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Design of geocell reinforced pavement overlays geopolymer concrete

Rushikesh Sapkal, Shivam Kasurkar, Rohit Patil, Sanket Kamble

1-4 Students B.E Civil Engineering
Department of Dr. D Y Patil School of Engineering and Technology, Lohegaon,
Pune, Maharashtra, India
Dr. Vishwjeet Kadlag, Assistant Professor,
Department of Dr. D Y Patil School of Engineering and Technology, Lohegaon,
Pune, Maharashtra, India

Abstract : **This paper describes the results of a study carried out for investigating the structural behavior of different types of cell-filled pavements. The main objective of the present study is to examine the behavior of pavements constructed by filling the cells with (a) cement concrete (b) geopolymer concrete. A formwork of compartments of thin recycled plastic sheets was used to construct cell-filled concrete pavements, which function as cast-in situ linked block pavements. A comparison of costs of different types of cell-filled concrete pavements with those of traditional flexible and rigid pavements designed for low traffic volumes indicates that cell-filled pavements are cost-effective compared with conventional pavements, mainly in locations with shortage of aggregates.**

Keywords: geocell pavement, geocell, geopolymer concrete, pavements, fly ash, concrete road.

1.INTRODUCTION

Maximum of the low volume village roads being constructed are flexible roadways provided with a tinny bituminous surface. Quite frequently, these roads get damaged due to loaded vehicles , insufficient drainage facility also water logging problems, and hence need early periodic maintenance. Also, in the absence of adequate fund and timely maintenance, the usability level of the roads deteriorates quickly.

Therefore, to there is a need to come up with new advanced technologies. The cell filled concrete pavements gives long-lasting concrete pavements at low early cost which are more durable and almost maintenance free. The cells are tensioned and spread across the foundation layer and concrete is poured and compacted into the cells. Upon compaction the cell walls get deformed resulting in interlinking of end-to-end individual concrete block.

Fly ash is produced from burning of coals in thermal plants. 65% of countries electricity depends on thermal power plants. The consumption of coal produces tones of fly ash which is a waste product. The fly ash can be used in concrete by replacing certain percentage of cement. Replacement cement by fly ash reduce cost of construction as fly ash is cheap. Fly ash also helps in improving strength and ease of pumping of concrete and lower heat of hydration. The aim of study to use M25 grade of concrete at 7,28 days curing by replacing cement by fly ash and conducting various tests.

2.OBJECTIVES :

- Design and Evaluation geopolymer concrete for plastic cell filled concrete pavements.
- Extensive studies on mechanical behaviour of concrete containing fly ash of different proportions and comparison of the results with normal concrete.
- The main objective of replacement of fine aggregate and cement is to increase the strength of concrete by partial replacement of cement by fly ash.
- To compare the behaviour of conventional concrete pavement, flexible Pavement and cell- filled geo polymer fly ash concrete pavement of different categories.
- Use of industrial waste in full manner to reduce the disposal problem in present and future days and significantly reduce co2 emission and plastic disposal.

3. PROJECT SCOPE :

- The cell filled concrete pavements gives long-lasting concrete pavements at low early cost which are more durable and almost maintenance free.
- Fly ash can be used with admixtures for increasing strength of concrete with partial replacement of cement

- Cement is costly and scarce so the partial replacement of these material by fly ash respectively, helps to reduce the cost of construction.
- Use of fly ash helps in reducing the environment pollution during the disposal.

4. METHODOLOGY :

4.1 Identification and Selection of site.

- Step1:- Clearance of location and layout marking for both geocell road and cement concrete road.
- Step2:- Placing bolder on cement concrete pavement and 40mm aggregate on geocell reinforced pavement.
- Step3:- Placing murum on both the side of 150mm thick layer.
- Step4:- Tamping and spreading water alternately on both the side of pavement.
- Step5:- Placing aggregate on cement concrete road and compacting it.
- Step6:- Applying formwork for cement concrete road.
- Step7:- Spreading and stretching geocell confinement on the prepared sub-base course.
- Step8:- preparing concrete of grade M30 and filling geocell web evenly with it. Also placing concrete in prepared formwork for cement concrete road.
- Step9:- Removing formwork after twenty-four hour of cement concrete road.
- Step10:- Curing for 28 days two times per day.

4.2 Testing

- Determination of properties of material and concrete.
- Production of test samples
- Testing various tests for project work.
- Conclusion based on result.

5. MATERIALS REQUIRED:

5.1 GEOCELLS:

The geocells are made from reclaimed high-density polyethylene sheets of thickness 0.22 mm to about 0.25mm.Plastic sheet manufacturers can supply rolls of strips 50mm to 100mm wide depending upon the depth requirement. since the cells remain buried so the colour is not important and reclaimed HDPE/LDPE sheets are usually rendered black in colour.

5.2 CEMENT:

Ordinary Portland cement of 53 grade is used. Cement is a binder material which sets and harden independently, and can bind other material together. Cement is made up of main four compounds tricalcium silicate(3CaO Sio2),Di-Calcium silicate(2CaO Sio2),Tricalcium aluminate(3Cao Al2O3) and tetra calcium aluminate(4Caco Fe2O3).

5.3 AGGREGATES:

Aggregates are the important constituents in concrete. They decrease shrinkage and effect economy. One of the most significant factors for manufacturing workable concrete is good gradation of aggregates. Good grading implies that a sample portions of aggregates in required proportion such that the sample covers minimum voids. Samples of the well graded aggregate containing minimum voids need minimum paste to fill up the voids in the aggregates. Least paste means less quantity of cement and less water, which is further mean increased economy, lesser shrinkage and greater durability.

a) Coarse Aggregate:

The fractions more than 4.75mm are used as coarse aggregate.

b) Fine aggregate:

The size of aggregate less than 4.75mm are termed as fine aggregate. The crushed sand is used**.**

5.4 FLY ASH:

Because fly ash is a by-product of coal combustion. material chemical constituents can vary considerably but all fly includes Silicon Dioxide (SiO2),Calcium Oxide (CaO) also known as Lime, Iron (III) Oxide (FeO2),Aluminum Oxide (Al2O3).There are two types of fly ash Class F fly ash and Class C. Class F fly ash used for work.

5.4 ADMIXTURES:

a)Sodium silicate

b)Sodium hydroxide

5.6 WATER:

Water is an significant element of concrete as it actually contributes in the chemical reaction with cement. Since it helps to from the strength generous cement gel, the quantity and quality of water is essential to be looked into very carefully.

6. TESTS TO PERFORM:

6.1 Test on Cement:

Initial and Final Setting Time: The initial setting time is observed as the time elapsed among the moment that the water is added to the cement and that time the paste starts loosing its plasticity. The final setting time is the time elapsed between the moment that the water is poured to the cement and the time when the paste has totally lost its plasticity and has achieved adequate firmness to

resist certain definite pressure. It is essential that cement set neither too fast nor too slowly. The initial setting time should not be too long which causes insufficient time to transportation and place the concrete before it becomes too rigid. Also, the final setting time must not be too high which tends to slow down the concrete work and also it force postpone the actual use of the structure because of insufficient strength at the anticipated age.

Vicat's apparatus

6.2 Slump cone test :

Slump cone test is used to measure the workability of concrete. The device used for doing slump test are Slump cone and Tamping rod. This is the utmost commonly used test of measuring the consistency of concrete. It is not a appropriate method for very wet or very dry concrete. It does not measure all aspects contributing neither workability, nor it is always representative of the place ability of the concrete. Though, it is used suitably as a control test and gives an indication of the consistency of concrete from batch to batch. It is performed with the help of a container shaped in form of a frustum of a cone opened at both ends.

Slump Cone

6.3 Compressive strength test

For cube test of specimen's cube of 150mm*150mm*150mm are used. For most of the works cubical molds of size 15 cm x 15cm x 15 cm are generally used. This concrete is filled in the moulds and tamped properly so as not to have any voids. After 24 hours these moulds are removed and test specimens are placed in water for curing. The upper surface of these specimens should be made uniform and smooth. This is done by putting cement paste and spreading efficiently on whole area of specimen. These specimens are tested in compression testing machine after 7 days curing or 28 days of curing.

Compression Testing Machine

7. CONCLUSION:

- Geocell reinforced pavements relieves hydrostatic pressure and manages surface water.
- Geocell reinforced pavements eliminates formwork and no need for expansion joints.
- Control cracking with no necessity of expansion joints.
- Geocells reinforced pavements assures exact concrete depth.
- Easier installation with shorter construction.
- It has been shown that concrete containing fly ash is more cost-effective than ordinary concrete. Concrete containing fly ash, transported to the construction site, can be from 10 to 35% more economical than normal concrete. The main factor affecting the decrease in cost is the fly ash content of the mix. The user should be aware of concrete containing fly ash requiring a high quantity of air-entraining admixture for the growth of a proper air-void system. In many cases, the rise in price due to the admixture requirements may remove any savings in cost gained by the use of fly ash.
- Better workability. The round shaped particles of fly ash act as tiny ball bearings within the concrete mix, thus providing a lubricant effect. This similar effect also progresses concrete pumpability by decreasing frictional losses throughout the pumping process and flat work finish ability.
- Reduces heat of hydration. Replacement of cement with the some amount of fly ash can decrease the heat of hydration of concrete. This decrease in the heat of hydration does not sacrifice long-term strength improvement or durability. The decreased heat of hydration lessens heat rise problems in mass concrete placements.
- Better durability. The reduction in free lime and the resulting increase in cementitious mixes, combined with the decrease in permeability improve concrete durability. This affords some benefits.

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