UTILISATION OF RECYCLED MATERIALS IN ROAD DEVELOPMENT

Pailla Shivaram[1], Mr. B.Vijaya sekhar[2]

[1]Master of Technology & Qis college of engineering and technology

[2]Assistant Professor & Qis college of engineering and technology

ABSTRACT

With the evolution of the road industry and growing traffic on roads, construction materials have also been evolved and more unconventional ingredients have been incorporated. The rationales was the scarcity of conventional natural materials and the jeopardized environment which have underpinned the tendency towards evaluation other materials resources to be incorporated in the road industry. The inclusion of such materials entails several secondary and tertiary materials. Several waste by-products and materials have been investigated, assessed, evaluated for utilizations and practiced in the field. Depending on the attributes of the characteristics of the recycled material, the inclusion varies. Some recycled material have been proven to possess preferable properties over the other and have performed satisfactorily in the field. However, there are numerous concerns regarding such incorporation based on both laboratory experimental, and field observations which have turned out to be of the essence for further in depth studies. In the present study experimental investigation of sub grade soil determined soil characteristics by using recycled materials like fly ash and plastic waste. The percentage of fly ash and plastic waste used is 0%FA+0%PW, 5%FA+1%PW, 10%FA+2%PW, 15%FA+3%PW and 20%FA+4%PW. The comparison of soil characteristics like liquid limit, plastic limit, standard compaction, un confined compressive strength and CBR test vales are determined for various percentages of recycled materials

KEYWORDS: recycled material, sub grade soil, fly ash, plastic waste

INTRODUCTION

Industrial waste is the waste produced by industrial activity which includes any material that is rendered useless during a manufacturing process such as that of factories, industries, mills, and mining operations. It has existed since the start of the Industrial Revolution.[1] Some examples of industrial wastes are chemical solvents, pigments, sludge, metals, ash, paints, sandpaper, paper products, industrial by-products, metals, and radioactive wastes. Toxic waste, chemical waste, industrial solid waste and municipal solid waste are designations of industrial wastes. Sewage treatment plants can treat some industrial wastes, i.e. those consisting of conventional pollutants such as biochemical oxygen demand (BOD). The building or construction industry involves different processes and utilizes huge quantities of resources. These processes have severe impacts on the environment which according to Horsley (2003), occur over a variety of timescales from the extraction and processing of raw materials used in construction, through the duration of the construction process, the operation of the building, up to the eventual demolition of the structure at the end of its operative life. Construction activities have been known to generate large and diverse quantities of waste. According to the US Green Building Council, (2001), it accounts for up to 30% of total waste output in the United States alone, put at about 136 million tons per annum. As a result, construction and demolition waste management has become one of the major environmental problems in many municipalities (Faniran and Caban, 1988; Kibert, 1994; Ferguson et al., 1995; Graham and Smithers, 1996; Guthrie et al., 1999; Symonds, 1999; Lawson and Douglas, 2001, cited in Poon et al, 2004)..

MATERIALS

A. *Expansive Soils*

As a piece of this examination, the sweeping dark cotton soil was obtained from the site. The dark cotton soil subsequently got was conveyed to the research center in sacks. A limited quantity of soil was taken, sieved through 4.75 mm strainer, gauged, and air-dried before gauging again to decide the common dampness substance of the equivalent. The different geotechnical properties of the secured soil are as per the following:

Sl. No.	Properties	Code referred	Value
1	Specific Gravity	IS 2720 (Part 3/Sec 1) - 1980	2.44
2	Maximum Dry Density (MDD)	IS 2720 (Part 7) - 1980	1.52 gm/cc
3	Optimum Moisture Content (OMC)	IS 2720 (Part 7) - 1980	22.65%
4	Natural Moisture Content	IS 2720 (Part 2) - 1973	7.28%

5	Free Swell Index	IS 2720 (Part 40) - 1977	105%
6	Liquid Limit	IS 2720 (Part 5) - 1985	65%
7	Plastic Limit	IS 2720 (Part 5) - 1985	37.08%
8	Shrinkage Limit	IS 2720 (Part 6) -: 1972	17.37%

B. *Fly ash*

A waste material extricated from the gases exuding from coal terminated heaters, by and large of a warm power plant, is called fly fiery debris. The mineral buildup that is abandoned after the consuming of coal is the fly cinder. The Electro Static Precipitator (ESP) of the power plants gather these fly cinders. Basically comprising of alumina, silica and iron, fly fiery remains are small scale measured particles. Fly powder particles are commonly circular in size, and this property makes it simple for them to mix and stream, to make an appropriate mixture. Both undefined and crystalline nature of minerals are the substance of fly fiery remains produced. Its substance differs with the adjustment in nature of the coal utilized for the consuming procedure, however it essentially is a non-plastic sediment. With the end goal of examinations in this investigation, fly fiery debris was gotten from Sesa Sterlite, Jharsuguda, Odisha. To separate out the vegetation and outside material, this fly powder was screen through a 2 mm sifter. The examples were dried in the broiler for around 24 hours before further utilization.

C. *Plastic waste*

The plastic waste were produced mainly from waste PET bottles. The plastic bottles were crushed and cut into small pieces using a crushing machine. The plastic aggregates were washed properly to make them clean and to ensure that no other dust particles were present there. Polyethylene terephthalate (PET) is thermoplastic polyester with tensile and flexural modulus of elasticity of about 2.9 and 2.4GPa, respectively, tensile strength up to 60 MPa and excellent chemical resistance. It is a semi-crystalline polymer, with a melting point of about 260°C and a glass transition temperature ranging from 70 to 80°C, in relation to the amount of crystalline region enclosed in the amorphous phase.

METHODOLOGY

To assess the impact of fly ash and plastic fiber as a balancing out added substance in far reaching soils, arrangement of tests, where the substance of fly powder in the sweeping soil was differed in estimations of 5% to 200% (products of 5) and 1% to 4% plastic fiber by weight of the all out amount taken. The Indian Standard codes were pursued during the conduction of the accompanying analyses:

- Standard proctor test – IS : 2720 (Part 7) – 1980
- Unconfined compressive strength (UCS) test – IS : 2720 (Part 10) – 1991
- California bearing ratio (CBR) test – IS : 2720 (Part 16) – 1987
- Liquid & Plastic limit test – IS 2720 (Part 5) - 1985.

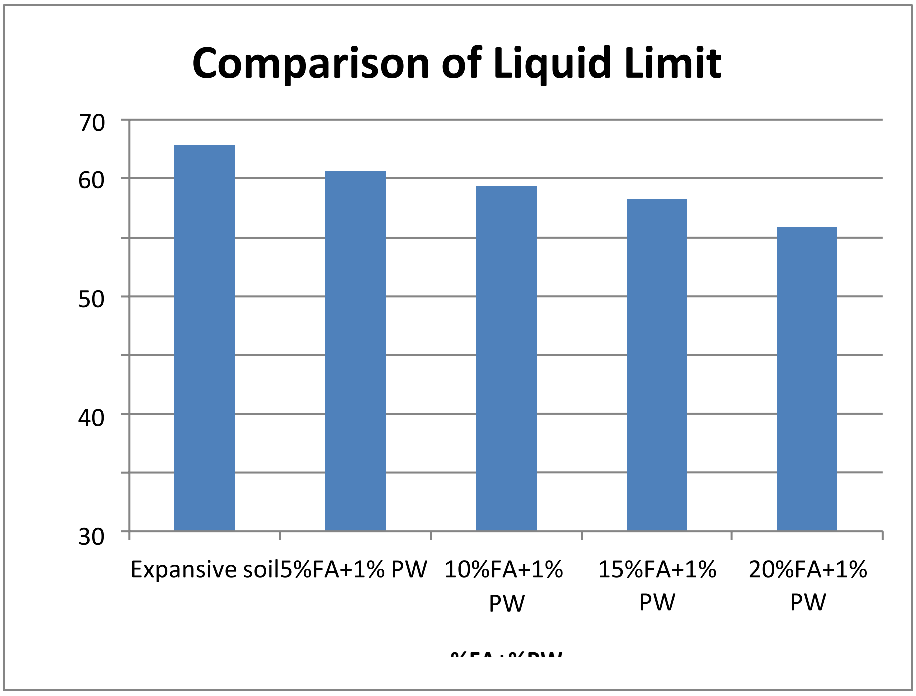
EXPERIMENTAL INVESTIGATION

D. *Atterberg's limit (Liquid limit & Plastic limit)*

As a hard, unbending strong in the dry state, soil turns into a brittle (friable) semisolid when certain dampness content, named as far as possible, is come to. In the event that it is a far reaching soil, this dirt will likewise start to swell in volume as this dampness substance is surpassed. Expanding the water content past the dirt's plastic point of confinement will change it into a flexible, plastic mass, which causes extra swelling. The dirt will stay in this plastic state until its fluid farthest point is surpassed, which makes it change into a gooey fluid that streams when jostled.

S. No	% Fly ash +%Plastic waste	Liquid Limit
1	Expansive soil	65.6
2	5%FA+1% PW	61.2
3	10%FA+1% PW	58.8

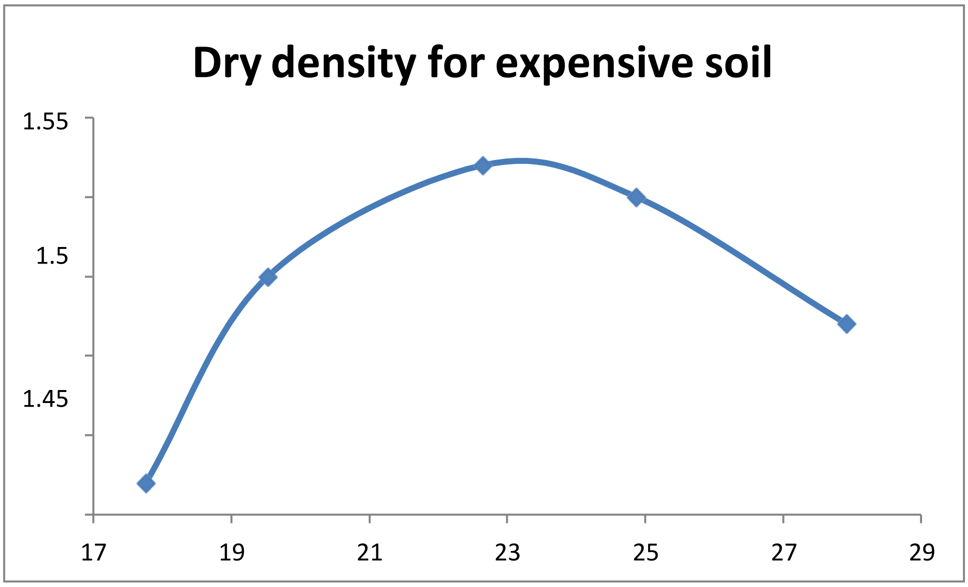
4	15%FA+1% PW	56.4
5	20%FA+1% PW	51.8



E. Standard proctor test

Table 6.3 Expensive soil

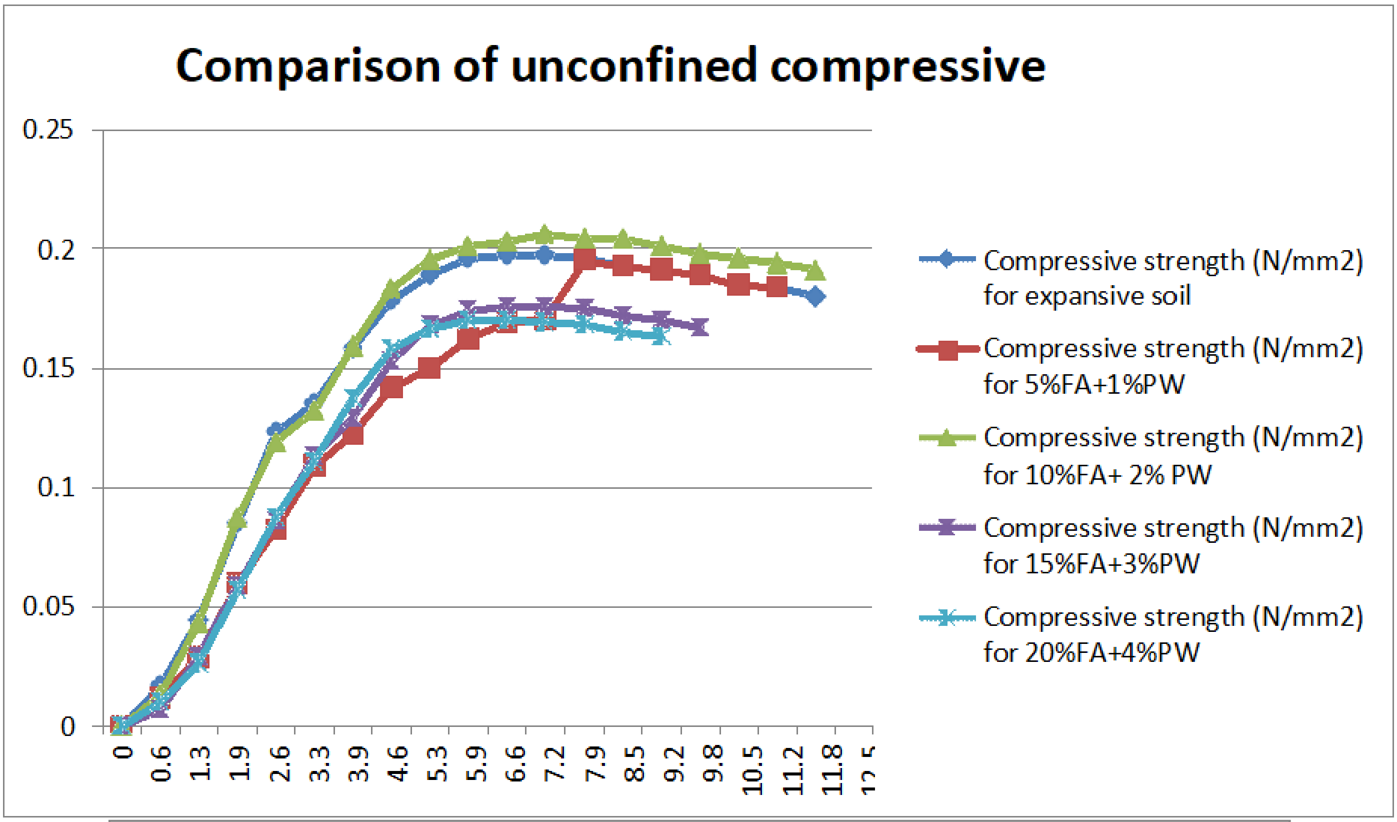
Volume of mould (m^3)	Weight of soil in mould (kg)	Bulk density (g/cm^3)	Moisture content (%)	Dry density (g/cm^3)
0.001	1.56	1.56	17.76	1.32
0.001	1.73	1.73	19.53	1.45
0.001	1.86	1.86	22.65	1.52
0.001	1.87	1.87	24.87	1.5
0.001	1.82	1.82	27.92	1.42

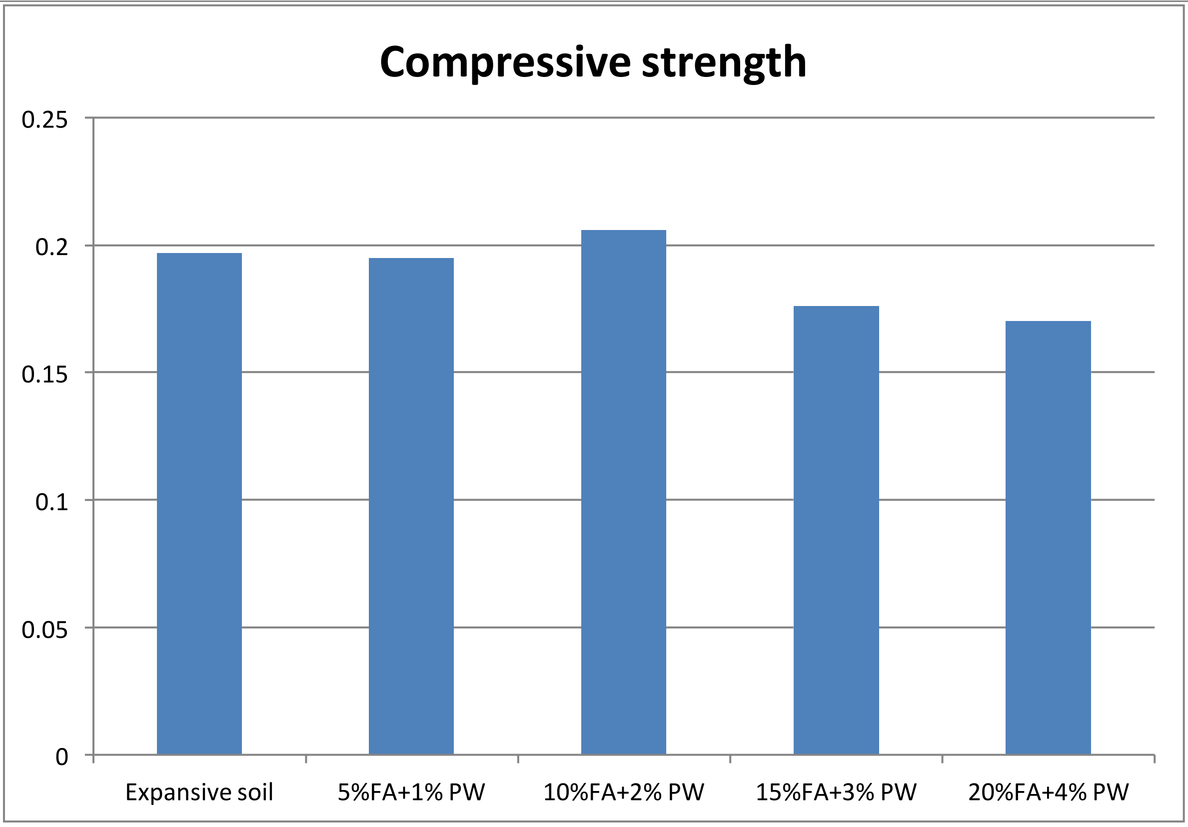


F. Compressive Strength

SL. No	Strain (%)	Compressive strength (N/mm2) for expansive soil	Compressive strength (N/mm2) for 5%FA+1%PW	Compressive strength (N/mm2) for 10%FA+ 2% PW	Compressive strength (N/mm2) for 15%FA+3%PW	Compressive strength (N/mm2) for 20%FA+4%PW
1	0	0	0	0	0	0
2	0.6	0.017	0.012	0.013	0.007	0.01
3	1.3	0.044	0.029	0.043	0.029	0.026
4	1.9	0.085	0.06	0.087	0.059	0.057
5	2.6	0.123	0.082	0.119	0.086	0.087
6	3.3	0.135	0.109	0.132	0.113	0.111
7	3.9	0.158	0.122	0.159	0.129	0.137
8	4.6	0.178	0.142	0.183	0.153	0.158
9	5.3	0.189	0.15	0.195	0.168	0.166
10	5.9	0.196	0.162	0.201	0.174	0.17
11	6.6	0.197	0.169	0.203	0.176	0.17
12	7.2	0.197	0.17	0.206	0.17	0.169

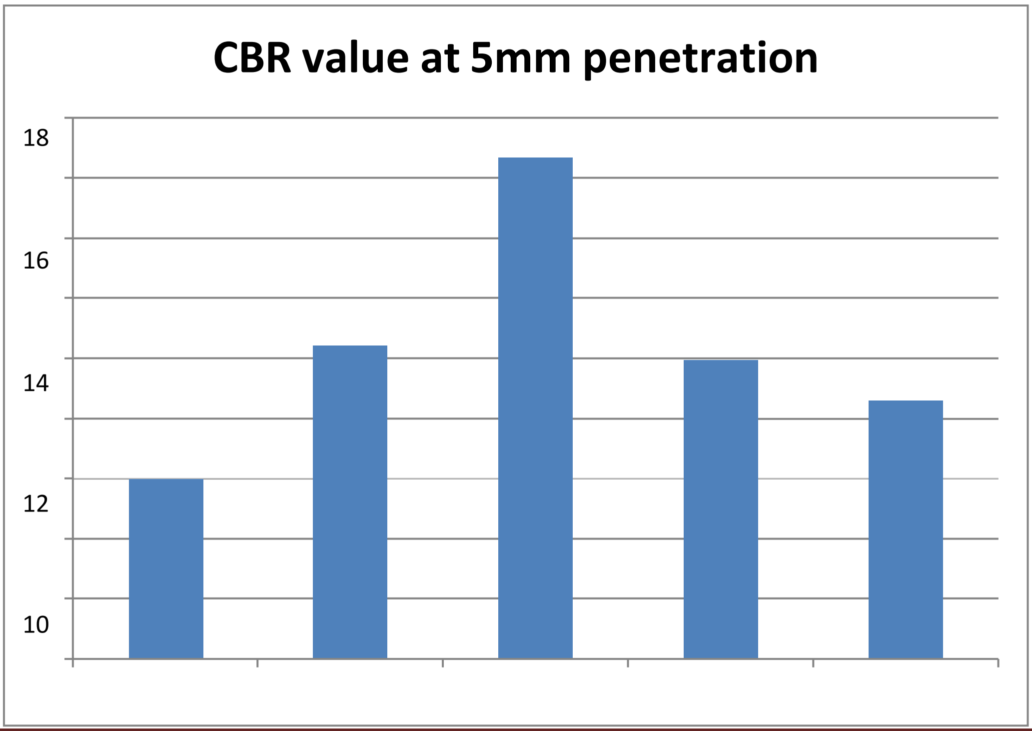
					6	
13	7.9	0.196	0.195	0.204	0.17 5	0.168
14	8.5	0.193	0.193	0.204	0.17 2	0.165
15	9.2	0.191	0.191	0.201	0.17	0.163
16	9.8	0.189	0.189	0.198	0.16 7	
17	10. 5	0.185	0.185	0.196		
18	11. 2	0.184	0.184	0.194		
19	11. 8	0.18		0.191		
20	12. 5	1.78				


Comparison of unconfined compressive
0.25
0.2
0.15
0.1
0.05
0
0
0.6
1.3
1.9
2.6
3.3
3.9
4.6
5.3
5.9
6.6
7.2
7.9
8.5
9.2
9.8
10.5
11.2
11.8
Compressive strength (N/mm2) for expansive soil
Compressive strength (N/mm2) for 5%FA+1%PW
Compressive strength (N/mm2) for 10%FA+ 2% PW
Compressive strength (N/mm2) for 15%FA+3%PW
Compressive strength (N/mm2) for 20%FA+4%PW


Compressive strength
0.25
0.2
0.15
0.1
0.05
0
Expansive soil
5%FA+1% PW
10%FA+2% PW
15%FA+3% PW
20%FA+4% PW

G. California Bearing Ratio

S. No	% Fly ash +%Plastic waste	CBR value at 5mm penetration
1	Expansive soil	5.99
2	5%FA+1% PW	10.4
3	10%FA+2% PW	16.67
4	15%FA+3% PW	9.95
5	20%FA+4% PW	8.61



CONCLUSIONS

This project is focused on the review of performance of fly ash and plastic waste as a recycle material in road material. The study suggests that if fly ash and plastic waste if properly mixed and applied, can be used as a great soil stabilization technique .On the basis of this project the following results were obtained.

- Fly ash is used as an excellent soil materials for highly active soils which undergo through frequent expansion and shrinkage.
- The Fly ash as an additive decreases the swelling, and increases the strength of the expansive soils.
- The higher value of maximum dry density was observed at 15% fly ash and 1% plastic fiber and the maximum value of Optimum moisture content was observed at 20% fly ash and 1% plastic fiber.
- The optimal value of unconfined compressive strength was observed at 10 % fly ash and 1%plastic fiber.
- The optimal value of CBR value was observed at 10% fly ash and 1%plastic fiber.
- The values of liquid limit and plastic limits decreases with increasing the percentages of fly ash from 0% to 20% with 1% plastic fiber.

REFERENCES

1. Tripti Goyal, Er. Rubel Sharma, et al.,(2018), “Experimental study of clayey soil stablised with fly Ash and recron-3s”, International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 05 Issue: 10 | Oct 2018 www.irjet.net p-ISSN: 2395- 0072.
2. Ankita Sonkar, S. Srividhya, et al.,(2017), “experimental study on strength Characteristics of palm fiber Reinforced soil stabilize using Bagasse ash”, International Journal of Civil Engineering and Technology (IJCIET) Volume 8, Issue 4, April 2017, pp. 2027–2035, Article ID: IJCIET_08_04_231.
3. Amit Tiwari1, H. K. Mahiyar2, et al.,(2014), “Experimental study on stabilization of black cotton soil by fly ash, coconut coir and crushed glass”, International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 4, Issue 11, November 2014).

4. Mahevi Malik Affan Masood Javeed1, Gavit Deepak Bhagwat2, et al.,(2018), "Stabilization of Black Cotton Soil using Fly Ash and Coconut Coir", IJSRD - International Journal for ScientificResearch & Development| Vol. 6, Issue 01, 2018 | ISSN (online): 2321-0613.
5. K.Padmavathamma1, S.Jyothirmayee2, L.Vimala3, et al.,(2017), "Experimental Study on Stabilization of Black Cotton Soil by Using Fly Ash and Coconut Coir Fiber", International Journal of Innovative Research in Science, Engineering and Technology
6. Sharan Veer Singh, Mahabir Dixit, et al.,(2017), "Stabilization of Soil by Using Waste Plastic Material: A Review", International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Website: www.ijirset.com Vol. 6, Issue2, February 2017
7. Jasmin Varghese Kalliyath, Jithin Thomas Joy, et al.,(2016), "Soil Stabilization using Plastic Fibers", IJSTE - International Journal of Science Technology & Engineering | Volume 2 | Issue 12 | June 2016 ISSN (online): 2349-784X.
8. Deekonda Gowthami, R. Sumathi, et al.,(2017), " Expansive Soil Stabilization using Plastic Fiber Waste Polypropylene", International Journal of Latest Research in Engineering and Technology (IJLRET) ISSN: 2454-5031
9. Sagar E. Shinde, Azim A. Shaikh ,Shubham D. Kulkarni, et al.,(2017), " EFFECT ON PROPERTIES OF SOIL USING WASTE PLASTIC FIBRES", International journal of advanced technology in engineering and science, vol no 5, issue no 2 Feb 2017.
10. 1muddada poojitha1 B.praveen babu2, "PAVEMENT DESIGN", INTERNATIONAL JOURNAL OF PROFESSIONAL ENGINEERING STUDIES, Volume VII /Issue 5 / DEC 2016.
11. I. Rohini and V. Arularasi, "NATIONAL HIGHWAY DESIGN-A CASE STUDY OF KADAPA TO KURNOOL NATIONAL HIGHWAY" International Journal of Civil Engineering and Technology (IJCIET) Volume 7, Issue 4, July-August 2016
12. 1panchadi manoj kumar1 b.praveen babu2 "A STUDY ON THE PERFORMANCE OF FLEXIBLE PAVEMENTS" International journal of research in advanced engineering technologies. Volume 5, Issue 5 DEC 2016.
13. Saurabh Jain1, Dr. Y. P. Joshi2, S. S. Goliya3 " DESIGN OF RIGID AND FLEXIBLE PAVEMENTS BY VARIOUS METHODS & THEIR COST ANALYSIS OF EACH METHOD" Saurabh Jain et al. Int. Journal of Engineering Research and Applications www.ijera.com Vol. 3, Issue 5, Sep-Oct 2013, pp.119-123.

14. Shital H. Jadhav1, Shital H. Ingle2, Rajpal G. Kumawat3 “DESIGN OF FLEXIBLE PAVEMENT BY VARIOUS METHOD” International Journal of Research in Advent Technology (IJRAT) (E-ISSN: 2321-9637).
15. Sai Phani Raghu Veer1, Siddharth Gupte2, Jayesh Juremalani3 “ A REVIEW OF LITERATURE ON GEOMETRIC DESIGN OF HIGHWAY” International ResearchJournal of Engineering and Technology (IRJET) Volume: 05 Issue: 02 | Feb-2018.
16. Ganesh Borude1, Vijaykumar Bhusare2 , Yogesh Surywanshi 3 “COMPARATIVE STUDYOF FLEXIBLE AND RIGID PAVEMENT SUBJECTED TO STATIC AND TRANSIENT LOADING IN ANSYS” Imperial Journal of Interdisciplinary Research (IJIR) Vol-3, Issue-9, 2017.