aid the designer to design and build walls with high levels of acoustic performance economically. Single-leaf walls, double-leaf walls and gypsum board attached walls were tried for this purpose. By and large mass of wall, depth of cavity and quantity of sound absorbing stuff play vital role with some exception. He Come up with result that concrete block walls provide good sound insulation.

An Engineer always looks for design with economy and stability of structure. In this regard investigation of Maroliya[17]is based on wall patterns constructed with hollow concrete block masonry keeping in view different stress, areas, and proportions. In this study author observed that the hollow concrete blocks of sizes 400 x 200 x 200 mm with 1:3:6 ratio have average compressive strength of 11.25 kg/cm2for cost of Rs.9. If admixture is used then cost increases by 2%. Based on strength and cost study the author concluded that hollow concrete wall is reasonably priced and speedy compared to brick wall.

Cement is main component in concrete blocks manufacturing with stability of price in the local market as compared to other component used. Hike in pricing of bricks, has given an edge to blocks as believed by Kamble et al[18]. Hollow concrete blocks using granite fines as an additive may further lessen price. Results taken from various test showed that 25% is optimum value for granite fines to be used with marginal change in density and water absorption, more compressive strength could be achieved by improving compaction techniques as compared to compaction with machine vibration.

John[19] presented an aspect of pavement structures, design life and visual observations of the performance for heavy duty pavements in container terminal concrete block pavements (CBPs) with that of asphalt or rigid concrete pavements, he examined that no perfect outcome guarantee and certain practice may contribute satisfactory performance. Coal bottom ash[20] as partial replacement of fine aggregates and self-compacting concrete[21] have also been used in production of concrete blocks.

EXPERIMENTAL WORK

In this experimental work 48 concrete masonry unit or concrete blocks casted in 8 different batches in block making machine. Each batch comprises of 6 blocks. Fine sand is replaced with local sand ranging from 0% to 70%. Table 4.1 gives the details of material proportioning for all batches of blocks. For all batches 1:4:8 mix with 0.45 water cement ratio is used. The size of all blocks is kept equal to 4"x8"x12" (figure 4.1). Local sand used in this study is collected from sand dunes. Before using, it is washed in water tank having drain pipe of 6 inch diameter with outer mouth covered with 200 No. sieve, to remove silt particles. The blocks casted are assigned number according to the replacement ratio of fine sand with local sand. Out of 48 blocks 24 blocks are cured for 7 days and 24 blocks are cured for 28 days in curing pond. The blocks after removal from curing pond and drying were made cut from center making a dimension of 4"x8"x6"(figure 4.2) by blade roller to meet the requirement of universal load testing machine. Compressive strength of all blocks in both horizontal and vertical positions then evaluated using universal load testing machine.

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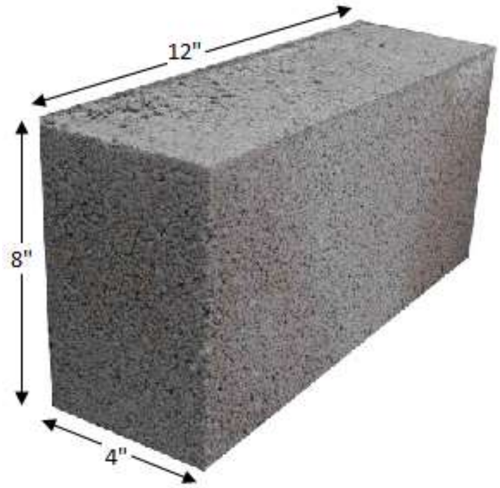

Figure 4.1: Specimen of size 4"x8"x12"

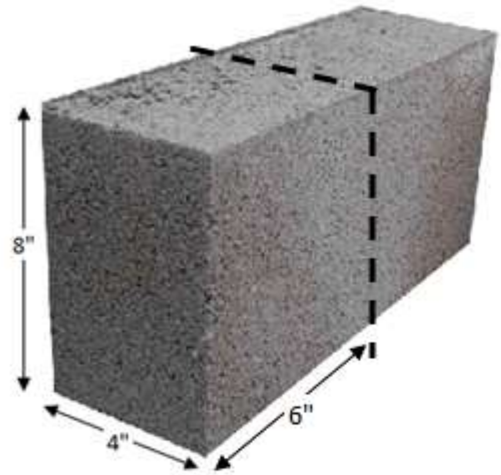

Figure 4.2: Specimen cut along length 4"x8"x6"

Table 4.2 shows detail of compressive strength of all CMUs in horizontal position cured for 7days.From these results it is observed that minimum and maximum average compressive strength is 720 psi and 1385 psi with 70% and 40% replacement of fine sand with local sand. Maximum reduction in compressive strength is 23.81% with reference to reference specimen whereas with 40% replacement of fine sand with local sand 46.5% increase in average compressive strength with respect to reference concrete is observed. When the specimen are tested in vertical position (table 4.3) 19.1% (70% replacement of fine sand) and 95.5% (40% replacement of fine sand) as maximum reduction and maximum increase in average compressive strength respectively is recorded.

Table 4.4 gives details of average compressive strength of specimen cured for 28 days and tested in horizontal position. Maximum reduction again is recorded for 70% replacement of fine sand and maximum increase in average compressive strength is recorded for 40% replacement of fine sand. 33.3% and 34.9% values are recorded as maximum reduction and maximum increase in average compressive strength of the concrete masonry units. Table 4.5 shows the details of average compressive strength of all batches of concrete masonry units cured for 28 days and tested in vertical position. Maximum reduction in average compressive strength recorded for 70% replacement of fine sand is 27.58% whereas maximum increase in average compressive strength recorded is 71.89% for 40% replacement of fine sand.

Tables 4.6 shows details of average compressive strength all batches of concrete blocks tested in horizontal position and table 4.7 give details of percentage difference of compressive strength of all batches of blocks tested in horizontal position with reference to reference concrete blocks. The same information for all batches of blocks tested in vertical position is given in table 4.8 and table 4.9. Also the graphical representation of above mentioned information is given in figure 4.3and figure 4.4 for 7 day curing and 28 day curing respectively.

Table 4.1: CMU Material proportioning for all batches

S. No	Batch	Percentage Replacement of Fine Sand	Material (Ratio: 1:4:8)			
			Cement (%)	Fine Sand (%)	PIT Sand (%)	Crush (%)
1	B1	0	7.69	30.77	0.00	61.54
2	B2	10	7.69	27.69	3.08	61.54
3	B3	20	7.69	24.62	6.15	61.54

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4	B4	30	7.69	21.54	9.23	61.54
5	B5	40	7.69	18.46	12.31	61.54
6	B6	50	7.69	15.38	15.38	61.54
7	B7	60	7.69	12.31	18.46	61.54
8	B8	70	7.69	9.23	21.54	61.54

Table 4.2: Compressive strength of CMU (Horizontal position) for7 day curing

SampleNo	0% (H)	10% (H)	20% (H)	30% (H)	40% (H)	50% (H)	60% (H)	70% (H)
	psi	psi	psi	psi	psi	psi	psi	psi
1	1001	1022	1187	1191	1347	1148	775	753
2	936	993	1195	1265	1394	1064	705	773
3	899	1066	1108	1277	1413	1197	733	633
Average	**945**	**1027**	**1163**	**1244**	**1385**	**1136**	**738**	**720**

Table 4.3: Compressive strength of CMU (Vertical position) for 7day curing

S.No	0% (V)	10% (V)	20% (V)	30% (V)	40% (V)	50% (V)	60% (V)	70% (V)
	psi	psi	psi	psi	psi	psi	psi	psi
1	621	757	868	950	1153	857	639	449
2	580	708	846	980	1281	803	612	518
3	652	736	809	895	1184	783	651	533
Average	**618**	**734**	**841**	**942**	**1206**	**814**	**634**	**500**

Table 4.4: Compressive strength of CMU (Horizontal position) for 28 day curing

S.No	0% (H)	10% (H)	20% (H)	30% (H)	40% (H)	50% (H)	60% (H)	70% (H)
	psi	psi	psi	psi	psi	psi	psi	Psi
1	1056	1102	1292	1344	1459	1158	780	694
2	1126	1234	1264	1371	1670	1148	748	768
3	1179	1203	1200	1370	1405	1095	828	778
Average	**1120**	**1180**	**1252**	**1362**	**1511**	**1134**	**785**	**747**

Table 4.5: Compressive strength of CMU (Vertical position) for 28 day curing

S.No	0% (V)	10% (V)	20% (V)	30% (V)	40% (V)	50% (V)	60% (V)	70% (V)
	psi	psi	psi	psi	psi	psi	psi	Psi
1	757	898	905	1069	1307	898	659	562
2	774	903	970	1089	1292	867	714	595
3	764	845	979	1145	1346	883	695	504

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Average	**765**	**882**	**951**	**1101**	**1315**	**882**	**690**	**554**

Table 4.6: Average compressive Strength of CMU (Horizontal position)

S. No	Curing Period (Days)	B1	B2	B3	B4	B5	B6	B7	B8
1	7	945	1027	1163	1244	1385	1136	738	720
2	28	1120	1180	1252	1362	1511	1134	785	747

Table 4.7: Percentage difference of Compressive Strength of CMU (Horizontal position)

Batch	% Replacement of fine sand	Curing Period 7 days			Curing Period 28 days		
		Mean Strength		% Difference	Mean Strength		% Difference
		psi	MPa		psi	MPa	
B1	0	945	6.5	0.00	1120	7.7	0.00
B2	10	1027	7.1	8.70	1180	8.1	5.40
B3	20	1163	8.0	23.10	1252	8.6	11.80
B4	30	1244	8.6	31.60	1362	9.4	21.60
B5	40	1385	9.5	46.60	1511	10.4	34.90
B6	50	1136	7.8	20.20	1134	7.8	1.30
B7	60	738	5.1	-21.90	785	5.4	-29.90
B8	70	720	5.0	-23.80	747	5.1	-33.30

Table 4.8: Average compressive Strength of CMU (Vertical position)

S. No	Curing Period (Days)	B1	B2	B3	B4	B5	B6	B7	B8
1	**7**	618	734	841	942	1206	814	634	500
2	**28**	765	882	951	1101	1315	882	690	554

Table 4.9: Percentage difference of Compressive Strength of CMU (Vertical position)

Batch	% Replacement of fine sand	Curing Period 7 days			Curing Period 28 days		
		Mean Strength		% Difference	Mean Strength		% Difference
		psi	MPa		psi	MPa	
B1	0	618	4.26	0.00	765	5.28	0.00
B2	10	734	5.06	18.77	882	6.08	15.29
B3	20	841	5.80	36.08	951	6.56	24.31
B4	30	942	6.5	52.43	1101	7.59	43.92
B5	40	1206	8.32	95.15	1315	9.07	71.90
B6	50	814	5.61	31.72	882	6.08	15.29
B7	60	634	4.37	2.59	690	4.76	-9.80
B8	70	500	3.45	-19.09	554	3.82	-27.58

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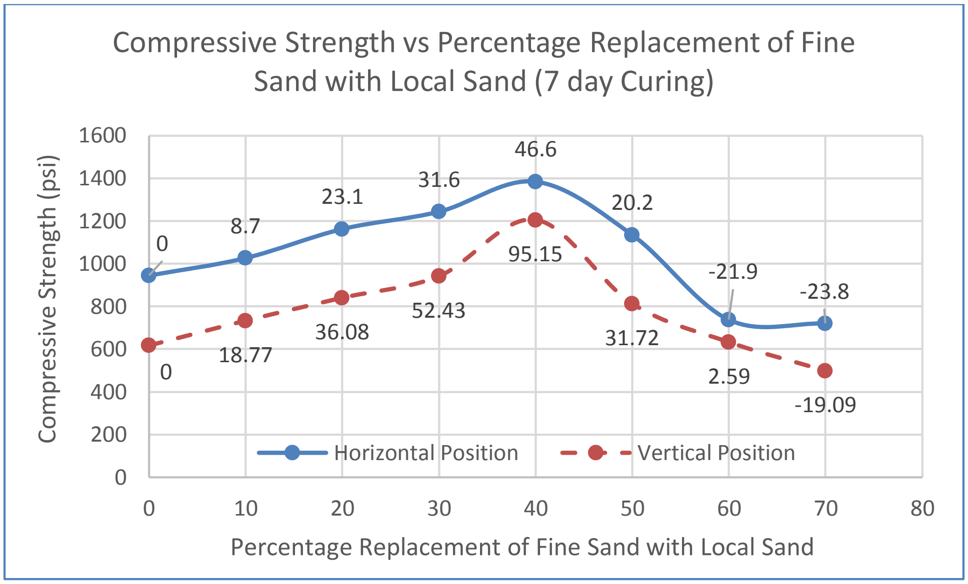

Figure 4.3: Compressive strength with % difference of all batches of CMU at 7 day curing

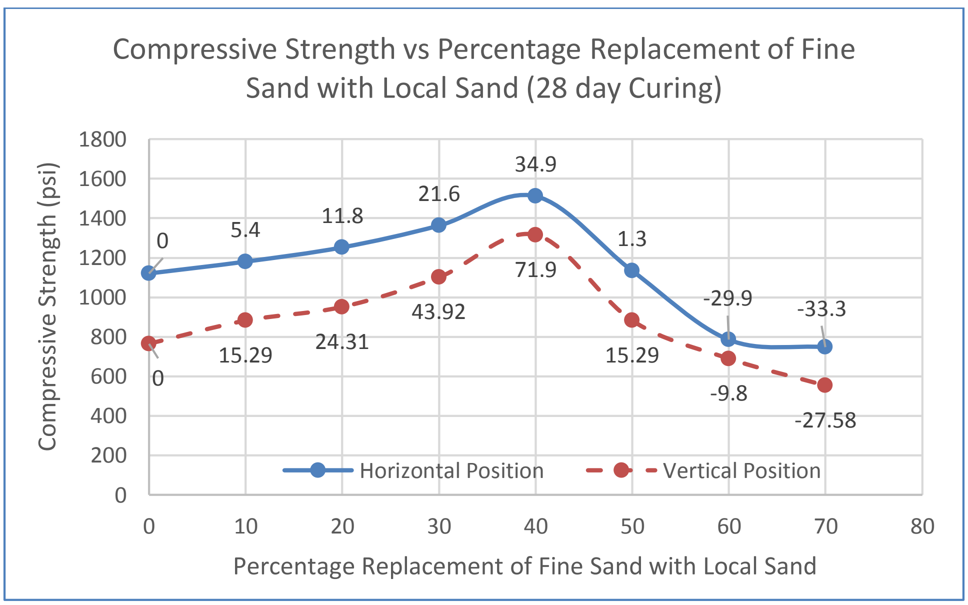

Figure 4.4: Compressive strength with % difference of all batches of CMU at 28 day curing

CONCLUSION &SUGGESTIONS
CONCLUSION
One of the options of dealing burnt clay bricks or its unavailability is the use of concrete masonry unit (CMU). In recent years it has got wide acceptance in construction industry. Normally cement, fine sand and crush are used as the ingredients of CMU. However availability of fine sand in many regions is made by transporting it from far distances, which makes the resulting product expensive. To this end use of alternative material in place of fine sand remained active area of research since long. In this experimental work partial replacement of fine sand with local sand is studied.

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Eight batches of concrete masonry units are prepared. Each batch contains 6 specimens. Fine sand is replaced in the percentage range of 0% - 70%. Concrete mix 1:4:8 with water cement ratio of 0.45 is used in preparation of the CMU. All specimen are prepared in the size of 4"x8"x12". Local sand is obtained from the vicinity of Nawabshah region and washed in tank with # 200 sieve at outlet before using it. Ingredients are mixed in roller mixer and specimen are prepared in standard fashion using concrete masonry unit making machine. All the specimen are then cured in water for 7 and 28 days. To meet the size requirement of universal load testing machine, the specimen are then cut at center using blade cutter. Finally compressive strength of all specimen are evaluated using universal load testing machine both in horizontal and vertical position. Based on this limited experimental work it is observed that compressive strength results of CMU tested in horizontal position is recorded as low as 720 psi (70% replacement) and as high as 1385 psi (40% replacement). Minimum and maximum compressive strength results recorded for vertical position are 500 psi and 1206 psi respectively. On the other hand 28 day cured CMU tested in horizontal position gave 747 psi and 1511 psi as minimum and maximum compressive strength values. The same for vertical position are recorded as 554 psi and 1315 psi respectively.

Based on the results it can concluded that utilization of local sand as replacement of fine sand has promising effect and is found that 40% replacement of the fine sand with local sand gives better results. It is further observed that use of concrete masonry units in vertical position is not advantageous as compressive strength of the units in this position is less than when used in horizontal position.

SUGGESTIONS

Conclusion of this experimental study is based on 48 specimen with replacement of fine sand with local sand from 10% to 70% in increment of 10%. The obtained results shows good agreement and promising effect of local sand. However for good insight and better results following suggestions are made

1. Local sand from different sources may be utilized.
2. Increment of replacement other than 10% may be used to check the impact of local sand.
3. Different mix ratios may be evaluated.
4. Impact of different water cement ratios may be checked.
5. Different washing techniques may be incorporated to wash the local sand and its effect on the final strength of the construction masonry unit may be checked.

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