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TYRE AS SUB-BASE INTO ROAD PAVEMENT

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Abstract : In tyres as sub-base into road pavement there is a unicellular restricted mixture unit which binds aggregates right in the tyre to bear transverse soil stress, additionally holds aggregates compacted right in the tyre which will take the load. It essentially helps the aggregates utilized in traditional avenue, confining it right into a single cell shape. The stones used as aggregates are contained by the cell shape of the tyres. The confinement can be tire-derived or any hollow cylindrical confinement; nevertheless, the article focuses on boosting the avenue's value effectiveness while also increasing its power and sturdiness, therefore recycled tyres are used in the traditional avenue's sub-base. The paper includes the take a look at consequences and evaluation the usage of rubber as a binding cylinder. Tyres as sub-base with aggregates in it having bearable tensile and right length to withstand the lateral stress acting on the tyre whilst the aggregates are located below load. Any recycled car mobile or truck tyre with its side partitions removed is the option here. Therefore the tyre used does now no longer take the homes of the tyre however by the production turns into Tire-Derived Geo cylinder.

IndexTerms **- Confined Aggregates, Waste tire recycling, Geo-synthetic cylinder, Tire Derived Geo Cylinders (TDGC).**

I. INTRODUCTION

The paper introduces an innovative alternate in laying of traditional street, hence focusing on the layout parameters and price effectiveness of the tyres as sub-base into road pavement over traditional roads. Tyres in sub-base are used to confine the stone aggregates to increase its load bearing strength. The paper aptly compares the benefits of tyres as sub-base over the traditional road designs. It depicts the use and the check carried on four specific materials used as fillers with inside the production of the road. The mixture of aggregates and the confinement offers a robust unit cell shape of TDGC. This cell shape has will become a unit building block of the sub-base of the street. This mobile may additionally be addressed as geosynthetic mobile. It has capacity identical to that of a concrete block. The shear strength and crushing value of the aggregates used as filler materials on this sort of roads. The stone aggregates utilized in the sub-base have various sizes and texture. Tyres utilized in sub-base with aggregates require no compaction subsequently has a part over the production of the traditional roads. The vertical masses implemented at the geo synthetic cylinder distribute the lateral shifting masses to acquire its capacity. Most roadways disasters are because of tremendous lateral strain distributed inconsistently because of unconfinement of aggregates used in traditional roads. Hence on this sort of roads the usage of geo-cells confines the aggregates dispensing the vertical masses stopping pothole formation because of lateral failure of the aggregates.

Objectives-

1. To attain economic system in production of roads, in the use of recycled materials.
2. To mitigate the value of maintenance.
3. Environmentally viable.
4. Use of easy method with minimal time for creation of road.

II. LITERATURE REVIEW

2.1 US patent 7470092, Samuel G. Bonasso, "System and method for reinforcing aggregate Particles, and structure resulting there from", issued 2008-12- 30.

a) The method includes placing of the tyres on the surface.
b) Between the each tyre the void will be present in which the aggregates are placed.
c) Filling of aggregates will be done such that the voids get completely filled with aggregates. The tyres filled with aggregates restrict lateral movement.

2.2 Three dimensional Confinement System Contribution to structural Pavement Reinforcement (Kief and Rajagopal, 2008).

a) Geocells can potentially allow for less excavation, haul, and material infill, and it can provide economic and environmental benefits.

b) This technology helps for roadway enhancement in areas exposed to seasonal weather changes and rural environments.

2.3 Improvement of Pavement Foundation Response with Multi-Layers of Geocell Reinforcement: Cyclic Plate Load Test (Khalaj et al. 2014).

a) The installment of these geocells can increase resilient behavior and total settlement of the pavement foundation due to load dispersion and energy absorbance of the geocells.

b) Results can conclude that geocells protect pavement from rutting due to the accumulation of high residual plastic stresses.

2.4 Advantages of Mechanical Concrete Road Over Conventional Road (Chakrey and Pawar, 2015).

a) Mechanical concrete in the construction of roadway systems has the potential to reduce installation time, minimize material costs, and provides durability due to aggregate confinement within the cylindrical tires.

b) Research estimates 27 % cost reduction with utilization of mechanical concrete system as per District Scheduled Rates

III. METHODOLOGY

The site must be accomplished to accommodate the TDGC cylinders recovered from tires by clearing the surface materials to the regionable depth. The TDGC is placed in the sub-base so that each tyre will be in contact with minimum three neighbouring tyres. The use of tyres, taken from cylinder hoops, for the manufacture of the sub-base consists of arranging TDGC in a grid formation, jointed together by tie wire. The easiest method is the use of a nail gun to insert a nail through adjacent tyres. To keep the circular shape of the TDGC's, placing of the confined aggregates occurs when the TDGC will be in contact with three tyres. This means that TDGC must be in contact with minimum three tyres. When filling tyres with the bulldozer front ends develop a serious issue since the adjacent tyre sidewalls collapse. Aggregates are placed in the tyre without compacting the aggregates used on the road, which supports to maintain the ratio. The manufacture of the freeways involves less skilled labour, so the cost of construction and repair work for this freeway is minimal compared to traditional freeways.

Fig. 1 Laying of Tyres as sub-base

IV. MATERIALS

The tire-derived cylinder is a thin-walled circular cylindrical segment made of a suitable special material with a load capacity greater than the circular tensile forces resulting from the lateral pressure of the ground caused by the dead weight of the aggregates (stones) and traffic loads per vehicle superimposed. Motive is sufficient by removing the side walls of the car tire. The cylindrical diameter of the tire tread shall not be greater than 0.71 m and less than 0.61 m. The width of the tire tread cylinder should not be less than 0.17 m and not more than 0.22 m. The tyre must be of uniform diameter and tread width with no exposed fiber belt inner steel on the tread surface.

V. GEOCELLS

In the Geosynthetic Cell (TDGC), the collection of similarly sized aggregates of the same species behaves like a thick hydraulic fluid of pure pressure quality. Aside from the friction between the particles have less or negligible transverse tensile strength and therefore appear fluid under compressive forces. The aggregates transmit the main bearing load down the axis of the tyre to the ground and transmit the lateral side pressure to the TDGC which then resists the hoop stress. The green heart of this technology is the tire-derived cylinder, which encapsulates and strengthens the stone aggregates. The Tire-derived Geo Cylinders (TDGC) are introduced and tested for loads greater than the wheel load HS 20. As the name suggests, the TDGC is made of tires that serve as a cylindrical boundary that gives lateral support to the stone aggregates, thus improving their carrying bearing strength and use**.** The apply of tread worn, discarded, vehicular tires with each facet walls removed, is evaluated and suggested for its use

because the confining cylinder for the TDGC. The tire derived cylinder performs functions the same as that of a cement and so acts as a binder by confining the aggregates used as fillers in it.

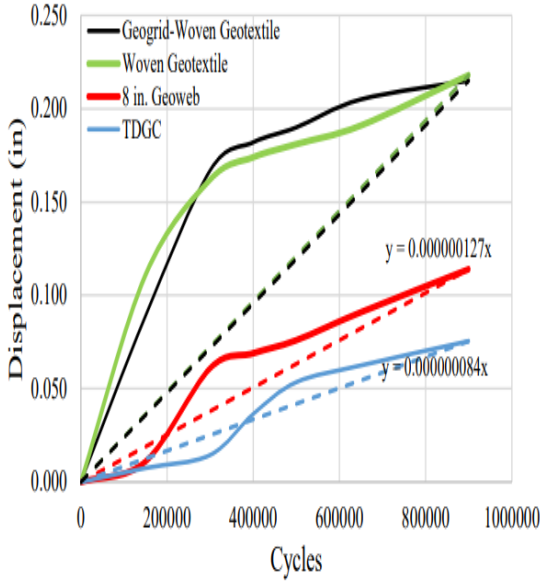

Fig. 2 Graphical trends following initial settlement for loads

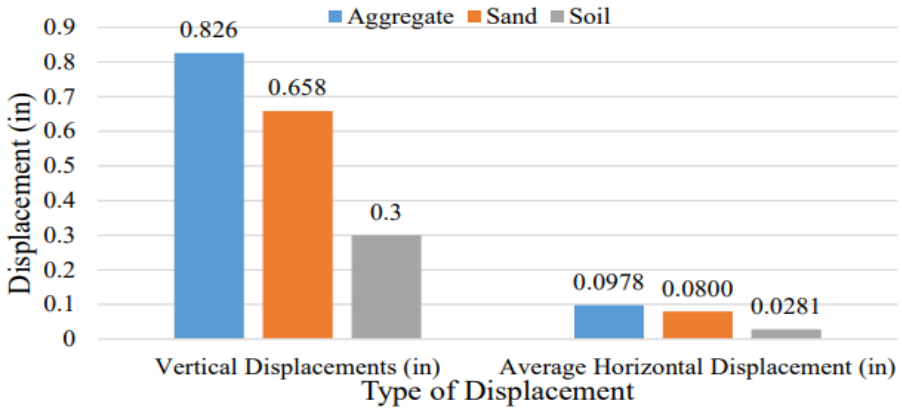

Fig. 3 Vertical and horizontal displacements in the final load cycle for each infill material

VI. COMPARISON OF TYRE AS SUB-BASE INTO ROAD AND CONVENTIONAL ROAD

Tyres used as sub-base into road pavement have varied advantages over the employment of typical roads with respect to the time, value and materials needed for manufacturing of road.

6.1 Time Comparison

The time needed to build the tyre as a sub-base road is less than with respect to that of conventional roads. In the construction of the road using the tires as a substructure with aggregate, there will be a difference in the completion time of various activities than the conventional road.

6.2 Material Comparison

The material needed to build the tyre as sub-base road is less than with respect to that of conventional road since compaction is not needed for the application of aggregates on such roads due to confinement, whereas compaction is must in a conventional road to achieve strength.

6.3 Cost Comparison

The cost needed to construct a 1 km long 12m wide Road is almost 22% less than the cost needed to construct a conventional road. The reduction within the value reduction will be clearly seen from the standard methodology of construction for standard road per the specification ordered down by IRC (Indian Road Congress).

TABLE I. COST COMPARISON BETWEEN TYRE AS SUB-BASE AND CONVENTIONAL ROAD

Tyre as sub-base into road pavement	**Conventional road**
Cost per km of 12m width road is Rs 85,81,850/-	Cost per km of 12m width road is Rs 1,10,42,100/-
Total saving of Rs 24,60,250	
22.28% of Construction Cost Saving	

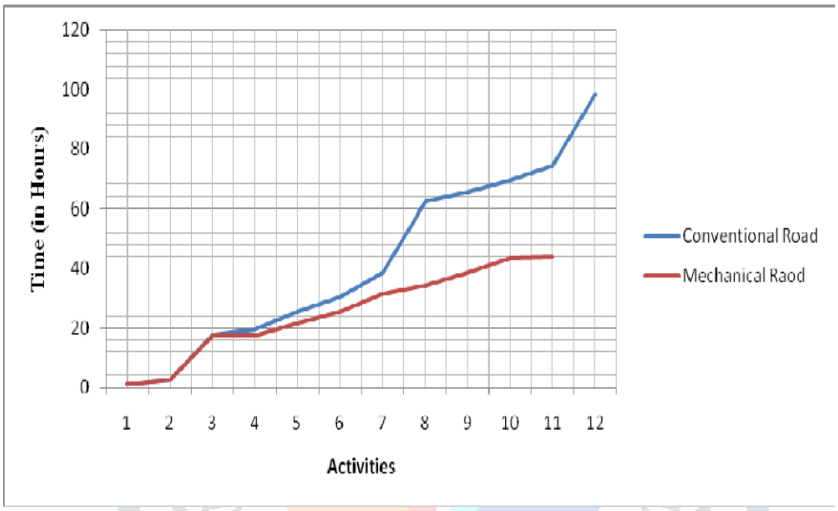

Fig. 4 Graphical representation of activity Chart.

VII. LABORATORY TEST & RESULTS

7.1 Fire & Flash point

During the heating of combustible material, vapor is generated near its surface. The flash point test measures the minimum temperature at which the vapor burns in the presence of an ignition source with an instant flame.

The fire point is the minimum temperature at which the material will catch fire and burn under the specified test conditions.

Fig. 5 Heating of bitumen

Fig. 6 Check the flash point

Fig. 7 Checking the temperature of fire point

TABLE II. OBSERVATION TABLE OF FIRE & FLASH POINT

Rate of heating: 105°C- 110°C

	Trial 1
Flash point	202°C
Fire point	215°C

RESULT

Flash point: 202°C

Fire point: 215°C

7.2 Confinement testing of TDGC

Initial laboratory load tests were conducted on aggregates enclosed in tyre derived geo cylinders (TDGC). A TDGC was filled with 20 mm aggregates. The loads were applied vertically to the instrumented TDGC with aggregates infill material. Three dial gauges were placed around the circumference to measure lateral displacement. Three loading cycles were performed independently. Note that small residual displacements were observed at each loading cycle. Table II reflect lateral displacement values recorded at 88.964 KN load.

Fig. 8 Confinement testing of instrumented TDGC infill with aggregates.

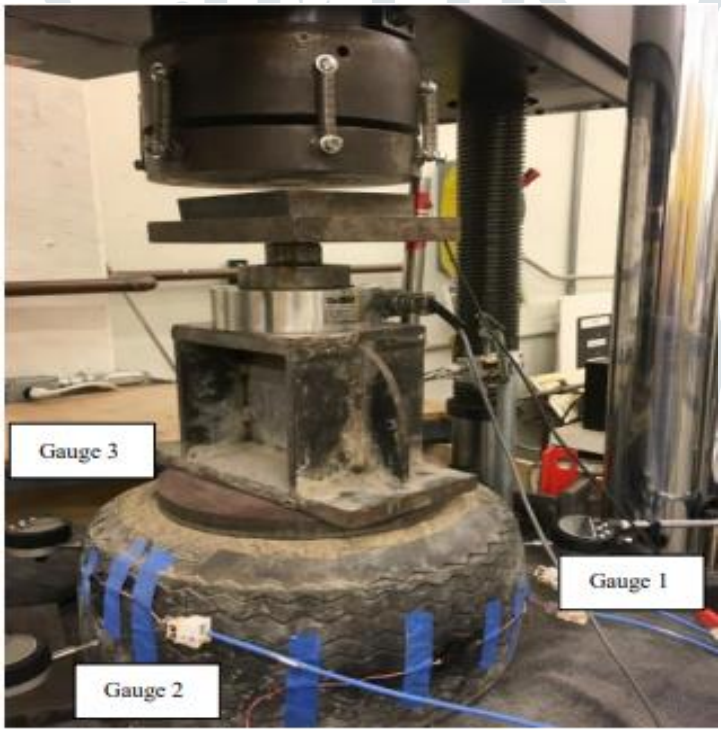

Fig. 9 Confinement data acquisition set-up to obtain micro-confinement data.

TABLE III. HORIZONTAL DISPLACEMENT OF THE TDGC WHEN FILLED WITH COARSE AGGREGATE

X-direction			
Gauge	**Load Cycle**	**Infill materials**	**Horizontal displacement(in)**
1	1	Aggregate	0.429
	2	Aggregate	0.223
	3	Aggregate	0.163
2	1	Aggregate	0.434
	2	Aggregate	0.249
	3	Aggregate	0.195
3	1	Aggregate	0.374
	2	Aggregate	0.349
	3	Aggregate	0.197

Conclusion of confinement test

As the load cycle increases the horizontal displacement of the TDGC are reduces and the use of TDGC confine the aggregates distributing the vertical loads preventing pothole formation due to lateral failure of the aggregates.

VIII. THE REASON WHY TYRES AS SUB-BASE INTO ROAD DO NOT FAIL

1. The main reason this type of unpaved road requires less maintenance is its behavior in the presence of water. On an unpaved road with tires as a sub-base, this degradation process ends at the wear surface. Rainwater can cause the compacted surface to deteriorate because it relies on the friction of the particles for its strength. However, the water does not cause the sub-base to lose its transverse strength because its strength comes directly from the material of the cylinder and not from the internal friction of the particles of the. Maintenance of wear surfaces is easier to perform and less expensive than basic maintenance.

2. The subsequent motive is that such unpaved road calls for much less renovation is the kind of ditch behaviour it promotes. Field observation shows that unpaved roads ought to have a crowns and or facet slopes of half of inch according to foot to support advantageous drainage. This water is drained away in by ditches or by foil drainage. Where ditches exist, their roadside-created slopes tend to deteriorate, and then collapse and fail with time and use. These ditch wall failures are also a result of the water reducing the internal carrying capacity of the aggregates in the road. Tyres as a sub-base with aggregate eliminate ditch wall failures because the side slope of the road ditch is the waterproof face of the cylinder.

3. The very last motive is that such unpaved roads require much less renovation is the superior integration and basis guide it provides. The additional under body tyre as sub-base with aggregates gives the more strength and economy compared to the typical for off-road use. Its consistent sharp-cornered interface integrates the usable area to function with the base as a unit, with the distributing loads more effectively into the subgrade. Geometrically the tyre-derived geo cylinder typically reduces the wheel load pressure of the subgrade by a factor of 2.5 to 3.0. This integration also allows for better rainwater management, whether through optimally compacted graded stone wear surfaces, permeated with resin soil stabilizers or chip seal techniques. When well sloped, unpaved street surfaces with a tyre as sub-base have a longer beneficial life.

IX. CONCLUSIONS

The use of tyres as sub-base decreases time, price and materials needed in the manufacturing of road with respect to standard road. Confinement of aggregates gives good durability. The maintenance costs of this pavement are reduced due to the higher proportion of voids that drains rainwater. There will be a reasonable amount of cost reduce in creation of such roads with respect to conventional roads.

X. ACKNOWLEDGEMENT

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