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Use of Old Tyres for Bedding of Building Foundations

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Abstract: Concrete being stiff material, it attracts more stresses and moment. Because of which, sizes of footings and all structural elements increases. If the Bedding soil strata upon which we are going to place foundations having less bearing capacity (SBC), then sizes of foundations becomes very massive. It becomes very costly and also it becomes non-sustainable structure. Pile foundation or Raft foundation can be costly option in such areas. If we introduce old wasted tyres in the soil strata beneath RCC foundation, it could be a cheap and sustainable solution.

At present the disposal of waste tyres is becoming a major waste management problem in the world. It is estimated that 1.2 billions of waste tyre rubber produced globally per year. It is estimated that 11% of post consumer tyres are exported and 27% are sent to landfill, stockpiled or dumped illegally and only 4% is used for civil engineering projects. Hence efforts have been taken to identify the potential application of waste tyres in civil engineering projects. In this context, our present study aims to investigate the optimal use of waste tyre rubber as a material to be placed at sub surface beneath foundations. (Kotresh K.M1, 1April 2014)[1]

In order to properly dispose these millions of tires, the use of innovative techniques to recycle them is important. The use of scrap tires including tire chips or tire shreds comprised of pieces of scrap tires, tire chip/soil mixtures, tire sidewalls, and whole scrap tires in civil engineering applications is the object of the standard ASTM D 6270. These materials can be used in lightweight embankment fill, lightweight retaining wall backfill, drainage layers, thermal insulation to limit frost penetration beneath roads, insulating backfill to limit heat loss from buildings, and replacement for soil or rock in other fill applications.

Rubber tires can also be used in civil and non-civil engineering applications such as in road construction, in geotechnical works, as a fuel in cement kilns and incineration for production of electricity or as an aggregate in cement-based products or in geotechnical field.

ASTM D 6270 studied the properties of shredded waste tires (Practical size of 2 mm and more), but not waste tire rubber powder. The objective of this paper is to present experimental work on the waste tire rubber powder. Further, a polynomial regression analysis of the cohesion and friction angle versus the particles size is proposed. (Asroun, 2014)[2]

Keywords: Old Tyres, Rubber, Concrete, Sand, murum Soil, Foundation, Construction Methodology.

I. INTRODUCTION

With the development of modern societies aftermath of industrial revolution, the mobility within automobile sector got momentum. The offshoot of this pragmatic revolution gave rise to new dimensions of problems in the form of rubber garbage. Tyre rubber wastes represent a major environmental problem of increasing significance. An estimated 1000 million tyres reach the end of their useful lives every year. At present enormous quantities of tyres are already stockpiled or land filled; Tyre land filling is responsible for a serious ecological threat. Mainly waste tyres disposal areas contribute to the reduction of Biodiversity also the tyres hold toxic and soluble components. Secondly although waste tyres are difficult to ignite, this risk is always present. Once tyres start to burn down due to accidental cause's high temperature take place and toxic fumes are generated besides the high temperature causes tyres to melt, thus producing oil that will contaminate soil and water. Still millions of tyres are just being buried all over the world. Tyre rubber wastes are already used for paving purposes; however, it can only recycle a part of these wastes. Another alternative is an artificial reef formation but some investigations have already Questioned the validity of this option. (Kotresh K.M1, 1April 2014) [3]

II. HEADING S

1. Experimental Investigation
2. Materials used for Bedding of Building Foundations
- **2.1 Old Rubber Tyres**
- **2.2 Sand**
- **2.3 Murum Soil**

3. Proportion of Materials

III. INDENTATIONS AND EQUATIONS

1. Experimental Investigation:
Objective
With the increase in urbanization of countries like INDIA &ETHIOPIA, the number of vehicles and consequently the amount of used tire is going to increase significantly in the near future. Hence, the no environmental nature of these wastes is going to be a potential threat.
• This study can show an alternative way of recycling tires by incorporating them into Building construction. Of course, the concept that the problem emerges from urbanization and the solution goes along with it can also be appreciated.
• Therefore, it is the aim of this study to introduce an environmental friendly technology, which can benefit the society and the nation.
• Application of used tires in Building construction is a new technology.
• Through this study, it is intended to utilize old rubber tyres with filling materials like sand or soil with proper compaction and to gain required compressive as well as tensile strength hence ultimately to reduce foundation sizes.
• Hence the possibility of using waste tires as an alternative construction material will be investigated. By conducting different laboratory tests on prepared specimens, it is intended to analyze the results. (Kotresh K.M1, 1April 2014) [4]

2. Materials used for Bedding of Building Foundations:
Old Rubber Tyres, Sand, Murum soil.

2.1 Old Rubber Tyres: The old rubber tyres can be collected from the local market. For uniformity and convenience, all the tires collected are from medium truck tire. The reason for choosing medium truck tires is that they can be handled and placed easily by workers.




https://www.google.co.in/search?q=murum&biw=1366&bih=633&tbm=isch&tbo=u&source=univ&sa=X&ved=0ahUKEwjSkpiBn7XSAhWHo5QKHThDATQQsAQIJA#tbm=isch&q=old+rubber+tyres&*

2.2 Sand: It is a coarse-grained soil, having particle size between 0.075 mm to 4.75 mm. The particles are visible to naked eye. The soil is cohesion less and pervious. Is of Zone-II as per IS: 383-1970, Crushed aggregate are 20 mm graded aggregates as per IS: 383-1970.


https://www.google.co.in/search?q=sandy+soil&biw=1366&bih=633&source=lnms&tbm=isch&sa=X&ved=0ahUKEwiOk4PknbXSAhUDspQKHZFOBcAQ_AUIBigB

2.3 Murum Soil: It consists of small pieces of disintegrated rock or shale, with or without boulders.


https://www.google.co.in/search?q=murum&biw=1366&bih=633&tbm=isch&tbo=u&source=univ&sa=X&ved=0ahUKEwjSkpiBn7XSAhWHo5QKHThDATQQsAQIJA#tbm=isch&q=murum+soil&*

3. Proportion of Materials: Sand and Murum Soil to be placed in same proportions in the gap between tyres. Reason being rubber tyre being flexible, will take tensile stress and Sand & Murum if placed in same proportions, will become flexible enough to take both compression as well as tension.

3.1 Physical Characteristics of the Rubber Powder:

TABLE I. RUBBER POWDER CHARACTERISTICS	
Properties	Rubber powder
Density	0.83
Size	80 μm – 1.6 mm
Elongation (%)	420
Rate of steel fiber	0%

3.2 Chemical analysis:

The tire is made up mainly by rubber. Its constitution varies a little between the car tires and heavy truck tires. Rubber consists of a complex mixture of elastomers, polyisoprene, polybutadiene and stirene-butadiene. Stearic acid (1.2%), zinc oxide (1.9%), extender oil (1.9%) and carbon black (31.0%) are also important components of tires [10-11]. In Table II, chemical composition of the used rubber powder is presented. The quantity of steel is generally about 15%, and it's more important for the heavy trucks tires. For this study steel and one part of textile were removed by magnetic separation and density.

TABLE II. RUBBER POWDER CHARACTERISTICS	
Material/element	Mass percentage
Rubber	54%
Carbon black	29%
Textile	2%
Oxidize zinc	1%
Sulfur	1%.
Additives	13%

3.3 Direct Shear Test: The tests were performed according to ASTM D 3080 standard [12]. The direct shear test is a laboratory testing method used to determine the shear strength parameters of rubber powder. (Asroun, 2014) [5]

IV. FIGURES AND TABLES

4. Results and Discussions: Figure 2 presents the results of the shear strength tests (curve intrinsic), the cohesion and the internal friction angle of the waste tire rubber powder, value relatively important if compared to some experimental values of the literature.

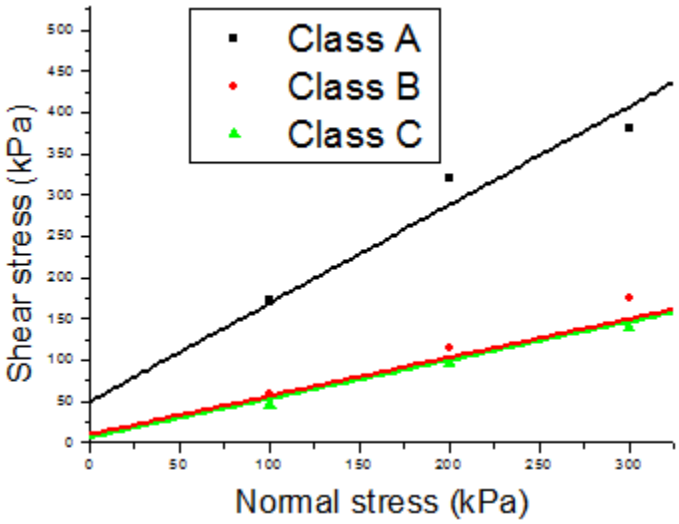

Fig. 2. Direct Shear Tests of rubber powder

The waste tire rubber powder is strongly compressible, moreover the surface quality of the powder produced by mechanical crushing with ambient temperature is irregular. The
Mohr-Coulomb shear strength parameters obtained from direct shear tests by these studies are presented in (1).

$T = c + tg\ \Phi$

Class A: $\tau = 6.5 + tg\ 25°$
Class B: $\tau = 10 + tg\ 25°$ (1)
Class C: $\tau = 50 + tg\ 8°$

It's observed that the cohesion values vary from 6.5 to 50 kPa, and fewer values were observed for class A and B sizes. Friction angles vary from 8 to 25° and it's increasing with
particle size. (Asroun, 2014) [6]

5. Construction Methodology: It is advisable for the loose soil like BC Soil (Black Cotton Soil) where we get no or minimum safe bearing capacity. Construction methodology involves digging a trench by excavating soil beneath at least 1/4th the building height. This proportion can be minimizing as $1/5^{th}$ for tall towers. After excavation, remove whole soil completely. Then cover sides of the trench by sheet piles to avoid collapse of the soil excavated. Barricade all sides for safety precautions. Then choose a standard size old wasted rubber tyres

and place it evenly over whole area above a 100 mm thick PCC layer. Now tie all the tyres together by binding wire to ensure proper bundling. Now pore and fill the gaps in between by combination of Murum Soil and Sand. Ensure a complete layer of it at least for 100 mm above layer of tyres. Now water it up till complete saturation of the whole combination. Then do proper compaction and to the confirmation of IS 2720. Now repeat same procedure from placing a layer of tyre, tying it, filling with Murum soil and sand up till proper compaction till it's height comes uptill founding level of the structure.

Now at Founding level, the depth where foundations are to place, prepare a PCC layer of 100 mm thick and place foundations over it. Proceed all further activities of constructing building structure as per regular standard practice.

http://glassford.com.au/main/building-menu/foundations/other-methods/rubber-tyre-footings/

https://www.google.co.in/search?q=rubber+tyres+in+construction+of+foundation&biw=1366&bih=633&tbm=isch&tbo=u&source=univ&sa=X&ved=0ahUKEwiQlcWwobXSAhUCHpQKHWuACdIQ7AkIQQ&dpr=1

V. CONCLUSION

This type of bedding made up of using tyres shall be really beneficial in the areas having loose strata like in the case of Black Cotton Soils. Black Cotton soil usually dries in summer and swells in rainy seasons. In that case, we have no option than to remove and replace that BC soil by new hard murum soil carried over to the site from somewhere else location. So cost of murum soil and Transportation cost goes very high. In the scenario this type of tyre based surface would be definitely a good solution. At the work site, where SBC (Safe Bearing Capacity) of soil is very low like 10 t/m^2 we may have option of Raft Foundation, which is very costly.

For the building towers of 21 floory heights or so, we require to take depth of raft around 2mts. In that case consumption of reinforcing steel is also very large. There also this type of founding surface would be beneficial solution. The main object of this type of tyre based founding subsurface is to resist Seismic (Earthquake) forces. If Earthquake occurs, building foundation being rest over tyre based founding subsurface, will take that lateral load of Earthquake also and it will resist it safely.

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