SHORT TERM STRENGTH ENHANCEMENT OF SOFT SOIL THROUGH STABILIZATION WITH TANNED WASTE ASH

A

PROJECT REPORT

Submitted in partial fulfillment of the requirements for the award of the Degree

of

BACHELOR OF TECHNOLOGY

IN

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Under the supervision

Of

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ABSTRACT

Soft soil stabilization is a crucial aspect of civil engineering, especially in regions prone to soil liquefaction and poor load-bearing capacities. This literature review explores the efficacy of utilizing tanned waste ash as a short-term solution for enhancing the strength of soft soil. Tanned waste ash, a byproduct of leather industry processes, has shown potential in soil stabilization due to its high silica content and pozzolanic properties. the most popular method of soil shear testing because it is one of the fastest and least expensive methods of measuring shear strength. It is used primarily for saturated, cohesive soils recovered from thin-walled sampling tubes. The test is not applicable to cohesion less or coarse-grained soils.

STUDENT'S DECLARATION

We, the undersigned, hereby certify that the project report titled **"SHORT TREM STRENGTH ENHANCEMENT OF SOFT SOIL THROUGH STABILISEDWITH TANNED WASTE ASH"** Submitted in partial fulfillment of the requirements for the Bachelor of Technology degree in Civil Engineering at the **Jaypee University of Information Technology, Waknaghat** is a genuine and original piece of work that we completed under the supervision of Dr. Niraj singh parihar This project report has not previously been submitted for consideration for any other degree or credential.

I declare that the contents of this project report are entirely our own and that we have taken every precaution to ensure that the information presented is correct and complete. We appreciate our supervisors' and other contributors' help and guidance in completing this project successfully.

In conclusion, I attest to this project report's authenticity, originality, and integrity, and I are confident that it meets the highest academic standards.

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CERTIFICATE

This is to certify that the project report titled **"SHORT TREM STRENGTH ENHANCEMENT OF SOFT SOIL THROUGH STABILISEDWITH TANNED WASTE ASH "** submitted to the Department of Civil Engineering, **Jaypee University of Information Technology, Waknaghat**, in partial fulfillment of the requirements for the degree of Bachelor of Technology in Civil Engineering, is an authentic record of work conducted by Apoorav Bedi [191622] between August 2022 and May 2023, under the supervision of Dr. Niraj singh parihar (Assistant Professor, Grade-II), Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat.

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1.1 General

Stabilizing soft soil with tanned waste ash can be an effective method for short-term strength enhancement. Tanned waste ash, being a byproduct of the tanning industry, contains various compounds that can react with soil components to improve its mechanical properties. Here's a brief overview of how this process works:

1. Chemical Reaction : Tanned waste ash typically contains calcium compounds, such as calcium oxide (CaO) and calcium hydroxide ($Ca(OH)_2$). When mixed with soft soil, these compounds undergo chemical reactions with the soil particles, forming stable compounds like calcium silicates and calcium aluminates. This process can lead to soil stabilization and increased strength.
2. Increased Soil Density : The addition of tanned waste ash to soft soil can also lead to increased soil density. The fine particles in the ash fill in the voids between soil particles, effectively compacting the soil and reducing its compressibility.
3. Water Absorption : Tanned waste ash has the ability to absorb excess water from the soil, reducing its moisture content. This helps in improving the soil's shear strength and stability.
4. Alkalinity : The alkaline nature of tanned waste ash can also contribute to soil stabilization by reducing soil acidity and promoting the formation of stable soil-aggregate structures.
5. Cost-Effectiveness : Utilizing tanned waste ash as a soil stabilizer can be cost-effective, as it repurposes a waste product that would otherwise require disposal.

1.2 Significance

Stabilizing soft soil with tanned waste ash can offer several significant advantages for short-term strength enhancement:

1. Immediate Improvementn : Tanned waste ash can quickly enhance the strength of soft soil upon application. This rapid improvement is particularly beneficial in situations where immediate stabilization is required to support construction activities or prevent soil erosion.
2. Cost-Effectiveness : Tanned waste ash is often available at low or no cost, as it is a by-product of the tanning industry. Using this waste material for soil stabilization can be a cost-effective solution compared to traditional soil improvement methods that involve purchasing expensive additives or materials.
3. Environmental Sustainability : By utilizing tanned waste ash, you're repurposing a byproduct that would otherwise require disposal, reducing the environmental impact associated with waste management. This aligns with sustainable practices and promotes environmental stewardship.
4. Versatility : Tanned waste ash can be used in various soil types and conditions, making it a versatile option for soil stabilization projects. Whether dealing with clayey soils, sandy soils, or other types of soft soil, tanned waste ash can be adapted to suit different situations.
5. Reduced Construction Time : Since tanned waste ash provides immediate strength enhancement to soft soil, it can help reduce construction time by allowing work to proceed without delays caused by soil instability issues. This can lead to cost savings and improved project timelines.

CHAPTER 2
LITERATURE REVIEW

Investigation was conducted on the probability of utilizing a blend of RHA (rice husk ash) and fly ash as a swell reduction layer between the sub-grade and foundation footing. When the fly ash content was incremented from 0 to 25%, it was observed that UCS (unconfined compressive strength) exhibited a notable escalation, with failures in strain and stress rising by 50% and 106% respectively. Furthermore, with an increase in rice husk ash content from 0 to 12%, there was a significant enhancement in UCS by 97% and CBR (California Bearing Ratio) by 47%. Consequently, for the purpose of reinforcing, a composition of 25% fly ash and 12% RHA was deemed optimal. In the process of forming a swell reduction layer, a fly ash content of 15% was chosen based on its satisfactory performance in laboratory tests. Ayyappan et al. (2010) explored the use of polypropylene fibers of varying lengths (6mm, 12mm, and 24mm) for soil reinforcement. Soil-fly ash mix samples were prepared with fiber additions ranging from 0 to 1.5% by weight. The optimal percentage of reinforcement for all soil-fly ash mix samples was determined to be 1% by weight. Notably, the maximum improvement was observed with 12mm fiber length for reinforcing the soil-fly ash mix. It was observed that the CBR value increased consistently across all mixes when employing 12mm fibers at 1% by dry weight, indicating superior performance of the reinforced soil-fly ash mix.. The preliminary investigations of the soil showed that it belong to A-7-5 class in the soil classification system of AASHTO. Atterberg's limits, free swell, free swell index, free swell ratio, compaction and subgrade strength tests were used to assess characteristics of stabilized soil. The soil was stabilized with bagasse ash in proportion of 5%, 10%, 15%, 20%, 25% and 30% by dry weight of the soil. Bagasse ash reduced plasticity index, swelling and MDD with an increase in OMC and CBR with all higher bagasse ash contents. It was found out that bagasse ash stabilized soil do not meet the minimum requirement of ERA (Ethiopian Roads Authority) pavement manual specification so that it could be used as a sub-grade material for pavement construction. Additional study is also incorporated as a supplementary work to investigate the effect of applying 3% lime as an activator in combination with 15% bagasse on the geotechnical properties of the soil for uncured and cured soil samples. The results indicated that lime in combination with bagasse ash is suitable for improving the plasticity index, swelling and CBR. The CBR value increased by curing showed that the mix had ability for time-dependent increase in strength that would decrease the amount of stabilizer required for the construction of roads on the soft soil. It showed that lime in combination with bagasse ash can be effectively used to improve expansive soils with low soaked CBR value and high plasticity. Kharade et al. (2014) [6] studied bagasse ash with partial replacement in black cotton soil in various proportions like 3%, 6%, 9%, 12%. They establish that optimum proportion of bagasse ash was 6%. The results at this proportion were like MDD increased by 5.8%, CBR increased by 41.52% and UCS increased by 43.58% which showed that, by adding bagasse ash CBR and compressive strength increased about 40%, whereas density showed considerable change only. Das and Roy(2015)[7] performed laboratory tests such as Atterberg's limit, compaction, specific gravity, grain size distribution, tri-axial compression on expansive soil using bagasse ash in proportions of 3%, 6%, 9%, 12%, 15% and 18%. Incorporating bagasse ash into the virgin soil demonstrated improvements in shear strength properties during tri-axial compression tests. Moreover, it was noted that the liquid limit decreased as the quantity of bagasse ash increased, proving to be both effective and cost-efficient. With an increase in bagasse ash content, there was an initial 9% rise in the liquid limit, followed by a subsequent decrease. Additionally, as the content of bagasse ash increased from 3% to 18%, there was a consistent improvement in the ϕ and c values, indicating enhanced shear strength with the further addition of bagasse ash.Butt et al. (2015) conducted research on high-compressibility clayey soil, utilizing human hair fibers (HHF) as a stabilizing agent in varying proportions of 0.5%, 1%, 1.5%, 2%, and 2.5% by weight to analyze their impact on clay performance. HHF, being non-biodegradable waste, contribute to environmental and health concerns. However, they are abundantly available at a low cost, making them viable for reinforcing not only to uplift underprivileged areas sustainably but also to mitigate disposal issues. Through tri-axial and CBR tests on different soil samples, the randomly distributed HHF exhibited various engineering advantages when compared with the virgin soil. Notably, at a fiber length of 25mm, superior strength characteristics, high toughness, and cost-effectiveness were observed.

As the quantity of human hair fibers increased, there was a slight initial reduction in dry density followed by a plateau. Additionally, due to moisture absorption from the hair fibers, the optimum moisture content (OMC) experienced a slight increase. The study concluded that a 2% fiber addition significantly enhanced the un-drained shear strength and CBR of expansive soil. Expansive soils can be found in many parts of the world, and their expansive nature can lead to significant problems for construction and infrastructure development. To address these issues, various methods of soil stabilization have been developed, including the use of industrial waste materials. Industrial waste materials have been shown to be effective in stabilizing expansive soils, as they can improve the soil's strength and reduce its susceptibility to swelling and shrinkage.Several studies have been conducted on the use of industrial waste materials for soil stabilization. One such study examined the use of waste foundry sand, fly ash, and lime as a stabilizer for expansive soils. The study found that the addition of these materials improved the soil's compressive strength and reduced its swell potential.Another study focused on the use of fly ash as a stabilizing agent for expansive soils. The study found that the addition of fly ash improved the soil's unconfined compressive strength and reduced its swell potential. Additionally, the study found that the use of fly ash reduced the soil's permeability, which can help to prevent water infiltration and reduce the potential for soil erosion.A study on the use of rice husk ash as a stabilizing agent for expansive soils found that the addition of this material improved the soil's strength and reduced its swell potential. The study also found that the use of rice husk ash reduced the soil's plasticity, which can help to prevent cracking and improve its overall stability.Other industrial waste materials that have been investigated for use in soil stabilization include blast furnace slag, cement kiln dust, and quarry dust. Studies have shown that these materials can also be effective in improving the strength and stability of expansive soils. Overall, the literature indicates that the use of industrial waste materials for soil stabilization can be an effective and sustainable approach to addressing the problems associated with expansive soils. However, further research is needed to determine the optimal amounts and methods of application for these materials in different soil types and environments.Durability assessment is a crucial aspect of evaluating the long-term performance and effectiveness of soil stabilization techniques using industrial waste. Various durability tests have been developed to evaluate the effectiveness of stabilised soils, including those for expansive soils stabilised with industrial waste

One such test is the repeated wetting and drying test, which involves exposing the stabilised soil samples to cycles of wetting and drying to simulate long-term weathering and moisture effects. Another test is the freeze-thaw test, which exposes the soil to cycles of freezing and thawing to evaluate its resistance to frost and freeze-thaw cycles. In addition to laboratory testing, field tests can also be used to assess the durability of stabilized expansive soil. These tests involve monitoring the performance of the stabilized soil over an extended period of time under actual weather and traffic conditions. Overall, durability assessment is a critical step in evaluating the long-term performance of expansive soil stabilised with industrial waste. By conducting these tests, engineers can determine the suitability and effectiveness of the stabilization technique and make informed decisions about its use in various applications.

2.1 EXPEANSIVE SOIL USING INDISTRIAL WASTE:

Expansive soil stabilization is an important process used to enhance the strength and durability of soils that are prone to swelling and shrinking due to changes in moisture content. One of the most effective and cost-efficient methods of stabilizing expansive soil is through the use of industrial waste materials.

Figure: 2.1 Soil Waste

There are different methods of using industrial waste for soil stabilization, and each method has its unique advantages and limitations. The most commonly used methods include mechanical stabilization, chemical stabilization, and thermal stabilization. Mechanical stabilization is a method that involves adding industrial waste materials to the soil through mechanical means. This method is suitable for coarse-grained soils such as sand and gravel. The waste materials are mixed with the soil using different techniques such as mixing, grinding, and pulverizing. This method helps to improve the soil's mechanical properties such as shear strength, compressibility, and bearing capacity. Chemical stabilization is another method used to treat expansive soil with industrial waste materials. This method involves the use of chemical agents to enhance the soil's strength and stability. Industrial waste materials such as fly ash, cement kiln dust, and lime are often used as chemical agents. The chemical agents are mixed with the soil in specific proportions to achieve the desired results. Chemical stabilization helps to reduce the soil's susceptibility to moisture-induced volume changes and improve its durability. Thermal stabilization is a method that involves using high temperatures to modify the soil's properties. Industrial waste materials such as blast furnace slag and coal fly ash can be used for thermal stabilization. The waste materials are mixed with the soil and then subjected to high temperatures in a process known as thermal treatment. The high temperatures help to modify the soil's properties and enhance its strength and durability.

This method of expansive soil stabilization using industrial waste materials is a cost-effective and sustainable way of improving soil strength and durability. The selection of the most appropriate method of soil stabilization depends on factors such as soil type, environmental conditions, and the availability of industrial waste materials.

There are several methods of expansive soil stabilization using industrial waste. These methods involve the use of various industrial waste materials, depending on the availability of waste materials and the specific soil stabilization needs. Some of the commonly used methods include:

1. Chemical stabilization: This method involves the use of chemical agents such as lime, cement, and fly ash to stabilize the expansive soil. Lime and cement react with the soil to form calcium silicates and calcium aluminates hydrates, respectively, which help to stabilize the soil. Fly ash is a byproduct of

2. Mechanical stabilization: This method involves the use of mechanical devices such as geotextiles, georgics, and soil nailing to stabilize the expansive soil. Geotextiles are permeable fabrics that are placed between the soil layers to improve the soil's strength and stability. Georgics are polymeric materials that are used to reinforce the soil, while soil nailing involves the insertion of steel bars into the soil to improve its stability.

3. Biological stabilization: This method involves the use of plant roots to stabilize the soil. Plant roots penetrate the soil and help to hold it in place, reducing the risk of soil erosion and landslides. This method is particularly useful in areas where the use of chemicals or mechanical devices is not feasible.

4. Thermal stabilization: This method involves the use of heat to stabilize the soil. Heat can be applied to the soil through steam injection or heating with electrical resistive elements. This method helps to dry out the soil and reduce its swelling potential.

5. Electro kinetic stabilization: This method involves the application of an electric field to the soil, which helps to modify its properties and reduce its swelling potential. This method is particularly useful in areas with high soil moisture content.Expansive soil stabilization using industrial waste is a complex process that requires careful selection of the appropriate method. Chemical stabilization is the most commonly used method and involves the use of chemical agents such as lime, cement, and fly ash. Lime and cement react with the soil to form calcium silicates and calcium aluminates hydrates, which help to stabilize the soil. Fly ash is a byproduct of coal-fired power plants and contains silica, alumina, and lime, which can also help to stabilize the soil. Mechanical stabilization is another method of soil stabilization that involves the use of mechanical devices such as geotextiles, georgics, and soil nailing. Geotextiles are permeable fabrics that are placed between the soil layers to improve the soil's strength and stability. Geogrids are polymeric materials that are used to reinforce the soil, while soil nailing involves the insertion of steel bars into the soil to improve its stability. Biological stabilization involves the use of plant roots to stabilize the soil. Plant roots penetrate the soil and help to hold it in place, reducing the risk of soil erosion and landslides. This method is particularly useful in areas where the use of chemicals or mechanical devices is not feasible.Thermal stabilization involves the use of heat to stabilize the soil. Heat can be applied to the soil through steam injection or heating with electrical resistive elements. This method helps to dry out the soil and reduce its swelling potential. Electro kinetic stabilization is a relatively new method of soil stabilization that involves the application of an electric field to the soil. This field helps to modify the properties of the soil and reduce its swelling potential. This method is particularly useful in areas with high soil moisture content.

This method of expansive soil stabilization using industrial waste depends on various factors such as the type of soil, availability of waste materials, and specific soil stabilization needs. A thorough evaluation of the soil and the available waste materials is essential to determine the appropriate method to use for soil stabilization. The method selected should provide long-lasting and effective soil stabilization while being environmentally friendly and economically feasible.

There are several methods of stabilizing expansive soil using industrial waste, each with its own advantages and limitations.

Chemical stabilization is the most commonly used method, involving the use of chemicals such as lime, cement, and fly ash to react with the soil and create stable compounds. This method is effective and widely available, but the chemicals can be costly and potentially harmful to the environment.

Mechanical stabilization involves using devices such as geotextiles, geogrids, and soil nailing to reinforce the soil and improve its stability. This method is less harmful to the environment and can be cost-effective, but it may not be suitable for all soil types.

Biological stabilization involves using plant roots to stabilize the soil. This method is environmentally friendly and cost-effective, but it may take longer to achieve effective stabilization and may not be suitable for all soil types.

2.1.1 PROPERTIES AND CHARACTRCTICS OF INDUSTRIAL WASTE SOIL STABILIZATION

Industrial waste can be a useful material for soil stabilization, but its effectiveness depends on its properties and characteristics. Some key properties and characteristics to consider when selecting industrial waste for soil stabilization include:

1. Chemical composition: The chemical composition of the waste material can affect its ability to react with the soil and create stable compounds. Materials with high levels of calcium, such as lime and fly ash, are commonly used for soil stabilization.

2. Particle size distribution: The size of the waste particles can affect their ability to mix with the soil and create a stable mixture. A range of particle sizes is often preferred to ensure adequate mixing and stabilization.

3. Specific gravity: The specific gravity of the waste material can affect its ability to penetrate and stabilize the soil. Materials with a higher specific gravity can often penetrate deeper into the soil and create a stronger bond.

4. Moisture content: The moisture content of the waste material can affect its handling and mixing characteristics. Materials with high moisture content can be difficult to handle and may require additional drying or processing.

5. pH: The pH of the waste material can affect its ability to react with the soil and create stable compounds. Materials with a pH range between 8 and 12 are often preferred for soil stabilization.

6. Compressive strength: The compressive strength of the waste material can affect its ability to provide structural stability to the soil. Materials with high compressive strength can often provide more effective stabilization.

7. Environmental impact: The environmental impact of the waste material should be considered, including potential leaching of harmful chemicals and greenhouse gas emissions during production and transportation.

Overall, the properties and characteristics of industrial waste should be carefully evaluated to determine their suitability for soil stabilization. Materials with a high potential for effectiveness and a low environmental impact are often preferred.

The properties and characteristics of industrial waste play a crucial role in determining its effectiveness for soil stabilization. The chemical composition is one of the most critical factors, as it determines the ability of the material to react with the soil and create stable compounds. Materials with high levels of calcium, such as lime and fly ash, are commonly used for soil stabilization due to their ability to react with clay minerals in the soil.

Another important property is particle size distribution. The size of the waste particles can affect their ability to mix with the soil and create a stable mixture. A range of particle sizes is often preferred to ensure adequate mixing and stabilization. The specific gravity of the waste material is also important, as it affects its ability to penetrate and stabilize the soil. Materials with a higher specific gravity can often penetrate deeper into the soil and create a stronger bond.

The moisture content of the waste material is another crucial factor. Materials with high moisture content can be difficult to handle and may require additional drying or processing before use. The pH of the waste material is also important, as it affects its ability to react with the soil and create stable compounds. Materials with a pH range between 8 and 12 are often preferred for soil stabilization.

The compressive strength of the waste material is another important consideration. Materials with high compressive strength can often provide more effective stabilization and structural support to the soil. Finally, the environmental impact of the waste material should be carefully evaluated, including potential leaching of harmful chemicals and greenhouse gas emissions during production and transportation. Overall, a thorough evaluation of the properties and characteristics of industrial waste is necessary to determine its suitability for soil stabilization. Materials with a high potential for effectiveness and a low environmental impact are often preferred, but the specific needs and characteristics of the soil should also be carefully considered.

The properties and characteristics of industrial waste are important factors in determining their effectiveness for soil stabilization. Some of the key properties include chemical composition, particle size distribution, specific gravity, moisture content, pH, and compressive strength. Materials with high levels of calcium, such as lime and fly ash, are commonly used due to their ability to react with clay minerals in the soil. A range of particle sizes is often preferred to ensure

adequate mixing and stabilization, and materials with a higher specific gravity can penetrate deeper and create a stronger bond.

The moisture content and pH of the waste material are also important factors, as they can affect the material's ability to react with the soil and create stable compounds. Materials with a pH range of 8 to 12 are often preferred for soil stabilization. The compressive strength of the waste material is another consideration, as materials with high compressive strength can provide more effective stabilization and structural support to the soil.

In addition to the properties and characteristics of the waste material, it is important to evaluate the potential environmental impact of its use. This includes considering potential leaching of harmful chemicals and greenhouse gas emissions during production and transportation. Overall, a careful evaluation of the properties and characteristics of industrial waste is necessary to determine its suitability for soil stabilization, taking into account both effectiveness and environmental impact.

2.2 ADVANTAGES AND LIMITATIONS OF USING WASTE FOR SOIL STABILIZATION

Using industrial waste for soil stabilization has several advantages, but also some limitations.

Advantages:

Cost-effective: Industrial waste is often available at low or no cost, making it an economical option for soil stabilization.

Sustainable: Reusing industrial waste for soil stabilization can divert it from landfills and reduce the environmental impact of disposal.

Enhances soil properties: Industrial waste can improve the engineering properties of soil, including strength, stability, and durability.

Versatile: Industrial waste can be used in a range of soil types, making it a versatile option for soil stabilization.

Limitations:

Quality control: Industrial waste may vary in quality and composition, which can affect its effectiveness for soil stabilization. Therefore, careful testing and quality control measures are necessary to ensure the desired outcomes.

Environmental impact: The environmental impact of using industrial waste for soil stabilization should be carefully evaluated, including potential leaching of harmful chemicals and greenhouse gas emissions during production and transportation.- Regulatory restrictions: Some types of industrial waste may be subject to regulatory restrictions, which can limit their availability and use for soil stabilization.

Limited effectiveness: The effectiveness of industrial waste for soil stabilization can vary depending on the specific soil type and properties, and may not always provide the desired outcomes.

Using industrial waste for soil stabilization has some disadvantages and limitations, which include:

1. Quality control: The quality and composition of industrial waste can vary, which can impact the effectiveness of the soil stabilization. Therefore, it is essential to perform quality control testing to ensure that the waste material meets the desired standards.

2. Environmental impact: The use of industrial waste for soil stabilization may have an adverse impact on the environment, including potential leaching of hazardous chemicals, greenhouse gas emissions during transportation, and other environmental concerns. Therefore, it is essential to evaluate the potential environmental impact before using industrial waste for soil stabilization.

3. Regulatory restrictions: Certain types of industrial waste may be subject to regulatory restrictions, which can limit their availability and use for soil stabilization. Therefore, it is important to check local regulations before using industrial waste for soil stabilization.

4. Limited effectiveness: The effectiveness of industrial waste for soil stabilization may be limited depending on the specific soil properties and conditions. Therefore, it is essential to evaluate the soil and site conditions before using industrial waste for soil stabilization.

5. Compatibility with other materials: Industrial waste may not be compatible with other materials used for soil stabilization, such as cement or other additives. Therefore, it is essential to evaluate the compatibility of the waste material with other materials before use.

6. Maintenance: Industrial waste may require more frequent maintenance than other soil stabilization methods, as it may break down over time and require additional applications.

Overall, the use of industrial waste for soil stabilization can be an effective and sustainable option when done with proper evaluation, quality control, and environmental impact assessment.

CHAPTER 3

OBJECTIVES

- TO determine to effect on strength of expansive soil upon addition of tanned waste
- TO seek improment in a soil strength with respect to short term curring effect on tanned waste stabilization soil

CHAPTER 4

METHODOLOGY

4.1 General

Soil stabilization with tanned waste ash involves treating soil with ash derived from tannery waste to improve its engineering properties, such as strength, durability, and compressibility. Here's a general methodology for soil stabilization using tanned waste ash:

1. Collection and Characterization of Tanned Waste Ash : Collect tanned waste ash from tanneries. Characterize the ash to determine its chemical composition, particle size distribution, and other relevant properties. This step helps in understanding the potential benefits and challenges associated with using the ash for soil stabilization.

Fig4.1. 2 Blue leather waster

2. Soil Sampling and Testing : Collect soil samples from the site where stabilization is required. Conduct laboratory tests on the soil samples to determine their properties such as compaction characteristics, and strength

Fig 4.1.1 Dry soil

3. Mix Design : Based on the desired engineering properties and the characteristics of both the soil and tanned waste ash, establish a mix design. This involves determining the optimal proportions of soil and ash to achieve the desired soil stabilization objectives.

Fig 4.1.3 mixing with tanned waste

4. Preparation of Ash-Spreading : Soil stabilization using burned blue leather waste involves incorporating charred or ashed remnants of blue leather waste into soil to enhance its engineering

properties. The process begins with burning the waste to produce ash or char, which is then mixed with soil to improve its strength, reduce compressibility, and enhance durability. Laboratory tests ensure optimal mix proportions, and the stabilized soil can be used in various construction projects. This method offers a sustainable approach to managing leather waste while enhancing soil performance for construction applications. However, environmental considerations and regulatory compliance are essential in its implementation.

Fig4.1. 5 Blue leather waste burned in safe enviroment

6. Compaction :. Compacting tanned waste involves compressing or consolidating waste materials generated from the tanning process. Tanned waste typically consists of leftover leather scraps, trimmings, and other byproducts produced during leather manufacturing. Compaction processes aim to reduce the volume of tanned waste, making it easier to handle, transport, and manage. This can involve various methods such as mechanical pressing, baling, or shredding the waste materials to create denser and more manageable forms. Compaction of tanned waste is often a crucial step in waste management practices within the leather industry, helping to minimize storage space requirements, streamline disposal processes, and potentially facilitate recycling or repurposing initiatives for sustainable waste management.

Fig 4.1.4 passed through 600 mu sieve TW

7. Curing : Allow the stabilized soil to cure for a specified period under controlled conditions. This allows for hydration and chemical reactions to occur between the soil particles and the tanned waste ash, enhancing soil stabilization. Curing tanned waste involves treating the waste materials generated from the tanning process to stabilize them and prevent decomposition or putrefaction. This process typically involves the application of chemical treatments or heat to the tanned waste, effectively preserving it for further handling or disposal. Curing helps to minimize the risk of environmental pollution and unpleasant odors associated with decomposing organic matter. Additionally, curing may also serve to enhance the physical properties of the tanned waste, making it more suitable for certain recycling or repurposing applications. Overall, curing tanned waste is an essential step in sustainable waste management practices within the leather industry, ensuring the responsible handling and disposal of byproducts generated during the tanning process.

Fig 4.1.6 Curring

8. Testing : Conduct laboratory tests and field tests to evaluate the effectiveness of soil stabilization. These tests may include compressive strength tests, and others as per project requirements.

Fig 4.1.8 Sample out

4.1.2 UNCONFINED COMPRESSIVE STRENGTH TEST

The unconfined compression test is the most popular method of soil shear testing because it is one of the fastest and least expensive methods of measuring shear strength. It is used primarily for saturated, cohesive soils recovered from thin-walled sampling tubes. The test is not applicable to cohesion less or coarse-grained soils.The unconfined compression test is strain-controlled, and when the soil sample is loaded rapidly, the pore pressures (water within the soil) undergo changes that do not have enough time to dissipate. Hence it is representative of soils in construction sites where the rate of construction is very fast and the pore waters do not have time The Unconfined Compressive Strength (UCS) test is a crucial assessment in geotechnical engineering used to determine the strength of cohesive soils or cohesive-frictional soils under unconfined conditions. Unlike other compression tests, the UCS test applies axial loading without lateral restraint, allowing for deformation to occur freely. This test is particularly relevant for soils where lateral confinement may significantly alter their behavior.During the UCS test, a cylindrical specimen of the soil is prepared, typically with a standardized diameter-to-height ratio.

Figure 4.2 : UCS testing of soil sample

The specimen is then placed in a testing apparatus where axial load is gradually applied until failure occurs. Failure is defined as the point at which the soil specimen can no longer withstand additional load without significant deformation. "Blue leather waste" refers to discarded leather material that has a blue hue. This waste often arises from the production process of blue-colored leather goods or from the disposal of used blue leather items.

Fig 4.1.2 UCS testing of soil sample 2%,6%,10%

Proper management of blue leather waste is crucial to minimize environmental impact and promote sustainability within the leather industry. Recycling or repurposing blue leather waste can help reduce landfill waste and conserve resources. Additionally, innovative techniques such as upcycling blue leather waste into new products or incorporating it into composite materials can create opportunities for waste reduction and value creation in various industries. Efficient handling and utilization of blue leather waste contribute to a more environmentally friendly and economically viable leather production proces

4.1.3 CLASSIFICATIONS OF EXPANSIVE SOIL STABILISED WITH INDUSTRIAL WASTE

There are several classifications of expansive soil stabilised with industrial waste based on different parameters. One classification is based on the type of industrial waste used for soil stabilization. For example, fly ash, blast furnace slag, cement kiln dust, and lime are some common industrial wastes used for soil stabilization. Another classification is based on the percentage of industrial waste used for soil stabilization. Depending on the percentage of industrial waste, soil can be classified as treated soil or stabilised soil. Treated soil refers to soil where the percentage of industrial waste is less than 10%, while stabilised soil refers to soil where the percentage of industrial waste is between 10% and 30%.

There is also a classification based on the type of expansive soil. For example, some studies have classified expansive soil based on its mineralogical composition, while others have classified it based on its swelling potential. Depending on the classification, different types of industrial waste can be used for soil stabilization.

Finally, there is a classification based on the performance of the stabilised soil. Depending on the performance, soil can be classified as a temporary stabilised soil or a permanent stabilised soil. A temporary stabilised soil means that the soil will retain its strength for a short period, while a permanent stabilised soil means that the soil will retain its strength for a longer period.

- Classification based on type of industrial waste used:
  - Fly ash
  - Cement kiln dust
  - Lime
- Other industrial wastes such as red mud, sludge, and bottom ash can also be used for soil stabilisation.
- Classification based on percentage of industrial waste used:

- Treated soil: < 10% industrial waste

- Stabilised soil: 10-30% industrial waste

- Classification based on type of expansive soil:

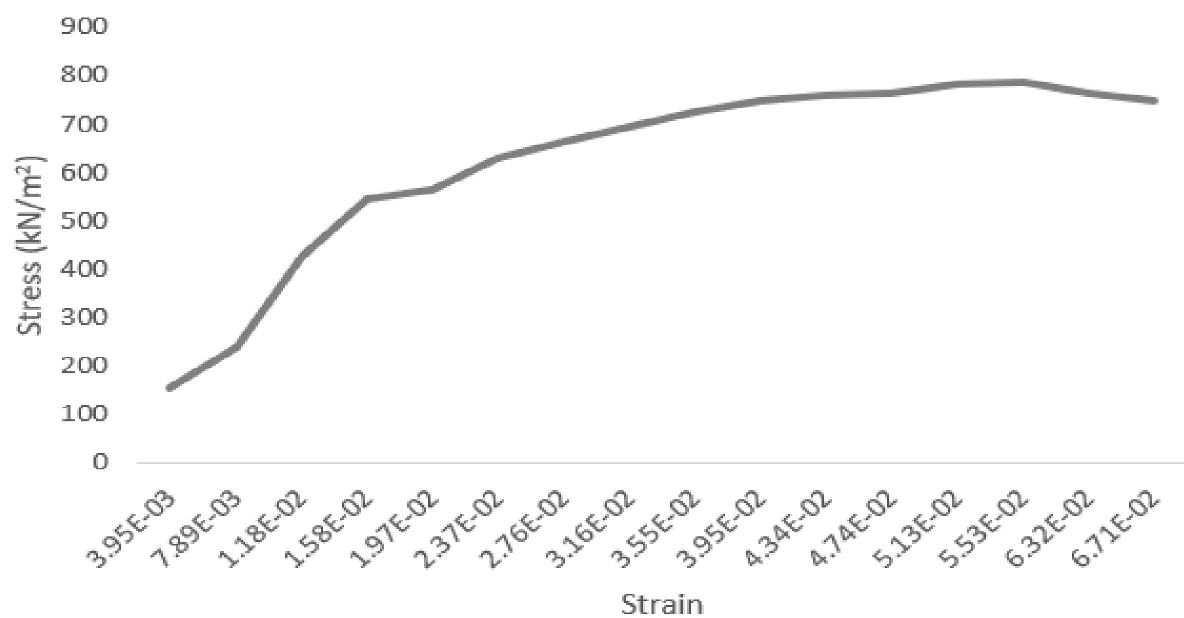
- Mineralogical composition: Expansive soil can be classified as montmorillonitic, illitic, or kaolin tic based on the mineralogical composition.

- Swelling potential: Expansive soil can be classified as high, medium, or low swelling potential based on the amount of swelling when exposed to water.

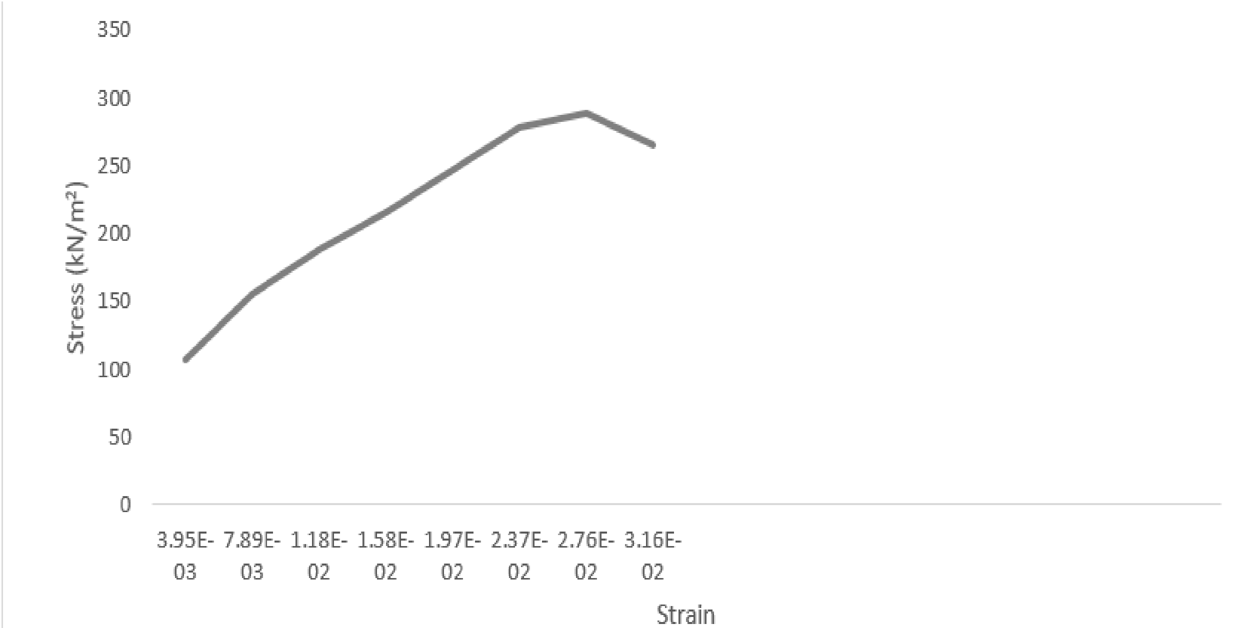
CHAPTER 6

RESULT AND DISCUSSION

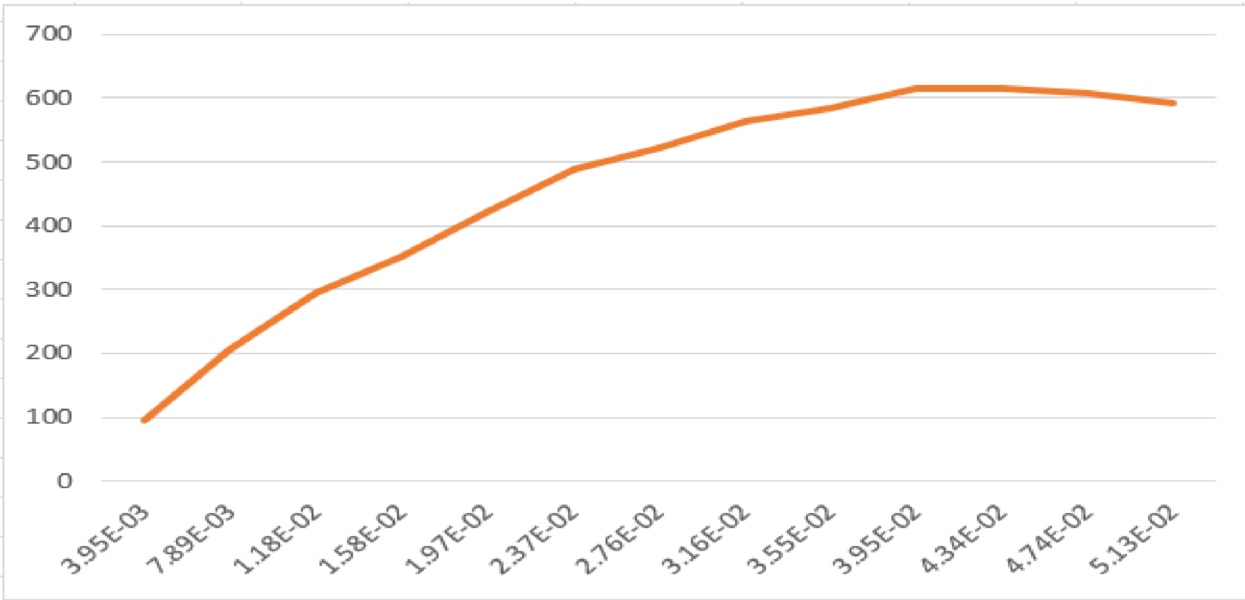
6.1.1 4- day curved strength



Graph 1 : stress – strain relationship for 2% TW



Graph 2 : stress – strain relationship for 6% TW

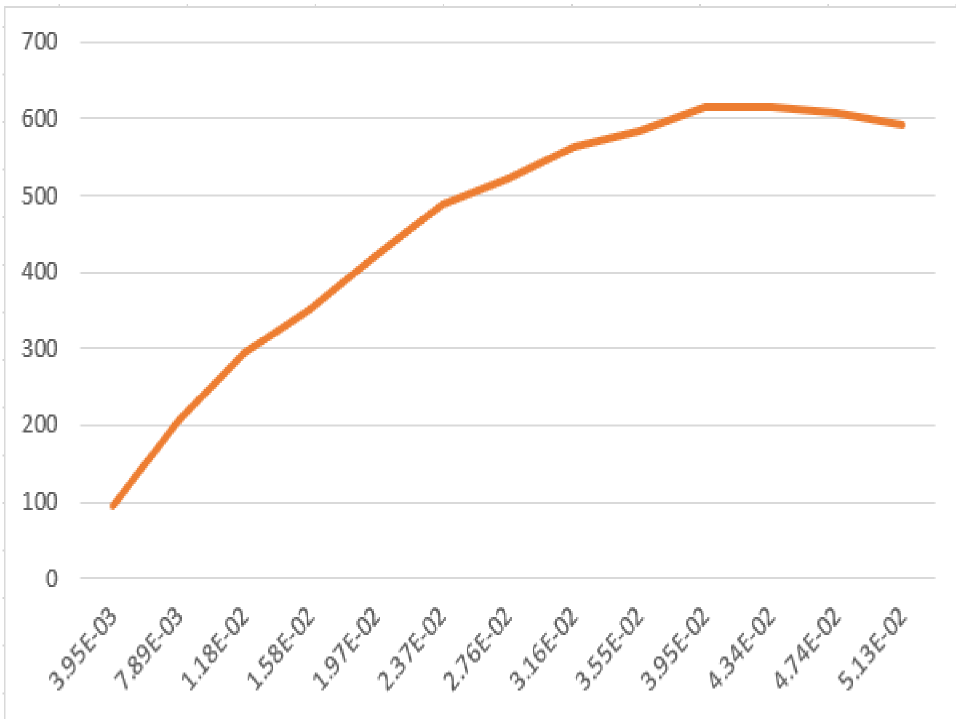


Graph 3 : stress – strain relationship for 10 % TW

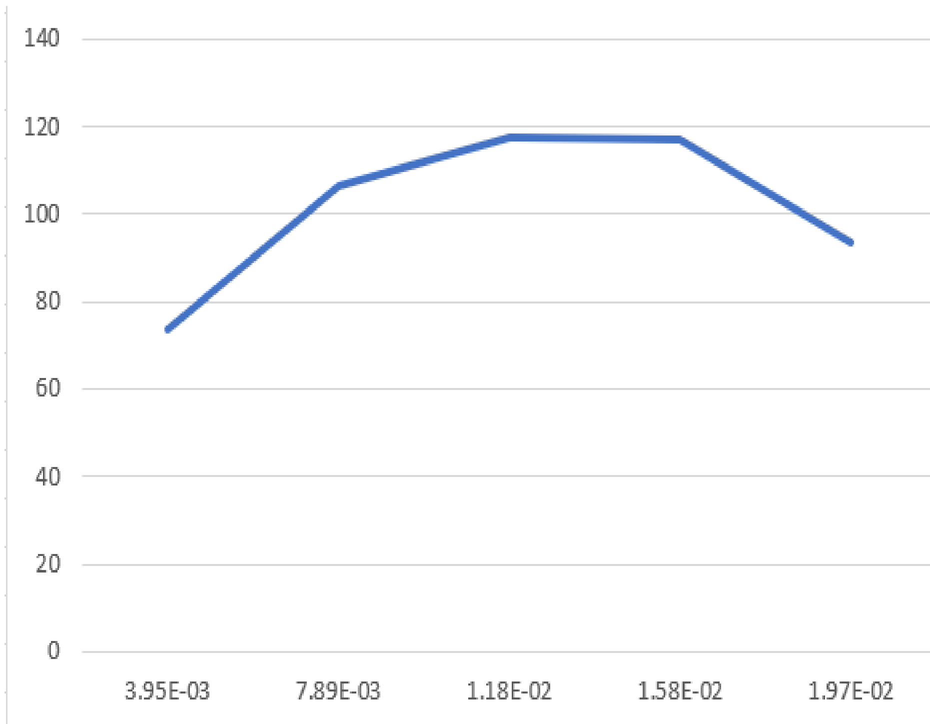
Compaction on 4 day test by U.C.S

2% TLW 4d		6% TLW 4d		10% TLW 4d	
stress (kN/m2)	Strain€	stress (kN/m2)	Strain€	stress (kN/m2)	Strain€
156.5225564	3.95E-03	39.47368421	3.95E-03	94.86215539	3.95E-03
238.5776942	7.89E-03	78.94736842	7.89E-03	205.5075188	7.89E-03
425.8489975	1.18E-02	118.4210526	1.18E-02	294.0946115	1.18E-02
543.6591479	1.58E-02	157.8947368	1.58E-02	351.5037594	1.58E-02
562.4843358	1.97E-02	197.3684211	1.97E-02	420.112782	1.97E-02
629.9561404	2.37E-02	236.8421053	2.37E-02	488.1578947	2.37E-02
664.4517544	2.76E-02	276.3157895	2.76E-02	523.226817	2.76E-02
696.3408521	3.16E-02	315.7894737	3.16E-02	564.9122807	3.16E-02
725.6516291	3.55E-02			585.5733083	3.55E-02
747.8383459	3.95E-02			615.1942356	3.95E-02
760.7080201	4.34E-02			614.943609	4.34E-02
764.3734336	4.74E-02			607.8696742	4.74E-02
781.5350877	5.13E-02			591.7982456	5.13E-02
787.2807018	5.53E-02				
762.8571429	6.32E-02				
746.3157895	6.71E-02				

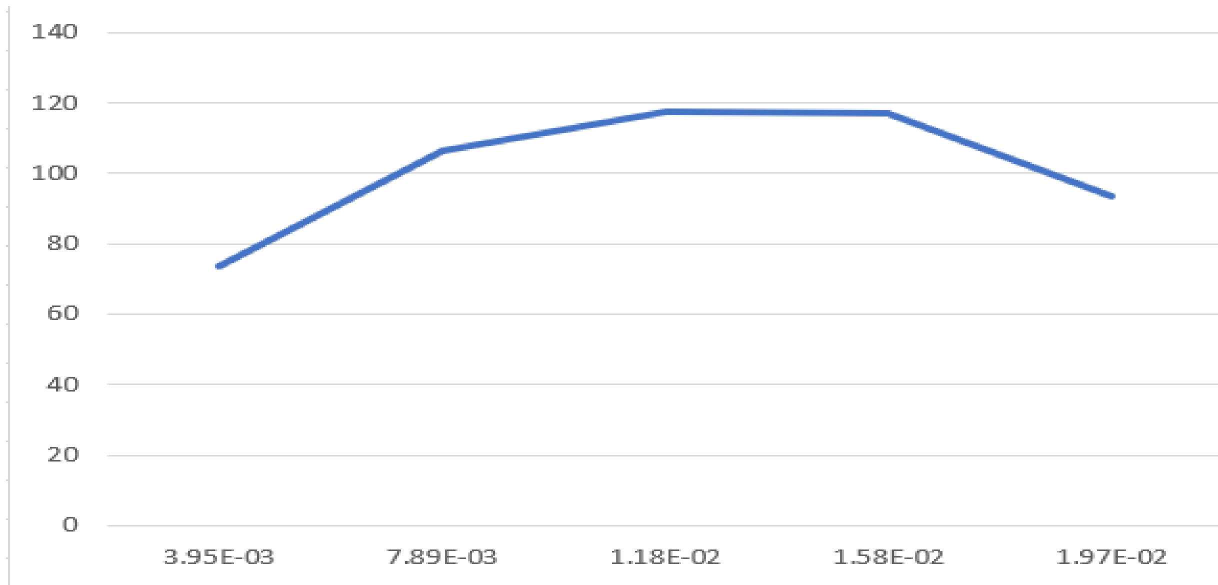
6.1.2 7- day curved strength



Graph 1 : stress – strain relationship for 2% TW



Graph 2 : stress – strain relationship for 6 % TW



Graph 3 stress – strain relationship for 10 % TW

7 day compaction test by U.C.S

2% TLW 7 d		6% TLW 7 d		10 % TLW d	
stress (kN/m2)	Strain€	stress (kN/m2)	Strain€	stress (kN/m2)	Strain€
187.3527569	3.95E-03	39.47368421	3.95E-03	237.1553885	3.95E-03
278.7343358	7.89E-03	78.94736842	7.89E-03	292.9072682	7.89E-03
409.3796992	1.18E-02	118.4210526	1.18E-02	527.0175439	1.18E-02
449.924812	1.58E-02	157.8947368	1.58E-02	731.1278195	1.58E-02
469.1259398	1.97E-02	197.3684211	1.97E-02	872.9010025	1.97E-02
527.6754386	2.37E-02			1048.377193	2.37E-02
562.5845865	2.76E-02			1171.472431	2.76E-02
583.358396	3.16E-02			1293.533835	3.16E-02
				1547.750627	3.55E-02
				1664.912281	3.95E-02
				1751.450501	4.34E-02
				1884.849624	4.74E-02
				1901.885965	5.13E-02
				2055.927318	5.53E-02
				2161.428571	6.32E-02

CHAPTER 7
CONCLUSION

"In conclusion, this study has demonstrated the potential of tanned waste ash as a viable option for short-term strength enhancement of soft soil. Through a series of laboratory tests and analyses, we have observed significant improvements in the engineering properties of the treated soil, including increased shear strength and reduced compressibility. These findings suggest that tanned waste ash can effectively mitigate the challenges associated with weak soils, offering a sustainable solution for infrastructure development and construction projects.

Furthermore, the utilization of tanned waste ash as a soil stabilizer presents environmental benefits by recycling industrial by-products and reducing the demand for traditional construction materials. This not only contributes to waste management but also aligns with the principles of sustainable development.However, it's essential to acknowledge the limitations of this study, including the need for further research to assess the long-term performance and durability of tanned waste ash-treated soil under various environmental conditions. Additionally, the feasibility of large-scale implementation and the potential impacts on surrounding ecosystems warrant thorough investigation.In conclusion, the findings of this study underscore the promising prospects of tanned waste ash as a cost-effective and eco-friendly solution for enhancing the engineering properties of soft soil in the short term. Continued research and collaborative efforts are necessary to fully unlock its potential and facilitate its practical application in geotechnical engineering projects."

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A Appendix

waste material at 2%						
Deflection	load	Load(kg)	Strain€	Ac=A0/(1-e)	Stress=	stress (kN/m2)
0.3	66	17.82	3.95E-03	1138.494055	0.015652	156.5226
0.6	101	27.27	7.89E-03	1143.023873	0.023858	238.5777
0.9	181	48.87	1.18E-02	1147.58988	0.042585	425.849
1.2	232	62.64	1.58E-02	1152.192513	0.054366	543.6591
1.5	241	65.07	1.97E-02	1156.832215	0.056248	562.4843
1.8	271	73.17	2.37E-02	1161.509434	0.062996	629.9561
2.1	287	77.49	2.76E-02	1166.224628	0.066445	664.4518
2.4	302	81.54	3.16E-02	1170.978261	0.069634	696.3409
2.7	316	85.32	3.55E-02	1175.770805	0.072565	725.6516
3	327	88.29	3.95E-02	1180.60274	0.074784	747.8383
3.3	334	90.18	4.34E-02	1185.474553	0.076071	760.708
3.6	337	90.99	4.74E-02	1190.38674	0.076437	764.3734
3.9	346	93.42	5.13E-02	1195.339806	0.078154	781.5351
4.2	350	94.5	5.53E-02	1200.334262	0.078728	787.2807
4.8	342	92.34	6.32E-02	1210.449438	0.076286	762.8571
5.1	336	90.72	6.71E-02	1215.571227	0.074632	746.3158

percentage of observation taken

2% , 6% , 10%

waste material 6%							
Deflection	load	Load(kg)	Strain€	Ac=A0/(1-e)	Stress=	stress (kN/m2)	
0.3	45	12.15	3.95E-03	1138.494055	0.010672	106.7199	
0.6	66	17.82	7.89E-03	1143.023873	0.01559	155.9023	
0.9	80	21.6	1.18E-02	1147.58988	0.018822	188.2206	
1.2	92	24.84	1.58E-02	1152.192513	0.021559	215.589	
1.5	106	28.62	1.97E-02	1156.832215	0.02474	247.3997	
1.8	120	32.4	2.37E-02	1161.509434	0.027895	278.9474	
2.1	125	33.75	2.76E-02	1166.224628	0.02894	289.3954	
2.4	115	31.05	3.16E-02	1170.978261	0.026516	265.1629	

waste material 10%						
Deflection	load	Load(kg)	Strain€	Ac=A0/(1-ε	Stress=	stress (kN/m2)
0.3	40	10.8	3.95E-03	1138.494	0.009486	94.86216
0.6	87	23.49	7.89E-03	1143.024	0.020551	205.5075
0.9	125	33.75	1.18E-02	1147.59	0.029409	294.0946
1.2	150	40.5	1.58E-02	1152.193	0.03515	351.5038
1.5	180	48.6	1.97E-02	1156.832	0.042011	420.1128
1.8	210	56.7	2.37E-02	1161.509	0.048816	488.1579
2.1	226	61.02	2.76E-02	1166.225	0.052323	523.2268
2.4	245	66.15	3.16E-02	1170.978	0.056491	564.9123
2.7	255	68.85	3.55E-02	1175.771	0.058557	585.5733
3	269	72.63	3.95E-02	1180.603	0.061519	615.1942
3.3	270	72.9	4.34E-02	1185.475	0.061494	614.9436
3.6	268	72.36	4.74E-02	1190.387	0.060787	607.8697
3.9	262	70.74	5.13E-02	1195.34	0.05918	591.7982

waste material at 2%						
Deflection	load	Load(kg)	Strain€	Ac=A0/(1-e)	Stress=	stress (kN/m2)
0.3	79	21.33	3.95E-03	1138.49406	0.018735	187.3528
0.6	118	31.86	7.89E-03	1143.02387	0.027873	278.7343
0.9	174	46.98	1.18E-02	1147.58988	0.040938	409.3797
1.2	192	51.84	1.58E-02	1152.19251	0.044992	449.9248
1.5	201	54.27	1.97E-02	1156.83221	0.046913	469.1259
1.8	227	61.29	2.37E-02	1161.50943	0.052768	527.6754
2.1	243	65.61	2.76E-02	1166.22463	0.056258	562.5846
2.4	253	68.31	3.16E-02	1170.97826	0.058336	583.3584

percentage of observation taken

2% , 6% , 10%

waste material 6%						
Deflection	load	Load(kg)	Strain€	Ac=A0/(1-e)	Stress=	stress (kN/m2)
0.3	31	8.37	3.95E-03	1138.494055	0.007351817	73.51817
0.6	45	12.15	7.89E-03	1143.023873	0.010629699	106.297
0.9	50	13.5	1.18E-02	1147.58988	0.011763784	117.6378
1.2	50	13.5	1.58E-02	1152.192513	0.011716792	117.1679
1.5	40	10.8	1.97E-02	1156.832215	0.00933584	93.3584

waste material 10%						
Deflection	load	Load(kg)	Strain€	Ac=A0/(1-e)	Stress=	stress (kN/m2)
0.3	100	27	3.95E-03	1138.494055	0.023716	237.1554
0.6	124	33.48	7.89E-03	1143.023873	0.029291	292.9073
0.9	224	60.48	1.18E-02	1147.58988	0.052702	527.0175
1.2	312	84.24	1.58E-02	1152.192513	0.073113	731.1278
1.5	374	100.98	1.97E-02	1156.832215	0.08729	872.901
1.8	451	121.77	2.37E-02	1161.509434	0.104838	1048.377
2.1	506	136.62	2.76E-02	1166.224628	0.117147	1171.472
2.4	561	151.47	3.16E-02	1170.978261	0.129353	1293.534
2.7	674	181.98	3.55E-02	1175.770805	0.154775	1547.751
3	728	196.56	3.95E-02	1180.60274	0.166491	1664.912
3.3	769	207.63	4.34E-02	1185.474553	0.175145	1751.451
3.6	831	224.37	4.74E-02	1190.38674	0.188485	1884.85
3.9	842	227.34	5.13E-02	1195.339806	0.190189	1901.886
4.2	914	246.78	5.53E-02	1200.334262	0.205593	2055.927
4.8	969	261.63	6.32E-02	1210.449438	0.216143	2161.429