Influence of Waste Tire Chips on Strength and Characteristics of Sandy Soils

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Abstract— In the modern days world waste tires contributes significantly to environmental problem. As such utilization of waste tire in geo-technical engineering application has gained increasing attention in the present study an effort is made to investigate the feasibility of waste tire chips to enhance the engineering properties of poorly graded sand (SP), and well graded sand (SW). A series of laboratory test like direct shear test and plate load test are carried out on both soils after adding different percentages of 10%, 20%, 30%, 40%, 50% by weight of soil. A series of small plate load test were also carried out on both soils for different tire chip percentages. By conducting the direct shear test the cohesion and angle of friction of the soil are improved by using plate load test the bearing capacity of soil improved, thus the influence of waste tire chips on the strength and deformation characteristics of cohesionless soil.

Key words: Waste Tire Chips, Well Graded Sand, Poorly Graded Sand and CBR

I. INTRODUCTION

The technique of sand is an important granular material. It consists of small rounded or angular grains of silica (SiO2) and is formed by the decomposition or disintegration of sandstone under the action of weather such as wind rain frost etc. Sand is sometimes referred to as natural or synthetic. Natural sand is granular material made up of fine mineral particles. Sand is the products of physical and chemical weathering. Sand is the most stable of the mineral components of soil; it consists of rock fragments, primarily quartz particles. As rock fragments, sandy soils feel gritty between the sand grains have little ability to stick together thus sandy soils cannot be rolled into a string when wetted. It is well known that sandy soils are droughty soils, because they retain little water when wetted. The soils can be quite differently depending upon the geotechnical characteristics. In coarse graded soils, where the grains are larger than 0.075 or (75µm), the engineering behavior is influence mainly by the Relative proportions of different sizes of sands (0.075 – 2.36mm). The coarse graded soils are relative proportions of the different grain size have significance influence on the engineering behavior of a coarse graded soil. The factors affecting geotechnical characteristics of a coarse graded soil are depends upon the density of the soil grains and the shape of the soil grains. The grain size distribution of a coarse graded soil is generally determine through sieve analysis, where the soil sample is passed through a stack of sieves and the percentage passing different size of sieves are noted. The coarse graded soils are it is necessary to do sieve analysis to obtain the complete grain size, distribution data. A coarse graded soils is said to be well graded if there is a good distribution of sizes in a wide range are smaller grains fill the voids created by the grains thus producing a dense packing. A sand is well graded if Cu> 6 and Cc=1-3. And a gravel is poorly graded if Cu< 4 and Cc=1-3.

The cohesion less soils are undisturbed samples. In which these soils such as clean sand, with no cohesive properties. These soils are which do not have cohesion equal to zero. These soils derive the shear strength from the intergranular friction these are also called frictional soils. For example: Sands, Gravels.

The material is smaller than 4.75mm size is called fine aggregates. Natural sands are generally used as fine aggregates; sand may be obtained from pits, rivers, lakes or sea shores. When it’s obtained from pits it will be washed to free it from clay and silt. Sea shore sand may contain chlorides which may cause. Efflorescence, and may cause corrosion of reinforcement.

Hence it should be thoroughly washed before use. Similarly if river sand contains impurities such as mud etc. Angular graded sand produces good and strong concrete, because it has good interlocking property, while round graded particles of sand do not afford such interlocking. Fine aggregate (sand) may be measured by weight for accurate works, and by volume for ordinary works. However, when dry sand absorbs water from atmosphere, when water is mixed it artificially its volume increases due to moisture in sand are known as “bulking of sand”. When the water particles lubricate the sand particles, causing surface tension, and due to these particles are pulled a part. This increase in volume depends on the gradation of sand.

II. LITERATURE REVIEW

The study of literature shows that a considerable amount of work related to our project and guidelines methodologies, and the determination of deformation and strength characteristics of Cohesion less soil is done worldwide.

M.S. Mashiri, M.Vinod (2000) The Disposal of waste scrap tires are environmental dilemma. It can be improved by the characteristics of soil which is an essential material of construction. In these shear characteristics of the soil is an essential material of construction. It’s finding this project is study to analyse the effects of normal stress, and sand matrix unit weight and tire content. The sand and tire chips were mixed with different percentages are 0%, 25%, 50% of the total weight soil used. We are considering the three normal stresses were considered for all the experiments. The experiments were analyzed and discussed in the internal friction angle and effect of different parameters. The cohesion less soils are undisturbed samples. In which these soils such as clean sand, with no cohesive properties. The study of results showed that adding tire chips can improve the shear characteristics of soil.

G. Venkatappa Rao, R. k. Dutta, (2002) the waste tire can be shredded into chips and can easily be mixed with...
granular soils. In this project considering with the behaviour of the admixture; triaxial compression tests, compressibility were carried out by different percentages of tire chips is added. The results are demonstrated that sand-tire chip mixtures up to could be a potential material for highway construction and embankment construction up to around 10m height. The shear strength of waste tire chips and mixture was analyzed in this research to convenient for using as a light weight material. In this thesis work, engineering properties are measured from laboratory testing. The study consists of characterization of sand soils. By using waste tire as construction materials in civil engineering is growing interest. Whole scrap tires have been used as culverts, retaining walls, highway embankment, lightweight backfill and road bed support.

M.S. Mashiri, M. Vinod (2007) the reuse or recycling of waste tire in civil engineering projects has research attention in recent years. It will be considered an experimental investigation reports has suggest the waste tire chips in sand increases the shear strength and decreases the dilatancy of sand. In these models have been developed to the monotonic behaviour of sand tire chip mixtures. This project has been developed using the critical state framework, constant stress ratio and state parameters has shear loading during sand tire chip mixtures. It shows this model can effectively simulate the monotonic behaviour of the sand tire chip mixture.

T.M. Neaz Sheikh (2007) in this project the waste tire disposal has been it comes more environmental problems in many urban cities due to the huge increase in the number of vehicles. These research efforts have been devoted in recent years to explore the use of waste tire in civil engineering application, as reuse or recycling of waste tires is the preferred option it’s from a waste management perspective. In this project investigates shear strength and compressibility behavior of sand- tire crumb mixtures for their application in civil engineering projects. In other studies where tire chips and tire shreds used shear strength of the sand tire mixtures has been found to decrease with the increase in the amount of tire crumbs in the mixtures. It also observed that a larger proportion of plastic strain develops after the first cycle of unloading, and settlement with the application of the mixtures can be significantly reduced by preloading.

Vinod V and Singh bales war (2008) the waste tire material as fill material in geotechnical engineering applications will considerably reduce their potential impact on the environment. The experimental study was conducted to determine the optimum mix proportions of tire shreds when mixed with a sandy soil for embankment applications. From the direct shear test, sand tire shred mixes show an increase in shear strength up to 30% and then reduces. The shear strength parameters from the test result were used in the slope stability analysis of a proposed embankment constructed with the reinforced sand.

Sungminyaona, Monica prezzia, Nayyarsiddikib, Bumjoo Kim (2008) in such use of tire shreds in construction projects, such as highway embankments, is becoming an accepted way of recycling waste tires. However, in the last decade there was a decline in the use of pure tire shreds as fill material in embankment construction as they are susceptible to fire hazards due to the development of exothermic reactions. When compared with pure tire shreds, tire shred sand mixtures are less compressible and have higher shear strength. The literature contains limited information on the use of tire shred soil mixtures as a fill material. These paper discuss and evaluate the feasibility of using tire shred sand mixtures as a fill material in embankment construction. An embankment construction using 50/50 mixture, by volume of tire shreds and sand was instrument and monitored to: (a) to determine the total and differential settlements. (b) To evaluate the environmental impact of the embankment construction on the ground water quality due leaching of fill material; and (c) the temperature variation inside the embankment.

Karstentherrmann, Christian gau, Jaachim Tiedemann (2010) the shear strength of soils is essential for any kind of stability analysis. It’s important to determine reliable values. The purpose of triaxial test is most appropriate. And direct shear test are mostly performed to determine the shear strength of soils. Actually this project deals with the factors affecting the results of direct shear tests, the study of results showed that adding tire chips can improve the shear characteristics of soil. The waste tire is using in different percentages are adding direct shear tests. It’s has been carried out to quality and quantity the different factors of influence and their significance. The material being tested is a heterogeneous till. Because of its frequency occurrence and variability this sediment is of particular importance for constructional engineering in the vicinity of Berlin. All results of direct shear test were considered statistically. This extensive statistical assessment included the values of friction angle and cohesion. It’s derived from the mohr-coulomb regression line and the measured values of peak shear strength. The most important result the investigation has shown that it makes a remarkable difference whether the pair of variable friction angle and cohesion or peak shear strength is considered.

M. Neazsheikh, M.S. Mashiri, and J.S. Vinod (2012) The disposal and stockpiling of scrap tires is a significant environmental hazard and has attracted ample research attention to explore viable solutions to recycling and reuse of scrap tire. The recently proposed a novel seismic isolation method using sand tire chips mixtures for protecting building and infrastructure although the static properties of sand tire chip mixtures have been extensively studied, the investigation on the dynamic properties of the mixtures has been limited. The property of sand tire chip mixture is important to its application for seismic protection of infrastructure. This paper discuss present the dynamic properties of damping ratio and shear modulus of sand tire chip mixtures for medium to large range of shear strain levels 0.15% to 0.5%. The number of shear strain cycles and effective initial confining pressure have been investigated. This project will also be essential for the application of the sand tire chip mixtures in other civil engineering projects.

M. AmelSakhi, Mahmud Ghazavi (2013) the usefulness of optimizing the size of waste tire shears on shear strength parameters of sand reinforced with shredded waste tire. When the soil uniform and has been mixed with randomly distributed waste tire shreds with rectangular shape and compacted at two degrees of compaction. The waste tire shreds were prepared with a special cutter in there width.
Three tire shred contents of 15%, 30%, and 50% by volume soil and mixed with the sand to obtain a uniformly distributed mixtures. In order to compare the shear strength of different sand and the two compaction efforts in terms of sand matrix unit weight of 15.5 and 116.8 KN/m3 were considered. In which the results shows that the influencing parameters on shear strength characteristics of sand. We are find out the shred mixtures are normal stress and matrix unit weight, compaction efforts, shred content, shred width, aspect ratio of tire shreds and the variation of aspect ratios. The initial friction angle is up to 113.5% that is 67. The value of aspect ratio variation on decreases in friction angle of the mixture for all tests has been found to be about 25%. The average values for lower and higher compacted samples containing different width and aspect ratios 37.6 and 17.2% respectively. This project investigate that for a given width of tire rectangular shred, there is a certain length which gives the greatest initial friction angle for sand tire mixtures.

M. GhazaviA. Hemmati (2014) did the work on this paper describe the results of performing laboratory CBR tests on mixtures of sand tire chip reinforced with geo grid. For in this purpose, different contents of tire chips and sand were mixed and reinforced with geo grids in CBR tests. In which the grain size of tire chips varied between 2mm to 7mm. The waste tire chips content of 15, 25, 30 and 35% by volume of were takes and mixed with sand at a sand matrix unit weight 14 KN/m2. In which these mixture are reinforced with geo grids at different depths in the CBR apparatus and tests were performed. In some tests the surcharge was also applied. This results show that for a given content of waste tire chips mixed with sand and reinforced with geo grids, the CBR values becomes greater than unreinforced sand. In addition grater CBR values can be obtained by increasing tire chips contents to a specified amount. This CBR values can be enhanced by displaying geo grid location in the mould.

Linguini, jia He, Hanlong Liu, and Yanghen (2015) the waste tire materials are generated in large quantities, such as waste rubber, plastics, and dredged soils, can potentially be reused as fill materials in construction projects. It will bring both economic and environmental benefits. In this paper discus presents a review on different method of reusing scrap tires and waste soils in construction. Other than a new method is using their two wastes as a fill material is prepared and experimentally evaluated. In which the material is formed by mixing waste soils, scrap tire chips, Portland cement, and water together in varying proportions. The isotropic compression and triaxial consolidated undrained compression tests were carried out. The geotechnical engineering properties of the material with varying additions of different components are investigated. It’s found that adding more tire chips in the material leads to an evident to dry soil by weight does not change very much. The test results also depends up on the increasing the cement content is an effective way to reduce the compressibility and improve the undrained strength, indicating that the mechanical behaviour of the material can be well controlled by adjusting the cement addition. The strength of the material is suitable for wall back fill and embankment fills in part or transportation constructions.

III. MATERIALS AND METHODOLOGY

A. Materials
In the present study, the following materials are used

1) Cohesion Less Soils
   a) Well Graded Sand (SW)
   b) Poorly Graded Sand (SP)

2) Waste Tire Collected From The Auto Mechanic Shop
   a) Well Graded Sand (SW)
   b) Poorly Graded Sand (SP)

In this type of soil used in this investigation is of having cohesion less soils. The soil was brought from near to the kamalapurum. In the well graded sand is collected from kamalapurum. The soil was taken for the study of properties. Different Engineering properties are soil initially can be find by conducting corresponding the experiments according to IS code specification. In this type of well graded sand measures of gradation of sand with Cu greater than 4 - 6 are considered to be well graded sand.

2) Poorly Graded Sand (SP)
In this type of soil used in this investigation is of having cohesion less soils. The soil was brought from near to the kadapa. In the poorly graded sand is collected from kadapa. The soil was taken for the study of properties. Different Engineering properties are soil initially can be find by conducting corresponding the experiments according to IS code specification. In this type of poorly graded sand measures of gradation of sand with Cu less than 4 are considered to be poorly graded sand.

3) Waste Tire Rubber Chips
Waste Tyre Rubber chips passing through 4.75 mm sieve were used in this study, as an alternative reinforcement material as shown in the Fig.1.

B. Methodology
In this work, the five different percentages (10%, 20%, 30%, 40%, and 50%) of waste tire chips are using in direct shear test and plate load test (PLT). The dimension of the tire chips is rectangular shape in dimensions 5mm×5mm×2mm. It will be consider square footing 300mm×300mm.

C. Shear Strength
The shear strength of soil depends up on the effective stress, the strain conditions, the density of the particles, the rate of strain, and the direction of the strain. The shear strength of a soil is its maximum resistance to shear stresses just before the failure. These soils are seldom subjected to direct shear. In which the shear stresses develop when the soil is subjected to compression. The shear failure of a soil mass occurs when the

Fig. 1: Waste Tire Chips
shear stresses induced due to the applied compressive loads exceed the shear strength of the soil.

![Fig. 2: Direct Shear Apparatus](image)

**D. Direct Shear Test**

Direct shear test is used to measure the shear strength of a soil. Direct shear device also called the shear box apparatus essentially consist of a brass box, split horizontally at mid height of the soil specimen. The direct shear test is a laboratory or field test used by geotechnical engineering to measure the shear strength properties of soil or rock material or of discontinuities in soil or rock masses. This test is performed on three or four specimens from a relative sandy soil samples. This specimen is placed in a shear box which has two stacked rings to hold the samples; the contact between the two rings is at approximately the mid weight of the soil samples. The confining stress is applied vertically to the specimen, and the upper ring is pulled laterally until the sample fails, or through a specified strain. The direct shear test can be performed under several conditions. The sample is normally saturated before the test is run at the insitu moisture content. The rate of strain can be varied to create a test of drained an undrained conditions, are depending upon the strain is applied slowly enough for water in the sample to prevent pore water pressure build-up.

The direct shear test is quick and inexpensive. It will be used to determine the shear strength of both cohesive and cohesion less soils. The shear test is conducted under three different drainage conditions. The direct shear test is generally conducted on sandy soils as a consolidated drained test. This test is used to determine failure envelopes for soils. The device is not suitable for determination of stress-strain properties of soils.

![Fig. 3: Waste Tire Added in Direct Shear Test](image)

**E. Plate Load Test**

The plate load test is done when shallow foundations are to be used when the temporary work structure such as piling rings would be required on site. This test checks the bearing capacity of the soil near the surface of ground. It also checks the possible settlement under a certain load. In this standard applicable to this test are British standard (BS) 1377 part 9 and American society for testing and material (ASTM) 1194. Generally a square plate is used. Minimum thickness is 25mm and minimum size is 30x30cm, maximum size is 75x75cm plate is used. For clayey, silt and sandy soil, normally met with in the field 60cm×60cm plate is also used and for gravelly and dense sandy soils 30x30cm plate is used. The bearing capacity of the soil at site is based on shear and settlement.

**F. Bearing Capacity**

The Bearing Capacity of soils is most important of all the topics in soil engineering mechanics. When the soil stressed due to loading tend to deform. The resistance to deformation of the soil depends up on the factors like water content and angle of friction, bulk density and the manner in which load is applied on the soil. In which the maximum load per unit area which is the soil or rock can carry without yielding or displacement is known as bearing capacity of soil.

![Fig. 4: Plate Load Test](image)

**IV. RESULTS AND DISCUSSIONS**

The results of the poorly graded sand and well graded sand in using direct shear test and small scale plate load test. And it will be finding sand characteristics and the shear strength and bearing capacity of two soils is SP and SW.

<table>
<thead>
<tr>
<th>S No</th>
<th>Experiments</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Specific gravity of soil particles (IS-2720 part-3, section-1980)</td>
<td>2.61</td>
</tr>
<tr>
<td>2</td>
<td>Sieve analysis (IS:2720-Part-4-1985)</td>
<td>Cu=3.89m, Cc=0.921mm</td>
</tr>
<tr>
<td>3</td>
<td>Permeability IS: ( 2720-part-36-1987)mm/sec</td>
<td>0.0264</td>
</tr>
<tr>
<td>4</td>
<td>Density (IS: 2720-part-28-1974)Kg/cm³</td>
<td>1.542</td>
</tr>
<tr>
<td>5</td>
<td>Direct shear test (IS:2720-Part-13-1986)</td>
<td>Cohesion c = 0 kg/cm² Angle of internal friction = 29° 38°</td>
</tr>
</tbody>
</table>

Table 4.1: Lists of Experiments of Poorly Graded Sand
The specific gravity of poorly graded sand is 2.62. And grain size analysis is well graded sand, the well graded sand particle sizes over a wide range. The permeability test in well graded sand is pervious. And the shear strength of this soil is excellent.

\[ \text{Normal stress N/mm}^2 = \text{Shear stress N/mm}^2 \]

<table>
<thead>
<tr>
<th>S.No</th>
<th>Percentage of waste tire (%)</th>
<th>Cohesion Kg/cm²</th>
<th>Angle of friction in degrees</th>
<th>Shear strength of poorly graded sand N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.</td>
<td>0</td>
<td>0</td>
<td>29.38</td>
<td>0.225</td>
</tr>
<tr>
<td>02.</td>
<td>10</td>
<td>0</td>
<td>29.14</td>
<td>0.218</td>
</tr>
<tr>
<td>03.</td>
<td>20</td>
<td>0</td>
<td>32.21</td>
<td>0.285</td>
</tr>
<tr>
<td>04.</td>
<td>30</td>
<td>0</td>
<td>31.27</td>
<td>0.265</td>
</tr>
<tr>
<td>05.</td>
<td>40</td>
<td>0</td>
<td>30.22</td>
<td>0.241</td>
</tr>
<tr>
<td>06.</td>
<td>50</td>
<td>0</td>
<td>28.59</td>
<td>0.385</td>
</tr>
</tbody>
</table>

Table 4.3: Shear Strength of Poorly Graded Sand

\[ \text{Shear strength} = \text{Maximum shear force/Area} \]

\[ \Phi = \text{the angle of internal friction in degrees; } \sigma = \text{the shear strength in N/mm²} \]

Table 4.4: Normal stress and shear stress for well graded sand.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Percentage of waste tire (%)</th>
<th>Cohesion Kg/cm²</th>
<th>Angle of friction in degrees</th>
<th>Shear strength of poorly graded sand N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.</td>
<td>0</td>
<td>0</td>
<td>30.51</td>
<td>0.249</td>
</tr>
<tr>
<td>02.</td>
<td>10</td>
<td>0</td>
<td>32.46</td>
<td>0.298</td>
</tr>
<tr>
<td>03.</td>
<td>20</td>
<td>0</td>
<td>32.51</td>
<td>0.297</td>
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<tr>
<td>04.</td>
<td>30</td>
<td>0</td>
<td>33.6</td>
<td>0.307</td>
</tr>
<tr>
<td>05.</td>
<td>40</td>
<td>0</td>
<td>31.5</td>
<td>0.269</td>
</tr>
<tr>
<td>06.</td>
<td>50</td>
<td>0</td>
<td>30.52</td>
<td>0.252</td>
</tr>
</tbody>
</table>

Table 4.5: Shear Strength of Well Graded Sand

\[ \text{qu} = \text{the ultimate bearing capacity of square footing} \]

\[ \Phi = 1.2 \cdot c' \cdot r + \gamma \cdot Df \cdot Nq + 0.47 \cdot B \cdot Nq \]

\[ c' = \text{the cohesion of poorly graded sand is zero} \]

\[ Nc, Nq, Ny \text{ are Terzaghi's bearing capacity factors} \]

<table>
<thead>
<tr>
<th>S.No</th>
<th>Percentage of waste tire (%)</th>
<th>Angle of internal friction in degrees</th>
<th>Nc</th>
<th>Nq</th>
<th>Ny</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.</td>
<td>0</td>
<td>30.51</td>
<td>17.48</td>
<td>15.24</td>
<td></td>
</tr>
<tr>
<td>02.</td>
<td>10</td>
<td>32.51</td>
<td>19.98</td>
<td>16.18</td>
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</tr>
<tr>
<td>03.</td>
<td>20</td>
<td>34.24</td>
<td>22.46</td>
<td>19.13</td>
<td></td>
</tr>
<tr>
<td>04.</td>
<td>30</td>
<td>37.16</td>
<td>25.28</td>
<td>22.65</td>
<td></td>
</tr>
<tr>
<td>05.</td>
<td>40</td>
<td>40.41</td>
<td>28.52</td>
<td>26.87</td>
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</tr>
<tr>
<td>06.</td>
<td>50</td>
<td>44.04</td>
<td>31.25</td>
<td>28.52</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.7: Percentage of Waste Tire and Angle of Internal Friction

\[ \text{B is the width of the square footing in mm.} \]

\[ \text{DF is the depth of the square footing in mm} \]

For analysis purpose standard direct shear device was used. And the sample were sand tire chips and the mixtures of then with 0%, 10%, 20%, 30%, 40% and 50% tire chips of the total weight. The study has demonstrated the benefits of reusing chips of tire for use as a lightweight material.

V. CONCLUSIONS

The study has demonstrated the benefits of reusing chips of waste tire to cohesion less soil. In this results basic the shear strength and bearing capacity of tire chips and sand mixtures was analysed in this research to find out whether it is convenient for using as a lightweight material.

1) For analysis purpose standard direct shear device was used. And the sample were sand tire chips and the mixtures of then with 0%, 10%, 20%, 30%, 40% and 50% tire chips of the total weight.

2) The poorly graded sand It findings indicate that adding 0% to 20% tire chips to sand increases the internal friction angle and shear strength. It was found that shear resistance of mixture greater than the sand alone and. In this case an increase in tire chips up to 20% increases the internal friction angle from 29.14° to 32.21°. The observation adding more tire chips decreases the angle gradually.

3) The well graded sand It findings indicate that adding 0% to 30% tire chips to sand increases the internal friction angle and shear strength. It was found that shear...
resistance of mixture greater than the sand alone and. In this case an increase in tire chips up to 30% increases the internal friction angle from 32.46º to 33.6º. The observation adding more tire chips decreases the angle gradually.

4) A useful tire improvement in the strength behaviour and increases in tire chips up to 20% to 30% increases the internal friction angle in sandy soils.

5) It is concluded that adding tire chips does not influence the strength of sand greatly but it has optimization role in it. Furthermore by adding tire chips, the weight of the mixture decreases which this fact also leads to decreases in the lateral earth pressure.

6) The bearing capacity of plate load test is a field test which is commonly adopted to determine the bearing capacity and settlement of soil under a given condition of loading. In this test a square plate of standard dimensions is placed at foundation level and load is applied in increments.

7) The sample were poorly graded sand, well graded sand, tire chips and mixture of them with 0%, 10%,20%,30%,40% and 50% tire chips of the total weight.

8) The plate load test also show an increase in bearing capacity of both SP and SW soils by adding of tire chips (up to 50%). Addition of 40% tire chips increased the bearing capacity of plate in SP soil by 1.8 times and SW soil by 2times. As such tire chip content of 30 to 40% is found to have brought significant increase in shear strength and bearing capacity of both SP and SW soils.

9) The poorly graded sand it findings that adding 0% to 20% tire chips to sand increases the bearing capacity is up to 150.776KN/m² to 223.827KN/m². The observation adding more tire chips decreases the angle gradually.

10) The well graded sand it findings that adding 0% to 40% tire chips to sand increases the bearing capacity is up to 171.63KN/m² to 256.53KN/m². The observation adding more tire chips decreases the angle gradually.

11) Then settlement of the plate corresponding to each load increment is recorded for calculating bearing capacity of soil. The plate load test is done when foundations are to be used or when temporary work structure would be used at a site.

REFERENCES