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Optimization of Partially Replacement of Natural Sand & Ordinary Portland cement By M-Sand and Lime stone powder

A.Jayaraman[*1], V.Senthil kumar[2], Dr.G.Anusha[3], M.Saravanan[4]

[*1,2,3,4] Department of Civil Engineering Bannari Amman Institute of Technology, Sathamangalam, Tamil Nadu, India

jayaraman.cvl@gmail.com

Abstract

A study is conduct to determine the engineering properties viz. Compressive Strength, tensile strength and water absorption capacity of the partially replacement of river sand and ordinary Portland cement . In recent days the demand for river sand is increasing due to its lesser availability. Hence the practice of partially replacing river sand with M-Sand and ordinary Portland cement with lime stone powder is taking a tremendous growth. It is also inferred from the literature that partially replacement of normal sand with M-Sand and ordinary Portland cement with lime stone powder produces no appreciable increase in compressive and tensile strength due to the variation in mix ratio. The lime stone powder obtained from limestone quarries. The concrete are made using varying contents of M-Sand, lime stone powder as fine aggregate and ordinary Portland cement. The Samples of concrete (eg.cubes and cylinders) are made in three different grades, namely: M15, M20 and M25. It was found that 0.50 water/cement ratio produced higher compressive strengths, tensile strength and better workability for M25 mix proportion. Specifically compressive, tensile strength and flexural strength ranged from 18.14 – 36.72 N/mm2, 10.76 -18.5 N/mm2 and 12.21- 40.08 N/mm2 for the mixes considered. These results compare favorably with those of conventional concrete. The concrete was found to be suitable for use as structural members for buildings and related structures.

Keywords: compressive strength, flexural strength, limestone powder, M-sand, tensile strength and water absorption.

Introduction

This paper is part of a study investigating the structural characteristics of concrete using various combinations of M – Sand as partially replacement for conventional river sand fine aggregate, and Limestone powder partially replacement for ordinary Portland cement. Lime stone powders are sedimentary rocks primarily of calcium carbonate. Limestone's are generally obtained from the calcareous remains of marine or fresh water organisms embedded in calcareous mud. They change from the soft chalks to hard crystalline rocks. The use of limestone as a concrete aggregate has sometimes been suspect on account of the unsuitability of the poorer grade rocks, and also because of a widespread fallacy that limestone concrete is less resistant to the action of fire than concrete made from other aggregates. He suggested that the use of limestones might not be beneficial in concrete products, which are to be cured in high-pressure steam. For many years has been increasingly used in concrete as coarse aggregate, lime stone powder or as a main cement constituent. It is applied in high performance concrete as well as in normal or low performance concrete. Compared to plain concrete with the same w/c ratio and cement type, concrete with high limestone powder content with suitable particle size distribution possesses generally improved strength characteristics. Concrete made with limestone powder as partial replacement of ordinary Portland cement in concrete can attain lime stone powder up to 10% without adversely effecting concrete strength .Concrete made with limestone filler as partial replacement of cement in concrete can attain lime stone filler up to 20% without adversely effecting concrete strength [1]. Concrete using various combinations of lateritic sand and lime stone filler as complete replacement for conventional river sand fine aggregate. It was found that 0.55 water/cement ratio produced higher compressive strengths, tensile strength and better workability for M20 mix, proportion. Specifically compressive and tensile strength ranged from 21.06 - 35.2 N/mm2 and 10.06 -15.5 N/mm2 for the mixes considered [2]. Limestone filler is regularly used as

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mineral addition in self-compacting concrete. In this overview, some interesting results are summarized concerning hydration, microstructure development, transport properties, and durability [3]. The additions of limestone filler or fly ash – taken separately or altogether, determine a decrease of the setting time for the blended cements in comparison with Portland cement, the effect being stronger in the case of cements with greater addition of fly ash (20-30%) [4]. The self compacting concretes with the limestone filler show higher water permeability and lower freeze – thaw resistance in the presence of de-icers than the concretes with the fly ash additive. These parameters can be improved by the higher fineness of limestone flour. The shortage of freeze – thaw resistance and the resistance to the attack of de-icers in case of the limestone containing self compacting concretes is the consequence of the microstructure of cement matrix [5]. In India, the conventional concrete is produced using natural sand from river beds as fine aggregate. Decreasing natural resources poses the environmental problem and hence government restriction on sand quarrying resulted in scarcity and significant increase in its cost The cheapest and the easiest way of getting substitute for natural sand is obtained from limestone quarries , lateritic sand and crushing natural stone quarries is known as manufactured sand The ordinary Portland cement is partially replaced with nano-silica by 0.75% and natural sand is fully replaced with manufactured sand, the better compressive strength, flexural strength and better durability and corrosion resistance[6]. In Konkan region of Maharashtra, the laterite stone is commonly used for the construction purpose. There are several laterite stone quarries in Konkan region. During excavation of laterite stone, around 25 – 30 per cent laterite stone scrap is generated. It is estimated that about 2.83 cum of the laterite stone scrap is generated during excavation of about 11.33 cum of the laterite stone. This laterite stone scrap creates problem in quarries and needs removal for further excavation. In order to add value to this waste material, it is felt necessary to manufacture the blocks using different constituents that are suitable for the construction. In this In this overview determine the Compressive strength, toughness index and water absorption capacity of the laterite stone scrap blocks [7]. Laterite of relatively good quality for building purpose (high compressive strength and low water absorption) [8]. The concrete are made using varying contents of M-Sand, lime stone powder as fine aggregate and ordinary Portland cement in concrete can attain more or less same compressive strength, tensile strength, permeability, modulus of rupture and lower degree of shrinkage as the control concrete. There are three different grades are used, namely: M15, M20 and M25. It is found that 0.50 water/cement ratio produced higher compressive strengths and better workability for M25 mix, proportion. Since we are replacing the proportion of 50% M- Sand to 10% lime stone powder produced higher values of compressive strength and tensile strength.

Experimental Investigation

Materials

***Cement*:** Portland pozzolanic cement 53 grade conforming to IS 8112 – 1989, and specific gravity of cement is found to be 3.18. The Chemical properties of cement given in Table.1

lime stone powder : lime stone powder conforming to IS 8112 – 1989, and specific gravity of cement is found to be 2.95. The Chemical properties of lime stone given in Table.1

Fine Aggregate: Locally available river sand having bulk density 1782 kg /m^3 is used and the specific gravity 2.68 and fineness modulus of river sand is 3.11

Manufactured sand: M-Sand is replaced is fully replacement of river sand .it is collected from BAG Groups Coimbatore, India. The bulk density of manufactured Sand 1560 kg/m^2 and the specific gravity 2.57 and fineness modulus of rive Sand is 2.78. The sieve analysis of river sand and M-Sand is given in table 2

Course aggregate: Considering all the above aspects, blue granite crushed stone aggregate of 12.5mm as maximum size and of typical particle shape “average and cubic” are used as the course aggregate for the present investigation. The aggregates are tested as per the procedure given in BIS: 2386- The bulk density of coarse aggregate 1630 kg/m2 and the specific gravity 2.79 and fineness modulus of coarse aggregate 6.93

Table 1. Chemical properties of lime stone powder and cement

Chemical properties of cement and Lime stone powder		
Component	**Cement**	**Lime stone powder**
Sio_2	21.8	1.81
$A1_20_3$	4.8	0.23
Fe_20_3	3.8	0.26
CaO	63.3	52.38
$S0_3$	2.04	1.68
Mg0	0.91	0.26
Na_20	0.21	-

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Table 2. Sieve analysis of river sand &M-Sand

IS sieve designation	River sand% Passing	M- sand% Passing
4.75 mm	99.43	98.1
2.36mm	95.84	98.23
1.18mm	66.27	43.35
600nm	47.27	29.6
300um	30	23
150um	9.27	5.3

Experimental Procedure

The mix ratio is prepared for 1:2:4, 1:1.5:3 and 1:1:2, for conventional and also M- Sand lime stone powder. The fine aggregate and ordinary Portland cement portion of the mix is achieved by combining M- Sand and lime stone powder in ratio with 50 %-10 %, 50%-20% and 50%-30%. The materials are then mixed thoroughly before adding the prescribed quantity of water and then mixed further to produced fresh concrete. Water cements ratios of 0.50 were adopted. The specimen is prepared for compressive strength for cube size (150 x 150 x 150) mm. The cylinder of height 30 cm and 15 cm diameter is prepared for tensile strength totally 108 cubes and 108 cylinders are made. The specimen size of (70x10x10) cm is used for flexural strength test. For durability test mortar specimen is prepared in a mix ratio of 1:3, the cube size of (50 x50 x 50) mm is prepared for water absorption test. The specimen is tested 28 days totally for 12 cubs. All the specimens are demoulded after 24 hours, and curing is done in water for 7 days, 14 days and 28 days. The specimens are tested for 7 days, 14 days and 28 days with each proportion of lime stone powder and M-Sand mix.

Result and Discussion

A. The Compressive strength of concrete are presented in table below

The test is carried out conforming to IS 516 -1959 to obtain compressive strength of concrete at the 7days, 14 days and 28 days. The cubes are tested using 400 tonne capacity HELICO compressive testing machine (CTM) .The results are presented in Fig.1, 2,and 3

Table 3. 7 Days Compressive strength of concrete

Mix ratio	Conventional concrete	50 % M - Sand-10% LSP	50 % M - Sand-20% LSP	50 % M - Sand-30% LSP
M15	17.64	21.14	16.34	13.64
M20	23.12	27.72	21.42	18.72
M25	22.43	28.43	22.63	19.43

The 7days compressive strength of conventional concrete, 50%-20% (M-Sand & LSP) and 50% - 30% (M-Sand & LSP) concrete 19.84% ,29.39% and54.98% of compressive strength is reduced when compared to the 50% - 10% (M-Sand & LSP) concrete which is found that 1:2:4 mix ratio. The compressive strength of conventional concrete, 50%-20% (M-Sand & LSP) and 50% - 30% (M-Sand & LSP) more or less same having M20 and M25grade of concrete. The Results of this test are show in table .3

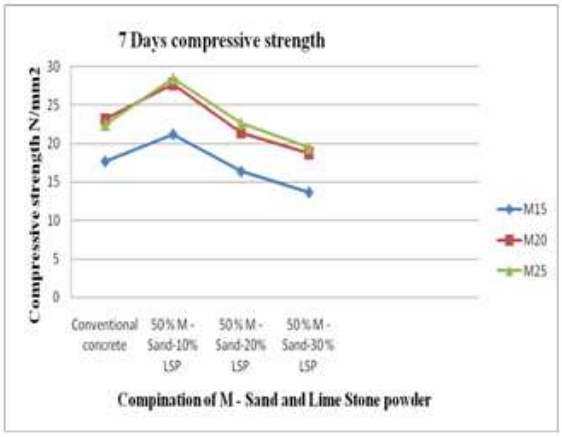

Figure:1 7 days compressive strength of concrete

Table -4. 14 Days Compressive strength of concrete

Mix ratio	Conventional concrete	50 % M - Sand-10% LSP	50 % M - Sand-20% LSP	50 % M - Sand-30% LSP
M15	18.29	21.26	19.06	16.16
M20	28.12	30.12	26.72	19.12
M25	29.16	31.26	27.06	21.26

The 14 days compressive strength of conventional concrete, 50%-20% (M-Sand & LSP) and 50% - 30% (M-Sand & LSP) concrete 16.24% ,11.54% and 31.58% of compressive strength is reduced when compared to the 50% - 10% (M-Sand & LSP) concrete which is found that 1:2:4 mix ratio. The compressive strength of conventional concrete, 50%-20% (M-Sand & LSP) and 50% - 30% (M-Sand & LSP) more or less same having M20 and M25grade of concrete. The Results of this test are show in table .4

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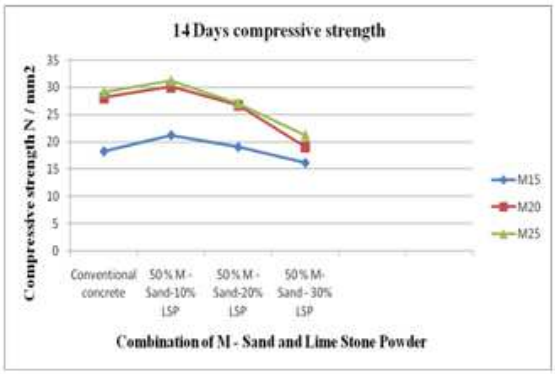

Figure:2 14 days compressive strength of concrete

Table -5. 28 Days Compressive strength of concrete

Mix ratio	Conventional concrete	50 % M -Sand-10% LSP	50 % M - Sand-20% LSP	50 % M - Sand-30% LSP
M15	22.06	26.06	20.06	19.06
M20	30.12	32.12	29.12	23.12
M25	31.43	34.03	32.53	23.43

The 28 days compressive strength of conventional concrete, 50%-20% (M-Sand & LSP) and 50% - 30% (M-Sand & LSP) concrete 18.14% , 29.91% and 36.72% of compressive strength is reduced when compared to the 50% - 10% (M-Sand & LSP) concrete which is found that 1:2:4 mix ratio. The compressive strength of conventional concrete, 50%-20% (M-Sand & LSP) and 50% - 30% (M-Sand & LSP) more or less same having M20 and M25grade of concrete. The Results of this test are show in table .5

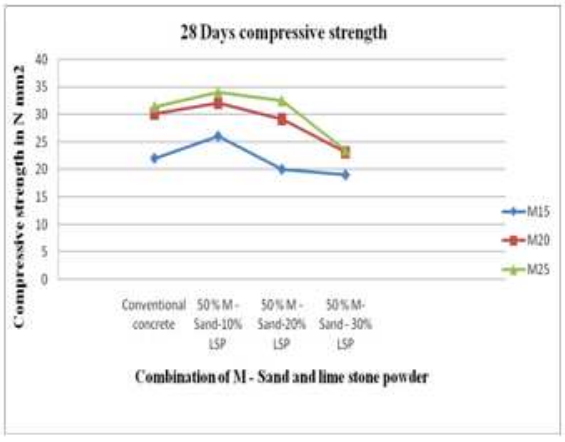

Figure:3 28 days compressive strength of concrete

B. Tensile strength of concrete are presented in table below

The test is carried out conforming to IS 516 -1959 to obtain tensile strength of concrete at the 7 days, 14 days and 28 days. The cylinders are tested using 400 tonne capacity HELICO compressive testing machine (CTM) .The results are presented in Fig.4,5 & 6

Table -6. 7 Days Tensile strength of concrete

Mix ratio	Conventional concrete	50 % M - Sand-10% LSP	50 % M - Sand-20% LSP	50 % M - Sand-30% LSP
M15	2.05	2.46	2.24	2.12
M20	2.82	2.98	2.85	2.66
M25	2.94	3.06	2.8	2.69

The 7days tensile strength of conventional concrete, 50%-20% (M-Sand & LSP) and 50% - 30% (M-Sand & LSP) concrete 20% ,10.39% and 16.08% of tensile strength is reduced when compared to the 50% - 10% (M-Sand & LSP) concrete which is found that 1:2:4 mix ratio. The tensile strength of conventional concrete, 50%-20% (M-Sand & LSP) and 50% - 30% (M-Sand & LSP) more or less same having M20 and M25grade of concrete. The Results of this test are show in table .6

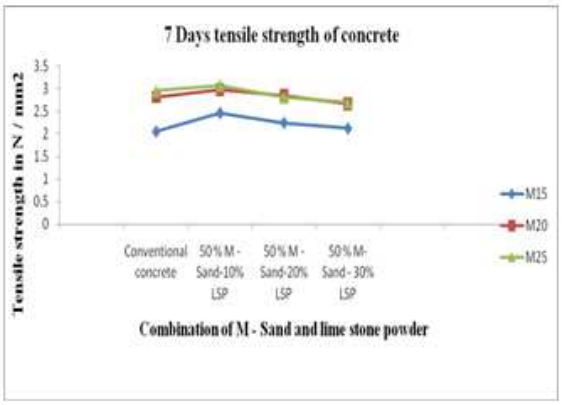

Figure:4 7 days tensile strength of concrete

Table -7. 14 Days Tensile strength of concrete

Mix ratio	Conventional concrete	50 % M - Sand-10% LSP	50 % M - Sand-20% LSP	50 % M -Sand-30% LSP
M15	2.46	2.52	2.12	2.12
M20	2.92	3.24	2.89	2.75

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M25	3.02	3.34	2.68	2.6

The 14 days tensile strength of conventional concrete, 50%-20% (M-Sand & LSP) and 50% - 30% (M-Sand & LSP) concrete 5 % ,18.89% and 18.89% of tensile strength is reduced when compared to the 50% - 10% (M-Sand & LSP) concrete which is found that 1:2:4 mix ratio. The tensile strength of conventional concrete, 50%-20% (M-Sand & LSP) and 50% - 30% (M-Sand & LSP) more or less same having M20 and M25grade of concrete. The Results of this test are show in table .7

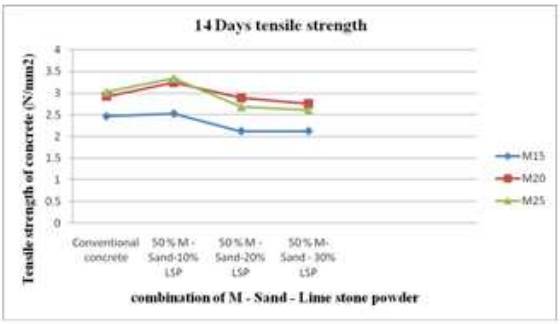

Figure:5 14 days tensile strength of concrete

Table -8. 28 Days Tensile strength of concrete

Mix ratio	Conventional concrete	50 % M - Sand-10% LSP	50 % M - Sand-20% LSP	50 % M - Sand-30% LSP
M15	2.52	2.79	2.45	2.36
M20	3.09	3.32	3.21	2.92
M25	3.16	3.44	3.39	2.83

The 28 days tensile strength of conventional concrete, 50%-20% (M-Sand & LSP) and 50% - 30% (M-Sand & LSP) concrete 10.714 % ,13.89% and 18.82% of tensile strength is reduced when compared to the 50% - 10% (M-Sand & LSP) concrete which is found that 1:2:4 mix ratio. The tensile strength of conventional concrete, 50%-20% (M-Sand & LSP) and 50% - 30% (M-Sand & LSP) more or less same having M20 and M25grade of concrete. The Results of this test are show in table .8

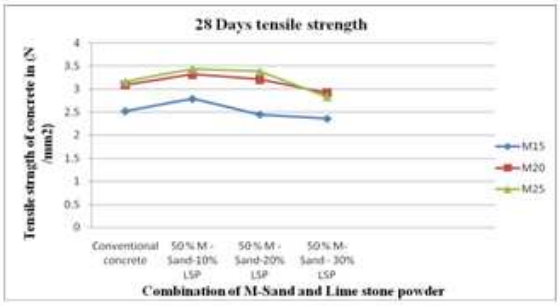

Figure:6 28 days tensile strength of concrete

C. Flexural strength of concrete

The test is carried out conforming to IS 516 -1959 to obtain flexural strength of concrete at the 28 days are tested using loading frame 750 kN. The results are presented in Fig.7 The 28 days Flexural strength of conventional concrete, 50%-20% (M-Sand & LSP) and 50% - 30% (M-Sand & LSP) concrete 12.21 % ,22.79% and 40.08% of flexural strength is reduced when compared to the 50% - 10% (M-Sand & LSP) concrete which is found that 1:2:4 mix ratio. The flexural strength of conventional concrete, 50%-20% (M-Sand & LSP) and 50% - 30% (M-Sand & LSP) more or less same having M20 and M25grade of concrete. The Results of this test are show in table .9

Table -9. 28 days Flexural strength of concrete

Mix ratio	Conventional concrete	50 % M - Sand-10% LSP	50 % M - Sand-20% LSP	50 % M - Sand-30% LSP
M15	7.12	7.99	6.51	5.36
M20	9.14	10.32	8.21	6.92
M25	10.27	9.88	8.39	6.83

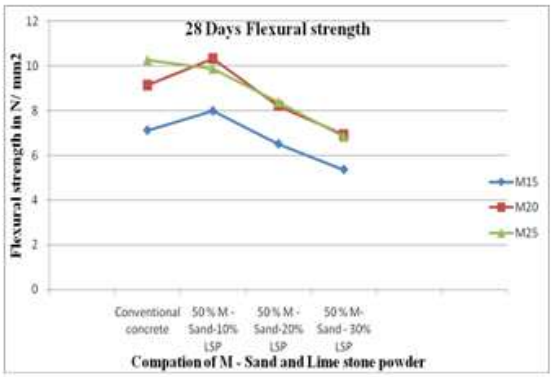

Figure:7 28 days flexural strength of concrete

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D. Water absorption test

This test is done as per procedure given in ASTM C 642-97 by oven-drying method. For this test 50mm x 50mm x 50mm cubes are cast. After 24 hours of remolding, the specimens are kept immersed in water. At the end of 28 days, the specimens are taken from the curing tank and air-dried to remove the surface moisture then taken the initial weight (W1) is taken. The final weight (W2) is taken to the specimens are dried in an oven at a temperature of $100+10^{o}$ C for 48 hrs, and allowed to cool at room temperature. Results of this test are show in table .10

Table -10. Water absorption test

Mix ratio	Conventional concrete	50 % M - Sand-10% LSP	50 % M - Sand-20% LSP	50 % M - Sand-30% LSP
M15	6.65	6.99	7.51	8.36
M20	4.41	7.32	8.21	9.92
M25	4.32	7.08	8.39	9.83

Conventional concrete specimen resulted to decrease of the water absorption and permeability of the concrete when compare to 50%-10% (M-Sand & LSP) , 50% - 20% and 50%-30% (M-Sand & LSP) mix.

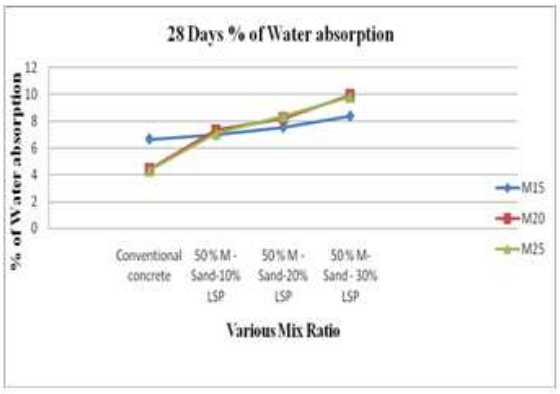

Figure:8 28 days % of Water absorption test

Conclusion

It can be seen from the results of this study that the combination of M- Sand and lime stone powder replaces the conventional river sand and ordinary Portland cement in the production of concrete for construction industry.

The compressive strength, tensile strength and flexural strength of concrete and water absorption test using M- Sand and lime stone powder are measured in the laboratory. Compressive strength, tensile strength and flexural strength is found to increase with age as for normal concrete. The 28 – day compressive, tensile strength and flexural strength is found 18.14 – 36.72 N/mm^2, 10.76 -18.5 N/mm^2 and 12.21- 40.08 N/mm^2 for different mixes. The above strength properties the proportion of 50%-10% (M-Sand & LSP) produced higher values of compressive, tensile and flexural strength. For the same proportion of 50%-10% (M-Sand & LSP) at 1:1:2 mixes and 0.50 water cement ratio. The water absorption is Conventional concrete specimen resulted to decrease of the water absorption and permeability of the concrete when compare to 50%-10% (M-Sand & LSP) Further work is required to get data for other structural properties of the experimental concrete

References

[1]. Rana Burhan Abdurrahman Alshahway, (2011). "Effect of Partial Replacement of Sand with Limestone Filler on some properties of Normal Concrete."A1-Rafidain Engineering ,June 2011.Volume19 No.3

[2]. A.Jayaraman, V.Senthil kumar, and M.Saravanan (2014). "Compressive & tensile strength of concrete using lateritic sand and lime stone filler as fine aggregate". International Journal of Research Engineering and Technology. Volume 3, Issue 1, January 2013)

[3]. G. De Schutter, Ghent University, Belgium, (2011) "Effect of limestine filler as mineral addition in self-compacting concrete." 36th Conference on our world in concrete & structures: 14 - 16 August 2011, Singapore

[4]. Maria Georgescu , Nastasia Saca ,(2009) "Properties of blended cements with limestone filler and fly ash content". U.P.B. Sci. Bull., Series B, Vol. 71, Iss. 3, 2009 ISSN 1454-2331

[5]. Stefania Grzeszczyk ,Piotr Podkowa,(2009) "The Effect of Limestone Filler on the Properties of Self Compacting Concrete". Annual transactions of the nordic rheology society, vol. 17, 2009

[6]. A.Jayaraman , V.Senthil kumar,(2013). "Optimization of fully replacement of natural sand by M-sand in high performance concrete with nanosilica". International Journal of Emerging Technology and Advanced Engineering., Volume 3, Issue 11, November 2013)

[7]. S.K. Jai1, P.G. Patil, N.J. Thakor,(2011) "Engineering properties of laterite stone scrap blocks".Agricultural Engineering International: CIGR Journal. Vol.13, No.3, 2011. ManuscripNo.1738.

ISSN: 2277-9655
Impact Factor: 1.852

[8]. Kasthurba. A. K, (2012) "Characteristics of Malabar Laterite as a Building Material Field and Laboratory Studies". International journal of earth secience. ISSN 0974-5904, Volume 05, No. 03 (01)