

Influence of Natural Rubber Latex on Properties of Laterised Concrete Block

Siji Babu ¹, Aswathy Mohan ², Kavitha P.E³

P.G. Student, Department of Civil Engineering, IIET, Nellikuzhy, Kerala, India¹

Assistant Professor, Department of Civil Engineering, IIET, Nellikuzhy, Kerala, India²

Associate Professor, Department of Civil Engineering, SNGCE, Kadayiruppu, Kerala, India²

ABSTRACT: The aim of this study is to produce a good strength and low cost concrete block used for construction purpose. In this experimental investigation, prepare concrete block with mix 1: 6 and 1:10 and it is compared with commercially available concrete block (mix 1:17) and locally available laterite block. Concrete block were prepared with mix 1:10 give required strength and more economical so it is used for further study. 0%, 1%, 1.5% and 2% natural rubber latex to water ratio is added as an admixture and the quarry dust was replaced by laterite soil in different percentages 0% to 100% at interval of 20%. Results have shown that 1.5 % (Latex/Water) Natural Rubber Latex (NRL) addition gives higher compressive strength than normal and other NRL modified concrete. Water absorption of Laterised Concrete Block (LCB) decreases with increase in L/W ratio. Density and Compressive strength of LCB decreases with increase in percentage of Laterite content and Water absorption of LCB increases with increase in percentage of Laterite content. The water absorption of LCB with 100% laterite is 5.08 %, which is less than Locally available Laterite Block (LLB) and the compressive strength of LCB with 100% laterite is 4.67 N/mm², which is greater than Commercially available Concrete Block (CCB) and Locally available Laterite Block (LLB) and also satisfy the IS code specification. Concrete Block (CB) with 1:10 mix satisfy the IS code specification but its material cost is Rs 24. The Laterised Concrete Block (LCB) with 100% laterite soil is also satisfy the IS code specification and its material cost is Rs 19. That is 20.83 % is less than concrete block.

KEYWORDS: Commercially available concrete block, Locally available laterite block, Concrete block, Natural rubber latex, Water absorption, Compressive strength.

I. INTRODUCTION

One of the basic requirements of human being to sustain in the world is shelter. After the evolution of human being, the need of shelter meant for safety arises. In ancient times, man started taking shelter in caves, excavated below ground level and under hanging mountain cliffs and this type of shelter just provided safe place from environmental extremities. The concept of stability and safety as per structural features of shelter were completely out of mind. With the development and maturity of human mind, man began to modify the structural formation of shelter so as to address the increasing needs and facilities which an optimum shelter design possessed. After achieving a feat by the use of easily available material like mud in constructing walls and then the technique of burnt clay brick masonry to form structural part of shelter, there was still a long journey in coming out for the best possible structural material for construction of stable and safe structural units of shelter.

The use of concrete blocks for buildings and high rise buildings has become popular due to development in concrete technology and availability of various types of building materials. Concrete blocks could lead to smaller member sizes for compression members and therefore provide considerable savings associated with material costs and reduction of dead loads. A major factor affecting the construction industry in developing countries is the cost of building materials most of which have to be imported. Walling materials constitute an essential element in housing delivery. It is

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

estimated that it covers about 22% of the total cost of a building. The choice of walling material is a function of cost, availability of material, durability, aesthetics and climatic condition. The desire for search of safe and stable structural materials keeping in view the economy of whole structure.

The use of abundantly available materials to replace normal aggregates in concrete for structural purpose would provide a reliable design data base on concrete produced with such materials is established. One of such materials is Laterite – a naturally occurring soil widely spread in the tropics and subtropics. Laterite is a cheap, environmentally friendly and abundantly available building material. Laterite has other advantages which make it potentially a very good and appropriate material for construction, especially for the construction of rural structures in the less developed countries. No specialized skilled labour is required for the production of Laterised concrete and for its use in the construction of structures and also, Laterised concrete structures have potentially sufficient strength compared with that of normal concrete.

The inclusion of both natural and synthetic latexes into concrete and mortar mixes began in the twentieth century. Natural rubber latex has superior qualities over other elastomeric latexes, especially in the areas of high performance applications that require excellent mechanical characteristics such as high tensile strength and resilience as well as abrasion resistance. Concrete matrix consists of pores and voids interconnected by channel or existing micro cracks, which are the main contribution to its moisture permeability. In fact, one of the most impressive characteristics of polymer modification is its ability to resist the entry of water and aggressive agents, thereby improving its impermeability and consequently saving the concrete from undue attack.

II. RELATED WORK

Collect and study twenty five journal related to project topics. Summary of this studies are following.

- Compressive strength decreases with increase in laterite content.
- Up to 40% replacement of sand by laterite attained the designed strength.
- Compressive strength significantly reduces with increase in acid concentration, immersion period and laterite content.
- Compressive strength of laterised concrete cured in magnesium sulphate solution is higher than cured in water.
- Water/air curing gives highest strength value and air curing gives least strength value at all age.
- The effect of exposure to high temperature of laterised concrete is same as that of normal concrete.
- Cost of block decreases with increase in laterite content.
- Compressive strength, flexural and tensile strength of laterite soil – cement block are directly proportional to the cement content and water absorption inversely proportional to the cement content.
- The optimum amount of NRL for maximum resistance to sodium sulphate penetration is 1.5% (L/W) and for minimum water absorption is 5% (L/W).
- 1.5 % (L/W) NRL addition gives higher compressive strength than normal and other NRL modified concrete.
- Compressive strength of NRL modified concrete decreases with increase in temperature at a rate faster than that of normal concrete.
- 1% (by weight of cement) NRL addition gives higher compressive strength.

III. EXPERIMENTAL PROCEDURE

Collect Commercially available Concrete Blocks (CCB) of 300 mm x 200 mm x 100 mm size from five different manufacturing units around the Kothamangalam, Kerala, India and Locally available Laterite Blocks (LLB) of 300 mm x 200 mm x 100 mm from single quarry at Mekkadampu, Kerala, India. Its Density, Water absorption and compressive strength are compared with IS 2185 (Part 1) : 2005 (Concrete Masonry Unit – Specification) code specifications. Then the raw materials are collected and test in laboratory. As per IS 2185 (Part I): 2005 the concrete mix used for blocks shall not be richer than one part by volume of cement to six parts by volume of combined aggregates (1:6) before mixing. In concrete block manufacturing unit 1:17 mix is used for concrete block production. For this study prepare Concrete Block with two different mixes 1:6 and 1:10. Concrete block were prepared with mix 1:10 give required

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

strength and more economical so it is used for further study. 0%, 1%, 1.5% and 2% natural rubber latex to water ratio is added as an admixture and the quarry dust was replaced by laterite soil in different percentages 0% to 100% at interval of 20%.

IV. MATERIALS

4.1 Cement: SANGHI Ordinary Portland Cement (OPC) of 53 grade conform to IS : 4031 – 1988 and IS : 269 – 2015 was used for this study. Specific gravity of cement is found to be 3.15 and standard consistency is 32 %.

4.2 Coarse Aggregate: Usually 6 mm and 12mm coarse aggregate are used for concrete block preparation. The aggregates are tested as per IS code. The fineness modulus of 6 mm and 12 mm coarse aggregates are 1.45 and 1.93 and the specific gravity 2.51 and 2.70.

4.3 Quarry Dust: Quarry dust is used as fine aggregate for concrete block preparation and it tested as per IS code. The fineness modulus of quarry dust is 1.73. Specific gravity is 2.62; water absorption is 1.63 and Bulk density 1.036 kg/l.

4.4 Laterite Soil: Laterite soil is partially and fully replacement of quarry dust. It is collected from Mekkadampu, Kerala, India. Fineness modulus of laterite soil is 3.26. Specific gravity is 2.78; water absorption is 7.2 and Bulk density 0.888 kg/l.

4.5 Natural Rubber Latex: Natural rubber latex is collected from Rubber tree (*Hevea brasiliensis*) and it tested in Rubber Sombharana Unit Mekkadampu, Kerala, India. It contains 42% dry rubber.

V. EXPERIMENTAL RESULTS

5.1 Commercially available concrete block (CCB)

Collect Commercially available Concrete Blocks (CCB) of 300 x 200 x 150 mm size from five different manufacturing units around the Kothamangalam and test its density, water absorption and compressive strength. Table 1 shows the properties of Commercially available Concrete Blocks.

Table 1 Properties of Commercially available Concrete Block (CCB)

Properties	Block 1	Block 2	Block 3	Block 4	Block 5	Average
Density (kg/m ³)	2222.22	2272.22	2222.22	2111.11	2222.22	2209.998
Water Absorption (%)	4.5	4.16	4.5	4.47	4.25	4.38
Compressive Strength (N/mm ²)	2.49	2.23	2.43	2.5	2.93	2.52

5.2 Locally available laterite block (LLB)

Collect Locally available Laterite Blocks (LLB) of 300 mm x 200 mm x 100 mm size from single quarry at Mekkadampu and test its density, water absorption and compressive strength. Table 2 shows the properties of Locally available Laterite Blocks.

Table 2 Properties of Locally available Laterite Block (LLB)

Properties	Value
Density (kg /m ³)	2000
Water Absorption (%)	6.95
Compressive Strength (N /mm ²)	1.42

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

5.3 Comparison of CCB and LLB as per IS code

Properties of Commercially available Concrete Block (CCB) and Locally available Laterite Blocks (LLB) are compared with IS 2185 (Part 1) : 2005 (Concrete Masonry Unit – Specification) code specifications. Density and water absorption of CCB and LLB are within the limit of IS code specification. But compressive strength of CCB and LLB are less than the IS code specification. Table 3 shows the comparison of CCB and LLB as per IS code.

Table 3 Comparison of CCB and LLB as per IS code

Properties	CCB	LLB	As Per IS Code
Density (kg / m ³)	2209.998	2000	Not less than 1800
Water Absorption (%)	4.38	6.95	Not more than 10
Compressive Strength (N / mm ²)	2.52	1.42	4

5.4 Influence of different concrete mixes on properties of CB

In concrete block manufacturing units mix 1:17 is used for concrete block preparation. As per IS 2185 (Part 1) : 2005 the concrete mix used for blocks shall not be richer than 1:6 mixes. So for this study prepare concrete block with two different mixes 1:6 and 1:10. Table 4 shows that the properties of Concrete Block (CB) with different mixes.

Table 4 Properties of Concrete Block (CB) with different mixes

Properties	Mix 1:17 (CCB)	Mix 1:10	Mix 1:6
Density (kg / m ³)	2209.998	2433.333	2961.111
Water Absorption (%)	4.38	1.036	0.80
28 th day Compressive Strength (N / mm ²)	2.52	10.81	17.00

Density and compressive strength of concrete block increases with increase in cement content and Water absorption of concrete block decreases with increase in cement content. Fig. 1 shows that the cement aggregate vs density of concrete block (CB), Fig. 2 shows that the Cement aggregate ratio vs water absorption of CB and Fig. 3 shows that the cement aggregate vs compressive strength of CB. Concrete block were prepared with cement: aggregate ratio of 1:10 give required strength and are more economical so it is used for further study.

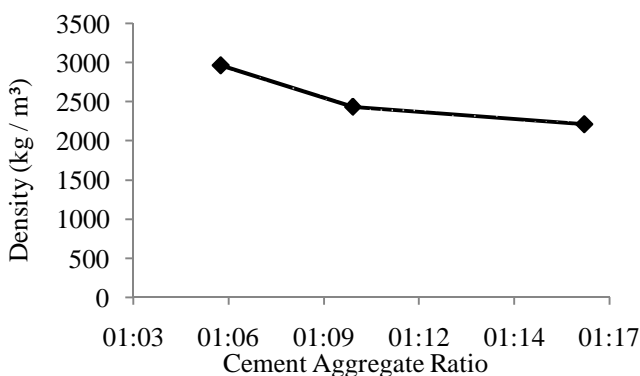


Fig. 1 Cement aggregate ratio vs density of CB.

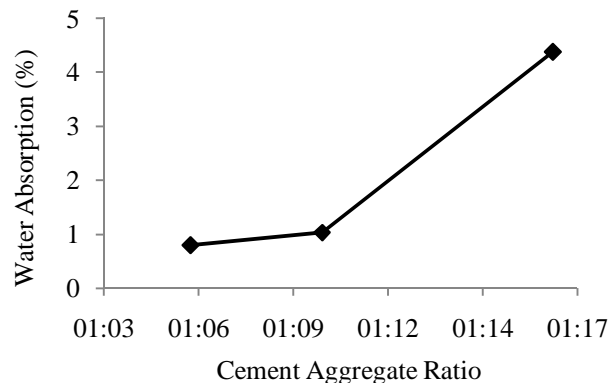


Fig. 2 Cement aggregate ratio vs water absorption of CB

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

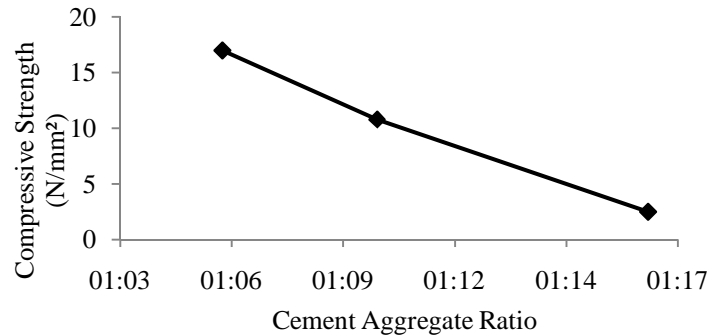


Fig. 3 Cement aggregate ratio vs compressive strength of CB.

5.5 Laterised concrete block (LCB) with NRL

5.5.1 Effect of NRL on Laterised Concrete Block (LCB): Prepare Laterised Concrete Block (LCB) with 20% quarry dust replaced by laterite soil and the natural rubber latex was added as admixture in different latex / water ratios 0%, 1%, 1.5% and 2%. Table 5 and Fig. 4 show that the compressive strength of LCB at different age and different latex / water ratio. Table 6 and Fig. 5 show that the water absorption of LCB at different latex / water ratio. The maximum value of compressive strength occurs at 1.5 % latex / water ratio. Water absorption of LCB decreases with increase in latex / water ratio.

Table 5 Compressive strength (N/mm²) of Laterised Concrete Block (LCB)

NRL \ Days	NRL			
	0%	1%	1.5%	2%
7	4.05	4.16	4.30	3.88
14	4.26	4.35	4.80	4.33
21	5.52	6.03	6.27	5.75
28	7.08	9.67	10.00	9.12

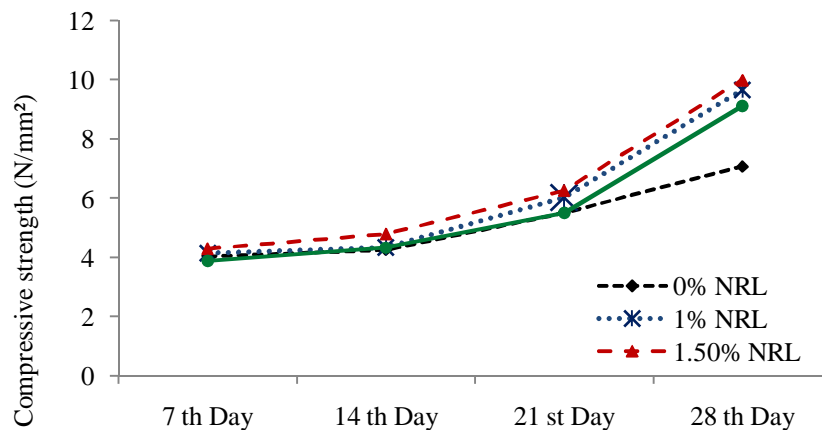


Fig. 4 Compressive strength of LCB at different age and different latex / water ratio

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

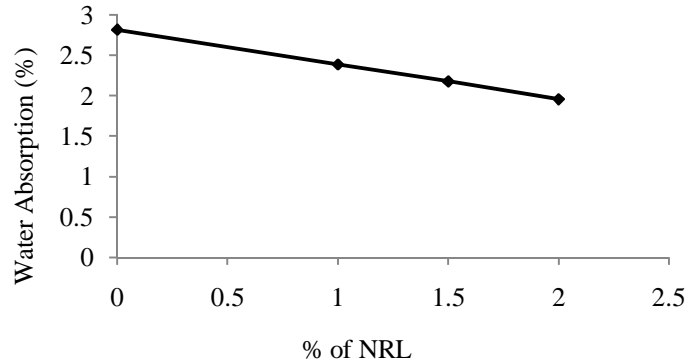


Fig. 5 water absorption of LCB at different latex / water ratio

Table 6 Water absorption of LCB at different latex / water ratio

% of NRL	Water Absorption (%)
0	2.82
1	2.39
1.5	2.18
2	1.96

5.5.2 Density of Laterised Concrete Block (LCB): Natural Rubber Latex to water ratio 1.5 gives higher compressive strength than normal and other NRL modified concrete. So further study 1.5 % NRL was added as admixture and the quarry dust was replaced by laterite soil in different percentages 0%, to 100% at interval of 20%. Table 7 and Fig. 6 shows that the variation of density with respect to laterite content. Density of Laterised concrete block decreases with increase in percentage of Laterite content.

Table 7 Variation of density of LCB with respect to laterite content

% of Laterite	Density (kg/m ³)
20	2344.44
40	225.56
60	2166.67
80	2078.68
100	1843.75

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

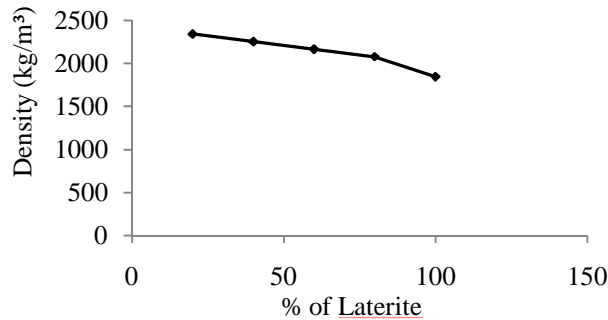


Fig. 6 Variation of density of LCB with respect to laterite content

5.5.3 Water Absorption of Laterised Concrete Block (LCB): Table 8 and Fig. 7 shows that the variation of water absorption with respect to laterite content. Water absorption of Laterised concrete block increases with increase in percentage of Laterite content. Water absorption of Laterised Concrete Block with 100% laterite is 5.08 %, which is less than Locally available Laterite Block (LLB).

Table 8 Variation of water absorption of LCB with respect to laterite content

% of Laterite	Water Absorption (%)
20	2.18
40	2.71
60	3.13
80	3.55
100	5.08

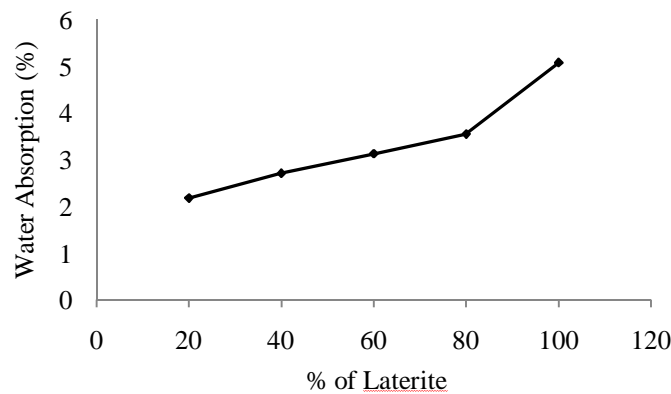


Fig. 7 Variation of water absorption of LCB with respect to laterite content

5.5.4 Compressive Strength of Laterised Concrete Block (LCB): Table 9 and Fig. 8 shows that the variation of compressive strength with respect to laterite content. Compressive strength of Laterised concrete block decreases with

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

increase in percentage of Laterite content. As per IS 2185 (part 1) : 2005 the concrete block shall be manufactured for minimum average compressive strength of 4 N/mm². Compressive strength of LCB with 100% laterite is 4.67 N/mm², which is greater than CCB and LLB and also satisfy the IS code specification.

Table 9 Variation of compressive strength of LCB with respect to laterite content

Laterite \ Days	20 %	40 %	60 %	80 %	100 %
7	4.30	4.03	3.87	3.73	2.57
14	4.80	4.53	4.13	4.00	2.73
21	6.27	5.97	5.37	4.70	4.37
28	10	9.47	8.17	7.00	4.67

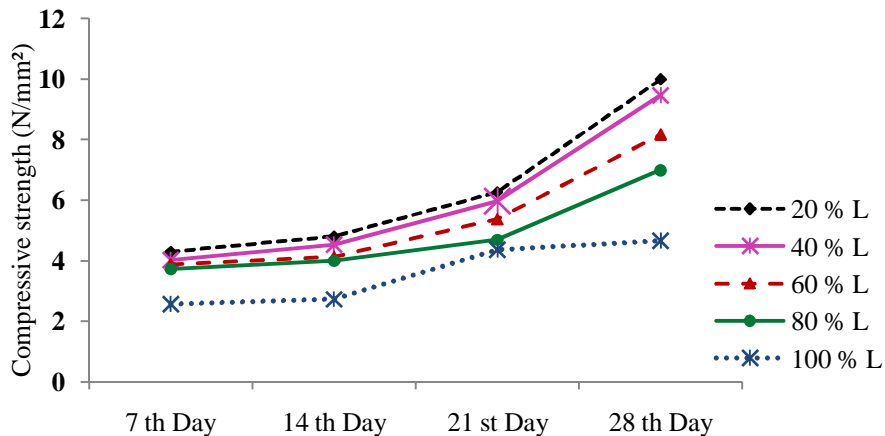


Fig. 8 Variation of compressive strength of LCB with respect to laterite content

5.6 Cost analysis

The cost of Concrete Block (CB) and Laterised Concrete Block (LCB) is evaluated and then compare these two costs. The cost analysis is based on current rate. The Cost of Commercially available Concrete Block (CCB) of size 300 mm x 200 mm x 150 mm is Rs 22/- each and the cost of Locally available Laterite Block (LLB) of size 300 mm x 200 mm x 200 mm is Rs 22/- each. Table 10 shows that the current rate of material and Table 11 shows that the cost of materials for each CCB, CB and LCB.

Table 10 Rate of materials

Materials	Rate (Rs)
1 kg of Cement	7.6
1 kg of 12 mm Coarse Aggregate (CA)	0.43
1 kg of 6 mm Coarse Aggregate (CA)	0.45

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

1 kg of Quarry Dust (QD)	0.68
1 kg of Laterite Soil (LS)	0
1 kg of NRL	66.50

Table 11 Cost of materials for each CCB, CB and LCB

Mix	Cement (Rs)	12 mm CA (Rs)	6 mm CA (Rs)	QD (Rs)	LS (Rs)	NRL (Rs)	Total (Rs)
CCB (1:17)	8.21	2.12	2.07	6.01	0	0	18.41 (18)
CB (1:10)	13.68	2.09	2.03	5.87	0	0	23.67 (24)
LCB LS – 20% NRL – 1.5%	13.68	2.09	2.03	4.69	0	1.33	23.82 (24)
LCB LS – 40% NRL – 1.5%	13.68	2.09	2.03	3.52	0	1.33	22.65 (23)
LCB LS– 60% NRL – 1.5%	13.68	2.09	2.03	2.35	0	1.33	21.48 (21)
LCB LS – 80% NRL – 1.5%	13.68	2.09	2.03	1.18	0	1.33	20.31 (21)
LCB LS – 100% NRL – 1.5%	13.68	2.09	2.03	0	0	1.33	19.13 (19)

Compressive strength of Commercially available Concrete Block (CCB) with mix 1:17 note satisfy the I S code specification. So it is not considered. Concrete Block (CB) with 1:10 mix satisfy the IS code specification but its material cost is Rs 24. The Laterised Concrete Block (LCB) with 100% laterite soil is also satisfy the IS code specification and its material cost is Rs 19. That is 20.83 % is less than Concrete Block (CB) with mix 1:10. That is addition of laterite soil can reduce the material cost of concrete block. The material cost can very much reduce if the cement to aggregate ratio of higher aggregate contents is adopted. The cost can be reduced by more trials with different mixes.

VI. CONCLUSION

Density and water absorption of Commercially available Concrete Block (CCB) and Locally Available Laterite Block (LLB) are within the limit of IS 2185 (Part 1) : 2005 Code specification but compressive strength of CCB and LLB are less than the IS Code specification. Density and compressive strength of Concrete Block (CB) increases with increase in cement content and water absorption of CB decreases with increase in cement content. Concrete block prepared with

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

cement to aggregate ratio of 1:10 give required strength as per IS code and found more economical compared to block with cement to aggregate ratio of 1:17 and 1:6. Natural Rubber Latex (NRL) to water ratio 1.5 gives higher compressive strength than normal and other NRL modified concrete and the water absorption of Laterised Concrete Block (LCB) decreases with increase in latex to water ratio. Density and Compressive strength of Laterised Concrete Block (LCB) decreases with increase in percentage of laterite content and the water absorption increases with increase in percentage of laterite content. The water absorption of LCB with 100% laterite is 5.08 % which is less than the water absorption of LLB and the compressive strength of LCB with 100% laterite is 4.67 N/mm^2 , which is greater than Commercially available Concrete Block (CCB) and Locally available Laterite Block (LLB) and also satisfy the IS code specification. The Laterised Concrete Block (LCB) with 100% laterite soil and 1.5 % Natural Rubber Latex (NRL) satisfy the IS code specifications of density, water absorption and compressive strength and also its material cost 20.83 % is less than Concrete Block (CB) with mix 1:10. Hence it can be concluded that Laterised Concrete Block (LCB) with 100 % laterite soil and 1.5 % Natural Rubber Latex (NRL) is a good alternative to CCB and LLB.

REFERENCES

- [1] Felix F.Udoeyo, Udemé H. Iron and Obasi O.Odim., "Strength Performance of Laterised Concrete", Construction and building materials, vol. No. 01, Is No. 07, pp. 1057 – 1062, 2006.
- [2] Biju Mathew, Dr. Benny Joseph and Dr. C Freeda Christy, "Strength Performance of Concrete Using Laterite as Sand Replacement", IJCERA, vol. No. 01, Is No. 03, pp. 38 - 42, 2013.
- [3] ATA Olugbeenga, "Durability of Laterite/Sand Hollow Blocks in Magnesium Sulphate Environment", AJER, vol. No. 03, Is No. 08, pp 263 – 266, 2014.
- [4] S.K. Jain, P.G.Patil and N.J. Thakor, "Engineering properties of laterite stone scrap blocks", CIGR, vol. No. 11, Is No. 03, pp 483 – 488, 2011.
- [5] M.S. Shobha, "Mechanical Properties of Latex Modified High Performance concrete", IOSR, vol. No. 11, Is No. 01, pp 13 – 19, 2011.