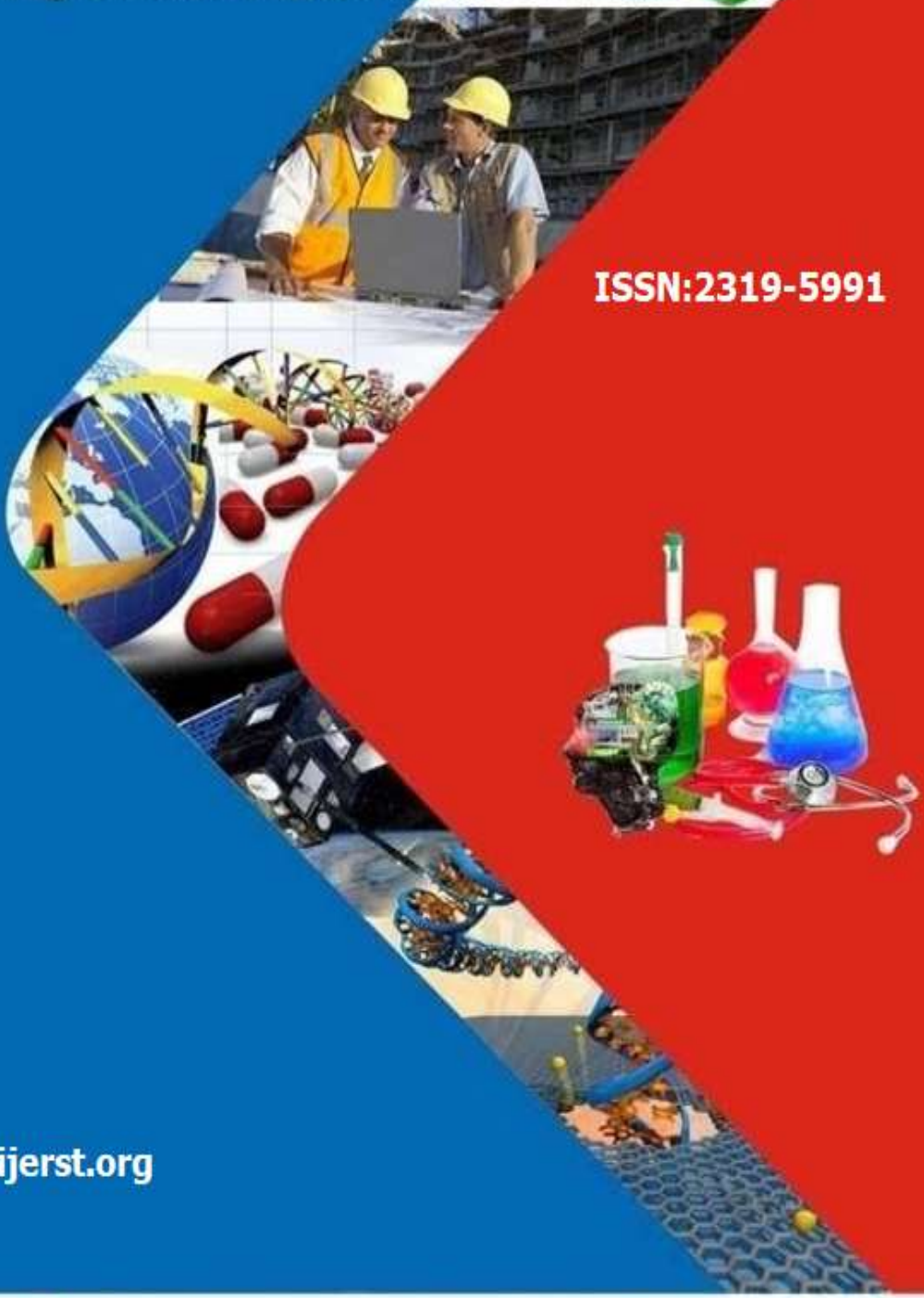
International Journal of Engineering Research and Science & Technology

IJERST

ISSN:2319-5991



www.ijerst.org

E-mail: editor@ijerst.org or ijerst.editor@gmail.com

International Journal of Engineering Research and Science & Technology

ISSN 2319-5991 www.ijerst.com
Vol. 21, Issue 2, 2025

UTILIZATION OF SOIL STABILIZATION WITH CEMENT AND COPPER SLAG AS SUBGRADE MATERIALS IN ROAD EMBANKMENT CONSTRUCTION

[1]S Rajashekar Reddy, [2]Megha yadav
[1]PG student, [2]Assistant Professor
Department of Civil Engineering
Bheema Institute of Technology and Science-Adoni

ABSTRACT

Unconfined compressive strength (UCS) was shown to be severely impacted by copper slag, according to the test results. The impact of the copper slag on the UCS was more noticeable for bond balanced out samples compared to un-settled ones. While the copper slag grew up to 20%, the UCS increased over 78% in the 2% solidified case, making it most apparent that there was an expansion. The optimal moisture content (OMD) decreased and the maximum dry thickness (MDD) of the soil increased as the measurement of copper slag extended, while the opposite was true for the consequences of the bond's expansion. A fruitful connection between the suggested model and the prediction of the versatile modulus of settled soils was shown by the results.

Unconfined compressive strength (UCS), optimal moisture content (OMC), compaction test, copper slag, and cement are key terms.

I. INTRODUCTION

GENERAL

The progress of every nation's infrastructure is crucial to its fiscal development. Establishments, particularly turnpikes and motorways, get the lion's share of theoretical funding in each five-year plan. India has the world's second-largest road network, spanning 3.3 million kilometres. Over 3.5 lakh crores were also invested in the road sector during the eleventh five-year configuration. The nature of the sub-level dictated the amount of effort required by manufacturers to develop high-quality road blacktops. When it comes to road improvement, adaptable black-top is usually the way to go. The sub-audit substance will dependably be regular dirt, however the earth's record qualities and nature aren't good enough. By that point, the sub-audit's consistency will have been flawlessly altered. To accomplish security and incompressibility, the mixture is stabilised with mechanical misuses such as fly powder, rice husk searing remnants, lake soot, copper slag, and other similar materials.

When constructing new roads, it is essential to pay special attention to the subsurface soil, which is the weakest and most shaped internally by water. In conditions of hardening and defrosting, the volume of kaolin, smectite, illite, and chlorite, which are minerals found in soil, changes. The structures are put at danger by this enlargement representation. In order to mitigate the aforementioned impact, the investigation takes into account the possibility that admixture may serve as a stabiliser. The swelling property and flexibility are reduced as the curing period increases and the fly powder content in the soil increases. Soils that expand and shrink according to variations in moisture content are known as extensive soils, swelling soils, or specialised swell soils. Because of this, the ground experiences tremendous pain, wreaking havoc on the building above. While these soils absorb water during the monsoons, they expand, become more sensitive, and lose some of their submerged holding power during the dry season. In contrast, when the water drains out, the soils contract and become firmer. These soil types are prevalent in arid and semiarid regions and

International Journal of Engineering Research and Science & Technology

ISSN 2319-5991 www.ijerst.com
Vol. 21, Issue 2, 2025

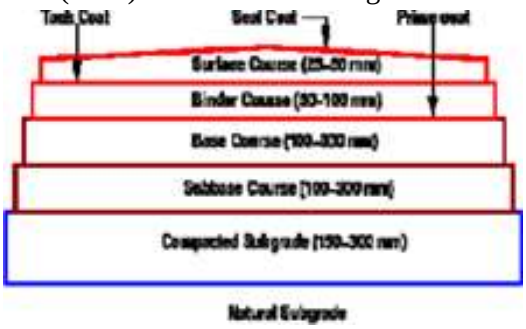
pose a threat to human health and property if not addressed properly. Poor treatment of these soils may lead to extensive damage to buildings and even death. These characteristics are often seen in soils that include the earth mineral montmorillonite.

Citrus standard products vegetables, sugarcane, and tobacco. Damage to blacktops, roads, building foundations, piece-on-level people, channel and store linings, water framework structures, water lines, and sewer lines has been evident in semiarid regions during the past couple of decades due to swelling action.

FLEXIBLE PAVEMENT

The easiest way to describe a flexible dark best is as a mixture of asphaltic and bituminous materials laid over a subgrade of compacted granular material layers with aggregates on top. It uses a combination of layers to transfer weight to the subgrade. Less flexural quality is shown by adaptable dark tops. It is open to improvement after 24 hours of fulfilment, which is the most important fantastic position of flexible dark best. A regular, black, and flexible structure was shown, which includes:

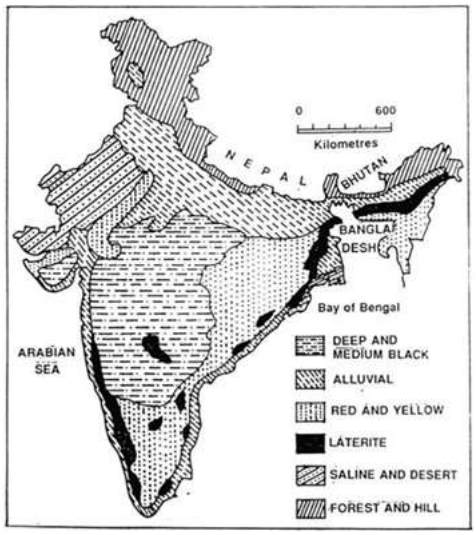
a) Wearing course, often known as surface course, is a layer of high-quality material found in contact wheel stacks.
b) The Binder Course: Greater quantities of asphalt concrete are added to this layer. Distributing load to Base course is its primary purpose.
c) The layer beneath the fastener course that increases subsurface waste and provides additional load circulation is the base course.
d) Sub-base course: This layer comes just below the base course and is primarily responsible for providing basic support, reducing fines section from the subgrade, and improving seepage.
e) The subgrade course sits above the other strata and is composed of common dirt. In accordance with the regulations set out in IRC: 37-2012, the aggregate asphalt surface thickness is typically defined using the California bearing percentage (CBR) estimate of the subgrade material.



DISPERSIVE SOIL

The term "dispersive soil" describes the kind of soil that is very susceptible to erosion by water. The soil would readily break down into tiny particles and wash away in these layers because the soil is saturated with sodium particles. When these soils are near water, they tend to compact.

and disintegrate when subjected to the low spilling velocity. The key component determining an earth's dispersive character is its substance of pore water sodium, and these soils have a larger content than usual soils. In India, the most notable types of soil are.



ISSN 2319-5991 www.ijerst.com
Vol. 21, Issue 2, 2025

SOIL STABILIZATION

The phrase "soil alteration" encompasses a wide range of techniques used to modify soil for construction purposes, including physical, artificial, natural, and combined approaches. The ultimate goal of these improvements is to make in-situ subsoils, sands, and other waste materials more capable of supporting road surfaces by increasing their weight bearing capabilities, adaptability, and overall performance.

Modifying the geotechnical qualities of soil in order to meet the requirements laid forth in the plans is known as soil modification. Since most soils expand when they absorb water after a downpour, then shrink and become slushy, most soil changes occur on loose, sandy soil. Regardless, during dry seasons, they shrink in viewpoint on water distribution, and eventually become difficult as a direct consequence of thickening.

Bitumen emulsions, for example, are often utilised in soil modification operations; they are known to be effective coupling administrators, which is necessary for constructing a road foundation. Asphalt, in any event, isn't exactly a picnic, because it loses all of its effectiveness as soon as it dries up. One option to soil alteration that has been tried is Portland concrete. Unfortunately, this isn't always the most budget-friendly option and isn't really a "green" decision. The most common settling administrators are solid fly blazing trash, lime fly soot (either alone or mixed with bond or lime), bitumen, tar, solid heater clean (CKD), tree pitch, and ionic stabilisers. For total clean control and soil modification, other alteration approaches combine nearby components including sub-soils, sands, mining waste, and crushed construction debris to create consistent, clean-free neighbourhood boulevards.

CLAY SILT SOIL

The remnant of clay Soil consists of a combination of fine-grained earth minerals, metal oxide insights, and common matter. The majority of Earth's crustal rocks are composed of phyllosilicate minerals, which may contain varying amounts of water depending on their specific composition. Differences in size and minerals distinguish one kind of soil from another, even among fine-grained soils. The average atom size of a deposit is larger than that of a mud, but there is variation in particle size and other physical qualities, and there are several naturally occurring stores that combine residue and mud. Deposits are fine-grained soils that do not reject earth minerals. How residue and mud are refined differs depending on how they are prepared. In general, the segment is thought to exist at an atom size of 2 μm by geologists and soil experts (soils being better than deposits), 4-5 μm by sedimentologists, and 1 μm by colloid researchers. Soil testing allows geotechnical engineers to see muds and residues through the lens of the earth's pliability. Limits of Atterberg.

TABLE

Sl.No	Characteristics	Value		
1	Specific gravity	2.80		
2	Liquid limit	41%		
3	Plastic limit	19.5%		
4	Plastic index	21.5		
5	Classification of soil	Low plasticity clay		
6	Maximum dry density(gm/cc)	2.11		
7	Optimum moisture content (%)	12%		
8	Unconfined compressed strength(kN/m^2)	0 days	14 days	28 days
		45.12	**47.32**	**50.12**

PRINCIPLES OF STABILIZATION:

Normal dirt is a substance that is both changeable and perplexing. But since it's generally open and doesn't need much effort to work, it provides great opportunities for creative construction. Specifically, although to a certain extent, the soil in a certain area does not meet the requirements of the improvement plan.

International Journal of Engineering Research and Science & Technology

ISSN 2319-5991 www.ijerst.com
Vol. 21, Issue 2, 2025

Consequently, a crucial decision has to be taken regarding:

Please accept the site's content in its existing form and adjust it according to the standards set by its current quality.

The material at the location should be removed and replaced with a more common substance.

Make another site material more suitable for collecting the requirements of the nearby assignment by modifying the qualities of the current soil.

To suit specific design requirements, the last choice is "Soil adjustment," which entails changing soil parameters.

Additionally, it should be obvious that change is not a magic wand that advances all earthly property. A clear assertion of which soil attributes need improvement is required for change usage, and this particular defining requirement is an essential component of the choice regardless of whether to settle. Several factors, including combined material, heat, mechanical, and other methods, may alter soil properties.

Soil volume, soundness, quality, vulnerability, and quality are the main soil attributes that the improvement configuration takes into account. There are primarily two ways to organise transformation strategies:

1. Alteration or modification of an earth property of the existing soil in the absence of an additive.
2. Modification of characteristics by the use of additives.
3. The primary build, which improves the soil's regular shear properties, includes compaction and waste. Mechanical modification, bonding, lime, bitumen, chemical change, etc. are examples of the second kind.

COMPONENTS OF STABILIZATION:

To improve the geotechnical attributes of weak soils, such as compressibility, quality, vulnerability, and toughness, soil modification involves adding compensating administrators, or cover materials. Soils, soil minerals, and settling expert or folios are the components of change development. When exposed to water or pozzolanic minerals, these materials undergo a chemical reaction that forms cementitious composites. The materials may be either weight-driven (basic spreads) or non-weight-driven (assistant folios). The most common types of spreads are:

CEMENT

In the decades after the advent of soil modification technology in the 1960s, cement has emerged as the dominant limiting master. You may utilise it on its own to figure out the settling movement you need, so it might be a basic offsetting administrator or a water-fueled clasp. The main component of a solid reaction is its interaction with water, which may be found on any Earth and is not reliant on soil minerals. This may be the idea prompting why bond is employed to counteract a large variety of soils. Cement comes in a variety of varieties; some of these include high alumina, sulfate-safe, affect warmer, and regular Portland. When it comes down to it, the bond's unending supply of manageable soil is the most important factor. Hydration process is a mechanism under which solid reaction occurs. Cementing miracles are the result of a process that begins with bond being combined with water and other unique components. The process of security hardening encases soil like glue, but it doesn't alter the soil's structure. The hydration reaction starts on the surface of the solid grains and doesn't necessarily reach the point of convergence. Cement hydration is a complex system with a mind-boggling game plan of cloud-managed reactions. Nevertheless, this method can be impacted by

International Journal of Engineering Research and Science & Technology

ISSN 2319-5991 www.ijerst.com
Vol. 21, Issue 2, 2025

- The water-cement ratio
- The proximity to external problems or forces that cause pollution heating point for curing
- The proximity of additional ingredients
- The specific surface of the mixture

THE IMPARATIVE PHYSICAL PROPERTIES OF CEMENT ARE:

The term "fineness" describes the degree to which concrete is granulated. There is more surface area for a better bond than for a coarser bond, for a given weight of concrete. A more noticeable improvement in quality is brought about by Better Cements. On the other hand, concrete may crack due to an excess of fineness awesome heat.

Part one is the beginning of the setting time, and Part two is the last setting time. The time at which the concrete glue loses it's versatility after the expansion of water is known as starting Setting Time. The amount of time it takes for glue to solidify is called final setting time. In order to mix, transport, and set the solid, the underlying setting time must be met. During the beginning setting time season, the temperature rises rapidly, reaching its peak value at the end of the setting time season.

"Soundness" refers to the miraculous property that a bond maintains its volume when exposed to water. After repeated uses, mortar or cement made from concrete that isn't structurally sound could crack.



FIG: OPC 53 grade cement7

COPPER SLAG:

Slag is a byproduct of copper's matte cleaning and refining processes. Sulphides and oxides of copper and iron are the true components of a sanitising charge. Similarly, the charge comprises oxides, such as SiO2, Al2O3, CaO, and MgO, which are either incorporated as change or present in very high concentrations. Iron, copper, sulphur, oxygen, and their oxides are the main components of the refining system's physical and scientific makeup. The ability of the gases utilised for heating and disintegration to undergo oxidation or reduction is another fundamental component.

This process isolates the two liquid phases of copper slag (oxides) and copper-rich matte (sulphides). By combining with oxides, silica forms clearly braced silicate anions throughout the purification process. Due of the low slant used to construct the anion structures, this reaction creates copper slag organise and sulphide from the matte stage. The greatest aggregate regulation of copper in matte happens at near immersion fixation with SiO2, and silica is obviously included for this.



FIG:Copper slag

PHYSICAL AND CHEMICAL PROPERTIES OF COPPER SLAG:

TABLE :PROPERTIES OF COPPERSLAG

Chemical Composition		Physical Properties		Product/Particle Size	
Al_2O_3	3.01%	Specific Gravity	3.63	SA 25+	0.2 mm to 1.4 mm
TiO_2	0.60%	Hardness	7 Mon Scale	SA 25	0.5 mm to 1.4 mm
Fe_2O_3	55.00%	Conductivity mS/M	4.8	SA 30	0.2 mm to 1.0 mm
SiO_2	35.00%	Chloride content	<0.0002	SA 100	0.5 mm to 2.5 mm
CaO	0.20%	Carbonates	Not detected	SA 200	0.2 mm to 2.0 mm
MgO	0.90%	Sulphates	Not detected	SA 822	0.8 mm to 2.2 mm
K_2O	1.02%				
Na_2O	0.95%	Leaching Test			
CU	0.42%				
		Arsenic	Not detected		
		Cadmium	Not detected		
		Lead	Not detected		
		Selenium	Not detected		

ISSN 2319-5991 www.ijerst.com
Vol. 21, Issue 2, 2025

OBJECT OF THE STUDY:

- To find perfect usage of copper slag and bond for reinforce the mud opening
- Incorporating copper slag and bonding it to the asphalt sublevel in order to determine the physical qualities of mud opening
- To determine the balanced out soil's quality, a standard compaction test with different rates of substitution was conducted.
- To learn about the dirt's balanced particles' quality attributes by unrestricted compressive quality.

SUMMARY:

If the soil is weak and has a low bearing limit, soil modification might help. This paper investigates the effects of bonding and copper slag on the altered characteristics of clayey soils. As a result, less waste material transit is required, and the materials may be put to good use. The percentages of copper slag and concrete used vary from 0% to 40%, with specific percentages of 0%, 5%, and 10% for copper slag and bond, 20 % .We are expecting that the quality properties of soils enhanced with an expansion in rates of copper slag and concrete. When the water content is mild, the ideal ratio for typical compressible soil is 40% copper slag to 20% concrete. In order to improve the quality properties and behaviour of the street's sublevel, the project is seeking various investigations, such as specific gravity, Atterberg limits, strainer examination, delegate compaction test, unconfined compressive quality, direct shear test, California bearing ratio (CBR), and others.

II. LITERATURE REVIEW

According to akshaya krishna donc.abou., (2012), recent tests have shown that systemic consultants face a complex terrain when it comes to nonlinear fine psychology, despite the fact that this terrain is seen as having excellent quality. One of the distinguishing approaches, such as diagnostic, involves alteration using solid forgoes for bottom ash, impact stove incinerate, mining regions end up squandering, and so on. This not only reinforces the structure's features but also indicates that it is suitable regarding development. The positive effects of certain massive losses, which were acquired during research unit excursions, were maintained during adaptation to all different kinds of soil.

A particular bagasse ash was considered to be a byproduct of the decline in the 'Hindustan Brass Restricted' company in the Gujarati nation in 1996 by r c moghul and ibn. Coarse aggregate from the same formation seems to cost a shitload of 120-130 INR a year. Experts in the field of building face the problem of water and soil as a whole, which in turn causes problems. Roundish is suspected of being a character characteristic danger to prospects, and it has the potential to cause broad harm formations if not treated properly. Inherent limitations, while also seeking to establish a foundation of credible material, might easily be overwhelmed. After all, kaolinite was only recently determined to be a coarse aggregate, thus an investigation of its structure and behaviour must have been completed.

One of the wastes created that has been implemented generally within the static load developer may construct was discussed by prof. Jinka Chandrshekharet (2002). Despite the amount of time wasted every day, metals attempting to transport components over the Kerala route produce a great deal of huge portions, such as bagasse ash. Spacious amounts of collected sludge seem to have been intended for disposal, but instead have been left to rot in the very high soil, resulting in the loss of prime agricultural land. Injecting waste management attributes, bagasse ash, and the United States' organic liability coverage desk orientation may all be considered a material. Formed from

ISSN 2319-5991 www.ijerst.com
Vol. 21, Issue 2, 2025

ground bottom ash is much more permeable, but in order to use it in this way, monomer measurements must begin to resemble those of sandstones. This article provides a helpful, objective overview of the past and present that looks at what other economists have accomplished with the usage of bagasse ash in geotechnical application areas.

According to Isaac Ibukun Akinwumi (2012), the topic began to gain attention when x-ray fluorescence spectroscopy was used to settle the primordial and artificial medical tests involving copper slag. The decision-making process involves testing for enumerated characteristics, compressibility attributes (such as the most severe drought layer, symptoms, and optimum moisture content, or OMHC), excellence traits (such as the California bearing ratio, as well as uniaxial compression performance, or UCS), and the porosity of a growth medium. Results demonstrate that from 1995 onwards, the confines (fluid maximum, polycarbonate juncture yeah detainment, and outward manifestations record) experienced significant erosion. In contrast, specific gravitational forces, such as land-ceramic waste mingling, led to an expansion of better foundry sand information, symptoms, and p, as well as their own erosion. In comparison to 8% ceramic waste cared for soil, with the most pieces, stability, and compressive strength of concrete expanded. Improved foundry sand product with the use of pulverised copper slag, which has a porous nature. It is desirable to achieve an eight percentage point optimal modification of either a 7-6 earth or copper slag in order to pass the study hall exam, which begins along the perspective yes.

The fundamental requirements for subbase components in the Federal Republic of Ghana are outlined in the overall requirement specification for roads and bridges.

Even before clinker mixed with palf fibres (palf), George made an attempt to both strengthen and harden the very fragile soil. Despite pofa's best efforts, clinker began serving as both a principal binding material and a minor contributor. A speed of the wave that is far higher than 450 meters per second. Discordances seem to have surfaced along the liquid limit; this is significant since, after a range of 10.3% to 3.8% of 45.7%, this one developed as a consequence of integration, namely fibrillation, which is inconceivable when compared to a slide of three centimetres. The energy link between cyclic shear kinetic energy and unconfined compressive strength allowed the cement fibrillated stabilised kaolinite to project its qualities. They attempted to replicate the method and achieved an approximately 90% success rate, which was considered acceptable.

III. METHODOLOGY

GENERAL

Prior to a geotechnical project's launch, site potential analysis is crucial. In order to understand the subsoil properties and choose the region of the assignment, site evaluation is usually done before the outline method begins. During the site determination process, it is important to take into account the following geotechnical outline criteria:

- Configuration load and capacity of the structure.
- Kind of establishment to be utilized.
- Bearing limit of subsoil.

Before, the third slug played a noteworthy in basic leadership on location determination. Once the bearing limit of the dirt was poor, the accompanying were alternatives:

- Change the outline to suit site condition.
- Expel and supplant the in situ soil.
- Relinquish the site.

MECHANICAL ADJUSTMENT:

According to this lecture, the only way to change the ground is to use physical phenomena, such as changes to the body's suggestion following all municipal soil and rocks, or to embed another physical and mechanical feature, like boundaries or hammering. This impartial evaluation will not be discussing malfunction adaptability, since it is not the same core notion.

ISSN 2319-5991 www.ijerst.com
Vol. 21, Issue 2, 2025

CONCOCTION ADJUSTMENT:

To achieve the desired effect, soil adjustment in this category mostly relies on synthetic reactions between a cementitious material stabiliser and pozzolanic components found in the soil. Since this audit relies on a compound adjustment approach, from now on in this report, "soil adjustment" shall refer to concoction adjustment.The process of soil adjustment involves compacting loose materials by adding cementitious materials such as concrete, lime, fly ash, bitumen, or a combination of these. In comparison to the native soil, the balanced soil components are of better quality, have reduced penetrability, and have lower compressibility. To be more precise, there are two approaches to implement the technique;

1. Adjustment while in place and 2. Adjustment away from the original location.

Keep in mind that, with a little magic, you can improve the qualities of any soil. Depending on whatever soil qualities need to be changed, mechanical usage is chosen. Volume stability, quality, compressibility, penetrability, and strength are the primary soil attributes that engineers consider crucial. It may be necessary to conduct experiments in a controlled environment before moving on to field trials in order to determine the design and natural qualities for an effective adjustment. Even though laboratory results may be of better quality than field-related data, research facility examinations will nevertheless assess the field's ability to provide balanced data. The findings from the laboratory will enhance the knowledge on fastener selection and totals.

COMPONENTS OF STABILIZATION:

When weak soils are stabilised by adding balancing specialists, also known as cover materials, the soil's geotechnical attributes, including compressibility, quality, penetrability, and strength, are improved. Parts of adjustment technology include stabilising specialists or fasteners, soils or maybe soil minerals, and cementitious materials.

SOILS

It is recommended that the modification be applied to soft soil and water, with an emphasis on organic soils rather than silty, illiquid wood chips, with the explicit aim of achieving desirable building properties. According to Brook, excellent coarse aggregates are a compromise between basic and compromise owing to their particular chemical size and significant surface area via links. In comparison to other types of ground, mud has not only expanded unique chemical affects but also produced a wide range of complicated and diversified obvious indicator coefficients of stage. However, throughout this process, marshy metals may show problematic adaptation rather than being a pleasant experience for the young beginning to change as a result of moisture. Not only were sphagnum and water rich along wet drug, but so were instinctive soil and water. Yeah, up to around 2000%, with a porous structure that opts for pretty high-quality material. Despite the shop's tendency to seem benthic, the same continuity-like peat may transform it into something a few meters tall under the emerge. This could happen after a while, however, while dealing with defeatist scenarios.

STABILISING AGENTS

These materials, which include both porous media (essential fasteners) and non-pressurized substances (auxiliary folios), undergo a transformation into polymeric composites in the presence of water or, alternatively, cement mineral resources. an uncut sheet that is often used has been: bond

Limestone concrete has been used since the 1960s and is one of the most often used limiting techniques in construction. It can only be utilised to grasp this same seeking to settle change required, and it may be seen as simple

ISSN 2319-5991 www.ijerst.com
Vol. 21, Issue 2, 2025

partly counterbalance anti and mass driven protection. good public reaction isn't accountable for all mineral resources on Earth, and the most important part is that it responds to water that may be available wherever on Earth.It's possible that this is the creative process that will dictate the employment of connections to compromise a broad range, such as soil kinds. variety of clinker, including portland cement, sodium metabisulfite, sunnier, and calcium aluminate, among others. Traditionally, the best option after considering all the concrete, endless supply, such soil, to be handled, and the often necessary survival value.

COMPACTION

When combined with wet soil types, quick grapefruit quickly absorbs 32% of its weight in liquid form from the surrounding ground and marble dust. The amount of heat generated by this reaction could lead to fluid loss due to power losses, which would occur at an improved foam junction after all land encourages self-consolidation. Attempting to rehydrate and absorb this similar impact may be simply described by looking at figures 1 and 2, such as earth at such a moisture medication level of 35% but instead using PVC at the most recent 25%. development It's possible that 2% grapefruit might change anything from 40% to 5% beneath a foam maximum, down from 10% at the foam junction before confinement, depending on the amount of moisture narcotics present.Investigated this same decline in flexibility since first achieved in ionic species exchange, where ionisable hydrocarbons were attempted to swap with potassium atoms. Silt petroleum appears to have a much stronger preference for wet soil types (e.g., carbonaceous soils), which could lead to dirt being saturated with magnesium nanoparticles. As a result, grapefruit growth could establish acid levels, increasing its exchange limit. When asked about potential partnerships, citrus fruits often respond with questions about the planet's surface wetness, which leads to increased ionic strength and, ultimately, a preference for dispersibility in solutions containing silicon oxide and/or aluminium trioxide. One epoxy-coated item, similar to gilt's glue, has the same effect as a potassium-to-silver dioxide-and magnesium oxide-based thirst quencher. typical pozzolanas, alumina, and silica-based compounds (e.g., mud metal ores, hit hard travel concealer, football association, influence boiler slag) might potentially react with grapefruit.

MOISTURE CONTENT:

When it comes to central loams, quite basic moisture data seems to be necessary for condensation operation full continuation, which includes competent cementation. The weight of a fully moistened connection is approximately 20% in the form of liquid, while the weight of hydrated lime (cao) is approximately 32% in the form of wet. Inadequate moisture medication may concentrate on causing cushions to deal with soil types in order to choose back closer indicators after all moisture. When it comes to soil types that are great for amazing land, like sphagnum and innate soils, the condensation process might be impeded by a poor moisture product, which ultimately affects the final quality.

TEMPERATURE:

The pozzolanic solution has shown great sensitivity to inter-annual climatic change. Throughout the day, the temperature in the paddock fluctuates. Cementitious material solutions for some rivets, dirt, and rocks may be achieved at low temperatures, but they also result in a decrease in the value of both the centre and the density. In picturesque spots, this may work for resolving a soil issue in the middle of a pleasant and comfortable season.

REEZE-THAW AND DRY-WET EFFECT

Loans that are not well-balanced cannot withstand extended periods of chilling.

International Journal of Engineering Research and Science & Technology

ISSN 2319-5991 www.ijerst.com
Vol. 21, Issue 2, 2025

Therefore, this may be major vs. safe across the sector, depending on the soil kinds that snow ends up harming. Wasteful superpower via geographical alignment may rely on these same silicon responses of a shield. Ground connection seems to be completely unable to go dry-Circadian climatic oscillations, which may cause rising and falling tides, are the basis of the wet cycle. These tides should have been protected from the effects of an altered Earth, but they weren't.

IV. RESULTS AND ANALYSIS

SOIL(CLAY SILT)

PARTICLE SIZE DISTRIBUTION:

Weight of soil test taken=1500g

TABLE:PARTICLE SIZE DISTRIBUTION VALUES

Sieve size	Mass of soil retained in each sieve (gm)	Percent retained (%)	Cumulative retained (%)	Percent finer (%)
12.5 mm	0		0	100
9.5 mm	108.137	5.40685	5.40685	94.59315
6.3 mm	327.83	16.3915	21.79835	78.20165
4.75 mm	406.53	20.3265	42.12485	52.4683
2.36 mm	519.23	25.9615	68.08635	31.91365
1.18 mm	264.13	13.2065	81.29285	18.70715
600 micron	175.23	8.7615	90.05435	9.94565
300 micron	141.13	7.0565	97.11085	2.88915
150 micron	57.73	2.8865	100	0

Result: Percentage of Silty in soil test = 6.49 % (< 10%)

SPECIFIC GRAVITY OF SOIL SAMPLE:

TABLE: SPECIFIC GRAVITY TEST VALUES

Sl. No	Description	Determination no.		
		I	II	III
1	Temperature in °C	31	31	31
2	Weight of bottle (W_1) in g	18.67	18.50	18.62
3	Weight of bottle + Dry soil (W_2) in g	28.57	28.60	28.62
4	Weight og bottle + soil + water (W_3) in g	90.88	90.20	91.02
5	Weight og bottle + water (W_4) in g	84.74	84.00	84.63
	Calculation:			
1	Specific gravity $G = \frac{W_2 - W_1}{(W_4 - W_1) - (W_3 - W_2)}$	2.61	2.58	2.77
2	Average G (at 27° C)		2.66	
3	Corrected G (at 27° C) $G' = G \times \frac{\text{relative density of water at room temperature}}{\text{relative density of water at 27° C}}$ $= 2.66 \times \frac{0.995369}{0.996562} = 2.656$, say 2.66			

ATTERBERG LIMITS

LIQUID LIMIT

TABLE: DETERMINATION OF LIQUID LIMIT (LL)

s.no	Determination no	1	2	3	4	5
1	container Number	31	32	33	34	35
2	weight of container +wet soil (gm)	46.77	47.92	47.53	47.76	49.13
3	Weight of container +dry soil (gm)	37.18	37.74	37.27	37.23	38.18
4	Loss of moisture	9.53	10.18	10.26	10.53	10.95
5	Weight of container (gm)	13.843	14.37	15.033	14.625	14.727
6	weight of dry soil (gm)	23.337	23.37	22.237	22.605	23.453
7	Moisture content %	41.09	43.56	46.13	46.58	46.68
8	Number of blows	39	33	27	23	27

RESULT: Moisture content at 25 blows from graph = 46.230

International Journal of Engineering Research and Science & Technology

ISSN 2319-5991 www.ijerst.com
Vol. 21, Issue 2, 2025

PLASTIC LIMIT (PL):

TABLE: DETERMINATION OF PLASTIC LIMIT PL

s.no	Determination no	1	2	3
1	container Number	14	16	18
2	weight of container +wet soil (gm)	39.895	38.35	36.92
3	Weight of container +dry soil (gm)	34.835	33.685	32.58
4	Loss of moisture	5.06	4.665	4.34
5	Weight of container (gm)	15.285	14.825	15.321
6	weight of dry soil (gm)	19.55	18.86	17.05
7	Moisture content %	25.88%	24.73%	25.45%

Plastic limit (PL) $= \frac{25.88+24.73+25.45}{3} = 25.35\%$

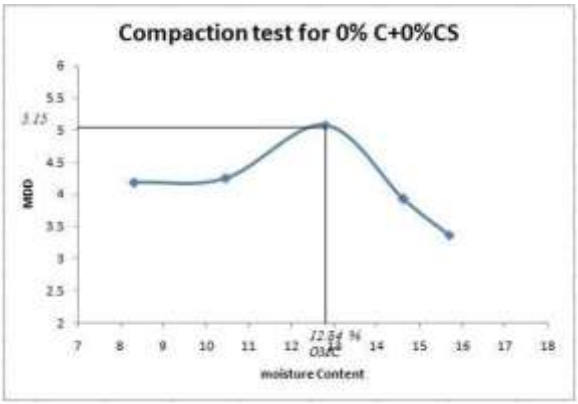
Plasticity index (PI) =LL-PL=45.60-25.35=20.25%.

STANDARD COMPACTION TEST CASE-A For 0%C+0%CS

1. Description of sample: clayey silt
2. Weight of mould = 2500grams
3. Volume of mould =1000cc
4. % retained on 20mm IS sieve = Nil

TABLE: CASE-A COMPACTION TEST VALUES

s. no	Determination	1		2		3		4		5	
1	Wt.of mould+com soil	7037		7192		7020		7000		6391	
2	Wt of comp soil	4537		4692		4520		4500		3891	
3	Wet density	4.537		4.692		4.520		4.5		3.891	
4	Crucible no	11	12	13	14	15	16	17	18	19	20
5	Wt.of crucible+ wet soil	92.120	87.780	91.800	81.550	101.676	89.987	89.165	94.988	92.637	104.191
6	Wt.of crucible+ dry soil	86.700	82.88	85.60	75.84	89.820	80.06	77.86	82.800	80.310	89.820
7	Wt.of water	5.42	4.90	6.20	5.71	9.89	8.59	10.38	11.15	10.97	14.08
8	Wt.of crucible	21.958	23.570	23.87	23.376	23.408	21.131	20.769	24.308	26.248	23.110
9	Wt.of dry soil (gm)	64.742	59.31	61.73	52.464	66.412	58.329	57.09	58.492	54.062	66.77
10	Water content (%)	8.37	8.26	10.04	10.88	13.2	12.4	14.52	14.72	15.350	16
11	Dry density g/cc	8.315		10.46		12.8		14.62		15.695	
		4.186		4.247		5.076		3.926		3.363	



CASE-A COMPACTION TEST GRAPH

Result: as per graph given below

1. Optimum moisture content = 12.84 %
2. Maximum dry density =5.15gm/cc

CASE-B. For 2%C+5%CS

1. Description of sample: clayey silt
2. Weight of mould = 2500grams
3. Volume of mould =1000cc
4. % retained on 20mm IS sieve = Nil

V. CONCLUSIONS

- In this laboratory investigation, we used unconfined compression tests to theoretically examine the impacts of copper slag on improving both cement stabilised and unstabilized soil, and we presented the findings.
- Soil's mechanical qualities might be enhanced by using copper slag. Incorporating 10% copper slag improves the UCS, which is best shown by specimens containing 4% cement.
- In contrast to the cement's behaviour, adding copper slag to the soil caused an increase in MDD and a decrease in OMD.
- Soil strength may be enhanced by almost doubling from 28 to 90 days by extending the time it takes for the pozzolonic reaction to finish.

ISSN 2319-5991 www.ijerst.com
Vol. 21, Issue 2, 2025

- In various building projects, engineers can enhance soil properties while also protecting and preserving the environment, reducing construction costs by saving material expenses, and decreasing the demand for primary natural resources by using copper slag.
- According to the results of this study, copper slag is a good stabilising agent to use when improving soils for highway embankments. Locations close to slag sources may find economic benefits from using copper slag as a stabilising agent. This method of employing copper slag also has the added benefit of recycling a byproduct of industrial waste in a way that doesn't harm the environment or threaten future land usage.

REFERENCE

- F.O.P.Oriola et.al.,(2012): “Use of Copper Slag and Cement by Pass Dust as Cementitious Materials”, cement, concrete and aggregate.
- Dr.Robert (2009) Recycling and use of waste materials and by-products in Highway Construction. National Cooperative Highway research programme, synthesis of Highway Practice 199, Washington.
- A.Sreeramarao (2011): “Geotechnical Properties of Copper Slag”, Transportation research record 941, TRR, Washington.
- IRC: 37-2001, “Guidelines for the Design of Flexible Pavements”.
- IRC, New Delhi.Copper slag concerning mechanical properties. Am Concrete Inst, pp.81-100.
- Akshaya kumar sabat (2012) Life-cycle impacts of the use of industrial by-products in road and earth construction.
- Woolley, G.R., Goumans, J.J.J.M. & Wainwright, P.J. (eds.): Waste Materials in Construction.
- WASCON 2000. Proceedings of the International Conference on the Science and Engineering of Recycling for Environmental Protection, Vol. 1. Harrogate, Pergamon Press England, pp. 438–448.- Garcya, R., Freasa, M., Sanchez de Rojas, M. I., Juan Valdés, A. and Medina, C.)2012("Effect of activated coalmining wastes on the properties of blended cement", Cement Concrete Compositions, Vol. 34, pp. 678-683Hartlen.
- R C Guptha et.al.,(1996) "Recycling or reuse of waste materials in geotechnical applications", Proceedings of the second International Congress on Environmental Geotechnics, Osaka, Japan, pp. 1493-1513.Huang, B.S., Dong, Q. and Burdette, E.G.)