AN EXPERIMENTAL STUDY ON EFFECT OF REINFORCEMENT ON STRESS- STRAIN BEHAVIOR OF FLYASH

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF

Master of Technology

in

Geotechnical Engineering

(Civil Engineering)

by

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NATIONAL INSTITUTE OF TECHNOLOGY

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CERTIFICATE

This is to certify that the thesis entitled "**AN EXPERIMENTAL STUDY ON EFFECTOF REINFORCEMENT ON STRESS- STRAIN BEHAVIOR OF FLYASH**" submitted by **Mr. NOOLU VENKATESH** (Roll No. 212CE1431) in partial fulfillment of the requirements for the award of Master of Technology Degree in Civil Engineering with specialization in Geo-Technical Engineering at National Institute of Technology, Rourkela is an authentic work carried out by him under my supervision and guidance.

To the best of my knowledge, the matter embodied in the thesis has not been submitted to any other University / Institute for the award of any Degree or Diploma.

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ACKNOWLEDGEMENT

First of all I would like to express my heartfelt gratitude to my project supervisor **Dr. N. Roy**, Professor and Head, Department of civil Engineering for his able guidance, encouragement, support, suggestions and the essential facilities provided to successfully complete my research work. I truly appreciate and value his esteemed guidance and encouragement from the beginning to the end of this thesis, his knowledge and company at the time of crisis will be remembered lifelong.

I sincerely thank to our Director **Prof. S. K. Sarangi**, and all the authorities of the institute for providing nice academic environment and other facilities in the NIT campus. I am also thankful to all the faculty members of the Civil Engineering Department, especially Geo-Technical Engineering specialization group who have directly or indirectly helped me during the project work. I would like to extend my gratefulness to the Dept. of Civil Engineering, NIT ROURKELA, for giving me the opportunity to execute this project, which is an integral part of the curriculum in M. Tech program at the National Institute of Technology, Rourkela.

Submitting this thesis would have been a Herculean job, without the constant help, encouragement, support and suggestions from my friends and seniors. Last but not the least I would like to thank my parents, who taught me the value of hard work by their own example.

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ABSTRACT:

In India, approximately 73% of total install power production capability is from thermal in which coal-based production contributing 90%. Most of the thermal power stations and several captive power plants used bituminous and sub-bituminous coal and produced large quantities of fly ash as a residue and these are disposed of on-site impoundments behind engineered earth dam. The country’s faith on coal for power production has unchanged. Thus fly ash management is a cause of concern for the future. One of the finest applications of fly ash is using it as a construction material as embankments, fills and others.

In the present study, an attempt had made to learn the properties of fly ash and properties of GI reinforcement and effect of the reinforcement on the stress-strain behavior of fly ash. A comprehensive set of laboratory uni- axial compression tests were carried out on fly ash with dry density and different optimum moisture content (OMC) which are obtained from standard proctor test. Uni- axial compression tests are done on fly ash with and without reinforcement. The above procedure repeated using dry density and optimum moisture content obtained from the modified proctor test. The stress strain behavior was analyzed by changing galvanized (GI) reinforcement numbers and location. The influence on number & location of GI iron reinforcement on stress strain behavior of sample were studied. It was observed that the inclusion of GI reinforcement increases the peak stress; axial strain at failure. It is observed that increase the numbers of GI reinforcement effect of reinforcement on fly ash also decrease and also observed that decrease the percentage of moisture content strength of fly ash increase. In general, inclusion of reinforcement in fly ash layer can greatly increase the strength, stiffness of fly ash layer thereby comparable strength can be obtained even with decrease of thickness of layer.

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CHAPTER 1

INTRODUCTION

1. INTRODUCTION

Composite materials consisting of more than one chemically distinct ingredient on a macro scale having a discrete interface separating them and having bulk performance which is considerably different from those of any of its individual constituents. Whether they used in buildings, bridges, pavements, or any other of its abundant areas of service, composite must have strength, the capability to combat force. The forces to resist may result from applied loads Composites are materials that include strong load carrying material known as reinforcement. . Reinforcement provides strength, stiffness and helping to support the load.

Fly ash, residue from coal based thermal power plants, and comprise of fine particles that rise with the chimney gases. The quantity of fly ash collect from furnace lying on a single plant can differ from a lesser amount of than one ton per day to several tons per minute. Normal we divided fly ash into 2 different categories; depend on their basis and their chemical and mineralogical work. Ignition of anthracite or bituminous coal commonly produce low-calcium fly ashes; high-calcium fly ashes product from flaming lignite or sub-bituminous coal. Both types have a preponderance of amorphous glass.[1]

Fly ash is a general term given for both bottom ash and pond ash. However, these ashes generally coming from coal plants and depending on storage, size these ashes. Fly slag is typically catch by electrostatic precipitators or other molecule filtration supplies before the vent gas achieve the stacks of coal-let go force plants, and working together with bottom cinder expelled from the lowest part of the heater is for this situation mutually known as coal powder. Contingent on the source and cosmetics of the coal being smoldered, the segments of fly slag shift impressively, yet all fly powder incorporates considerable measures of silicon dioxide(sio2) (both indistinct and crystalline) and calcium oxide (Cao), both being endemic elements in numerous coal-bearing rock strata [1].

Pulverization of solid fuels for the large boilers used in power stations generates an instant, urgent quandary safe dumping of fly ash, a waste conclusion of thermal power plants, is a challenge that the engineers and environmentalist are facing in the modern era of urbanization.

One safe method of disposing this waste by-product is to utilize them in the civil engineering construction activity. The reinforced earth is a recipe of tensile reinforcements and a frictional back fill soil. The methods used to design reinforced slopes are based mainly on the limit equilibrium concept. Methodssuch as Jewell (1980; 1991), Reugger (1986), Schmertmann et al. (1987), Leshchinsky and Boedcker (1989), and Michalowski (1997) all use limit equilibrium investigation or limit analysis in design of reinforce slopes. These studies used different methods in their analyses: the method of slices, two-part wedge and internal stability, deviation limit equilibrium, and kinematics limit analysis, respectively

Generally a well graded sand or gravel sand is used as a backfill material as they offer adequate friction and provide good drainage. With the usage of fly ash in the backfill not only the method of construction becomes more economical, the disposal problem of fly ash is also taken care to some extent. The research work carried out on the utility of fly ash when subjected to monotonic or static loading have established clearly the effectiveness of fly ash as backfill material. However the studies on the performance of this backfill material when subjected to repeated loads is limited.

Several investigators have studied stress-strain and strength characteristics of reinforced soil using tri axial, direct shear, and plane strain tests. Some of these investigations are given here to provide a reference to existing experimental data on the behavior of reinforced soils. Broms (1977) researched the mechanical behavior of geo textile reinforced sand with monotonous grain size using a number of tri axial tests. Holtz et al. (1982) conducted a number of long-term and short-term tri axial tests on dry sand reinforced by woven and nonwoven geo textiles. They also observed the influence of reinforcement on the creep of reinforced samples. Nakai (1992) investigated the stress-strain behavior of reinforced sand using tri axial tests and finite element analysis, a comprehensive set of laboratory unconfined compression tests was carried out on fly ash with and without reinforcement. The stress strain behavior was analyze by changing geo grid numbers with different locations. The influences of the number of geogrid layers on sample were studied and concluded that the hyperbolic equation (Kondner, 1963) can be used to represent the stress–strain relationship of both unreinforced and reinforced fly ash [10,15,16].

Mcgown et al. It reasoned that there are vital uniqueness among the conduct of rather low firmness geo material and high solidness aluminum. The previous has been described as a perfect extensible material. This sort of support brought about some fortifying however all the more widely cause unrivaled extensibility and littler misfortune of post-crest life when contrasted with the dirt alone or to the sand strengthened with high firmness metal. Ash and Al-Refeai (1986) led triaxial immovability tests on dry fortified sand utilizing various sorts of geo material. Test results exhibited that fortification expanded crest quality, hub strain at disappointment, and, as a rule, concentrated post-top misfortune of quality. At low strain (1%), support brought about a misfortune of compressive solidness. Disappointment envelope of the strengthened sand demonstrated an acceptable break concerning the restricting weight. After the purpose of break, disappointment envelope for the strengthened sand paralleled the unreinforced sand envelope. Athanasopoulos (1993) reported the choose of molecule size on the mechanical conduct of geo material fortified sand in immediate shear tests. The results delineated that militancy conduct of the strengthened sand by the opening degree (characterized as the proportion of the geo material gap size to the normal sand molecule size). It was observed that for "ne sand (high estimations of the gap degree), the fortification expanded volume development contrasted with unreinforced sand while the inverse conduct was fluctuated for coarser sand (low estimations of the gap proportion). Krishnaswamy and Isaac (1995) exhibited the aftereffects of the cyclic tri hub tests on little size (38 mm) and on expansive distance across specimens (100 mm) to assess the liquefaction capability of sand fortified with woven and non-woven [8].

Geo textiles.

It was shows that fortified earth execution might be guaranteeing elucidation for lessening the liquefaction approaching of sand. Moreover, comes about uncovered that the size attain is insignificant; all things considered, bigger examples, a higher battle to liquefaction was logical. Hence, it is proposed to depend on the evaluations acquired littler measurement specimens survey the liquefaction capability of strengthened sand. To study the impact of geotextile fortification on the anxiety strain volumetric conduct of sand acted to both monotonic and cyclic burden, Ashmawy and Bourdeau (1998) perform smashed tri pivotal tests on immersed sand example toughened both woven and non-woven geo materials. The qualities assign that the event of fortification brought about a noteworthy open up in monotonic shear quality and pliability of sand and a decrease in cyclic deformability. Besides, under both monotonic and cyclic stacking, a diminishment in potential for volume Change is presented by the geo material support.

The strengthened earth is a development technique which is picking up all the more prominently among the common designers as a result of its intrinsic qualities of effortlessness, outline trust and the simple system for development. The strengthened earth is a consolidation of elastic fortifications.

Steepened slopes befall gradually more invaluable because of the desire to expand area taking care of and lessening site improvement costs. The confirm model of pliable fortification permits development of inclines with far steeper face points than are for every mitted by the dirts characteristic edge of lean back. Steepened inclines fortified GI fortifications can build land utilization significantly while giving a regular appearance [8].

The solidness of a fortified fly ash incline could be undermined by disintegration because of surface water spillover, or more extreme powers connected with water flows and wave assault. Slant face disintegration may make rills and gorges, and bring about surface sloughing and perhaps profound situated disappointment (Berg.1993). Disintegration control and re-vegetation measures must, thusly, be a necessary a piece of all fortified soil slant framework outlines. The sort of disintegration control confronting alternative chose relies on upon the completed incline face point. [8].

- **Economics**: fundamentally brings down site improvement requires by on condition that dirt hold results without the expenses of holding divider facial supplies

- **Usability**: radically builds the measure of usable land inside a given bundle without the expense of a conventional holding divider

- **Aesthetics**: allows incorporation of 'green' surface

- **Efficiency**: speeds development and construction of site

- **Reliability**: proven design methodologies lead to successful implementation of steepened slopes

Applications of a Reinforced Steepened Slope System:

slopes are regularly geographic peculiarities arranged bordering to interstates and along the outskirts of building destinations in numerous ranges of the nation. These ranges must be unearthing out of the current territory, regularly leaving huge evaluation changes at the edges of the exhuming. The budgetary plausibility of develop a specific expressway coalition or the improvement of a bundle of area may be immovable by the capability to make sufficient level, or level, area to fulfill space wellbeing, or access necessities. Strengthened steepened slants give a practical intends to accomplish more effective evaluation changes than is conceivable with unreinforced inclines.[14]

1.1 OBJECTIVE

Construction of steep slopes reduces the usage area, though fly ash alone accomplishes it, for better results fly ash is combined with reinforcement. Economic way of conductions is possible by the inclusion of reinforcement since it reduces the thickness. The stress-strain curve of fly ash by varying the location and number of reinforcement can be used to represent the stress–strain relationship of both unreinforced and reinforced fly ash. A series of laboratory unconfined compression test has been carried out to prove the effectiveness of reinforcement in fly ash layer.

This paper having the following objectives:

- To find the effective reinforcement position (which increases the peak stress and strain)
- To study the effect of density on reinforced fly ash sample

1.2 SCOPE OF PRESENT WORK

The idea of utilization of fly ash as a construction material helps in two ways:

1. Utilization of fly ash for various purposes like in the embankment, tailing dam and other purposes so that more space or that more space or the upcoming waste can be treated and thus the storage problem can be reduced and the detrimental can be reduced.
2. The utilization of fly ash along with reinforcement supplements with upcoming some of the required properties in the construction material.

CHAPTER 2

LITERATURE REVIEW

2 LITERATURE REVIEW

This section provide the background information on the issues Consider in the present research effort and to focus the significance of the current study, the work already done so far and also to show the relevance of the current research work.

Fly ash has been using an element for use of in concrete 1915. Though, for the first time the use of fly ash in the concrete conduct by Davis et al. (1937). Abdun Nur (1961) compile information under the property and uses of fly ash from the literature from 1934 to 1959 including an annotated bibliography. Several other extensive review papers on the use of fly ash in concrete published over the years (Synder 1962. Joshi 1979, Berry and Malhotra 1985 and 1987, Swamy 1986) [2].

Before 1980 maximum research on literature for the fly ash in concrete maximum coming from power, chosen as Class F pozzolans in ASTM condition. Before 1960 only class F fly ash is there and then we found the applications of this fly ash next uses and disadvantages of class F fly ash found. Joint tests were conducted by ASTM group C-9 (1962) and study on the main exclusivity of Class F fly ashes was account by Minnick (1959) from side to side this period.[2]

2 .1 COLLECTION OF FLY ASH:

In the power plants burning of coal in maximum of carbon burned.th the burning of pulverized coal in suspension-fired furnaces of modern thermal power plants, the unstable matter carbon burned off. In these carbon ash minerals like clay, quartz, feldspar formed in different temperature. The slog particles and unburned carbon are collected as ash. The particles which have big size particles fall down in bottom, we can collect those type particles by bottom furnace The finer particle that get away with chimney gas are composed as fly ash using cyclone separators, electrostatic precipitators or bag houses[3].

Max of 86- 99% ash collected from the various furnaces from the fuel gases are fly ash only. in total coal ash up to 80% fly ash only remaining bottom. Generally Fly ash is pozzolanic or sometimes self cemantinous due to mineralogical concerto. The ash collected from bottom of the furnace is maximum pozzolanic nature. The ash released in the power plants not only fly ash it also contains different minerals and all the power plants not produce equal amount of pozzalanic so we have to take care while using in the concrete while mixing[3].

The Fly ash generated in power plants contains different minerals because of several reasons. Like type and mineralogical work of art of the coal, amount of coal pulverization, type of furnace and oxidation conditions including air-to-fuel ratio, and it is depended on how we collected and how we stored, how we handled before usage. The properties of fly ash properties also change in same plant due to different loads, within 24 hours. This type of fly ash causes many problems in concrete because properties are different [5].

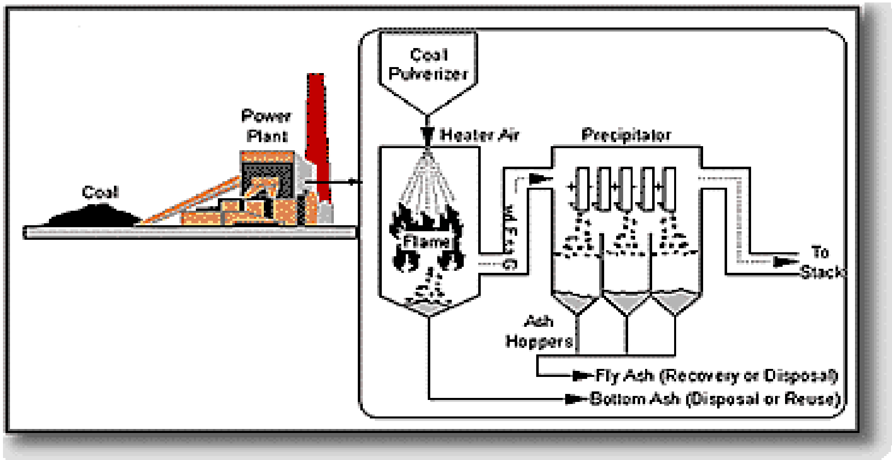


Figure 1: Generation of ash at the power plants

2.2 TRANSPORTATION

Fly ash can be transported and supplied like below

- **Dry state**: This method maximum usage for transport of fly ash. We can handle and transported like cement This is currently the most commonly used method of supplying fly ash. Dry fly ash is handled in a similar manner to Portland cement.
- **Conditioned**: For this we have to add water to fly ash for the compaction and handling. The amount water is added also take care. This type of fly ash generally used in aerated concrete.
- **Stockpiled***:* This is one of the type of fly ash it is stored and used for next dates. The water contained nearly 12%.
- **Lagoon***:* in power plants flyash stored in lagoons. And they are drain fly ash fly ash filled up to some limit like safe level. In general Because of the nature of the removal procedure the water content differ 20% [4].

2.3 CHARACTERIZATION

2.3.1 Classification

According to the ASTM C618-93 fly ash divided into 3 categories. These are named as class C, class F and class N. if u burn bituminous coal class C fly ash will produce. If u burn sub-bituminous coal class F fly ash will produce. In class N volcanic ashes generally fall down [5].

2.3.2 Definitions and specifications

.

- *Class N*: Raw or calcined natural pozzolanic such as some diatomaceous earths, opaline, chart and shale, stuffs, volcanic ashes and pumice are included in this category.

Class F: Fly ash normally produced from burning anthracite or bituminous coal falls in this category. This class of fly ash exhibits pozzolanic property but rarely, self hardening propriety.

- *Class C*: Fly ash normally produced from lignite or sub-bituminous coal is the only material included in this category.[5].

Table 1: physical and chemical properties fly ash[5]

Requirements	Mineral admixture class		
	N	**F**	**C**
S03 + Al203 + Fe203,min%	70.0	70.0	50.0
SO3, max%	4.0	5.0	5.0
Moisture content, max%	30	3.0	3.0
Amount retained when wet sieved on 45 µm sieve,	34	34	34
Pozzolanic activity index, with lime at 7days,min(MPa)	5.5	5.5	-
Water requirement, max% of control	115	105	105
Autooc1ave expansion or contraction, max %	0.8	0.8	0.8
Specific gravity, max variation from average %	5	5	5
Percent retained on 45 µm sieve ,max variation percentage points from average	5	5	5

Table1 presents chemical and physical requirements for fly ash and natural pozzolanic for use as a mineral admixture in Portland cement concrete. The table also includes a list of procedures and materials used for assessing the quality of fly ash/natural pozzolanic to meet the requirements of ASTM C618 [5].

2.4 UTILIZATION OF FLY ASH:

This formed from bituminous and sub bituminous coals can be used in several civil engineering applications. One common application is an admixture to Portland cement to increase workability, strength, and reduce heat of hydration of concrete. Fly ash is able to be used in mixture with lime, or by itself for soil stabilization of road base and sub bases to increase the bearing capacity of soil. Fly ash is also combined with water, Portland cement, and sand to manufacture flow able fills that flow like liquid and set up like a solid. Other fly ash applications that have been reported include use in grouts, fast track concrete pavements, and as structural fills and backfills.

Portland cement and sand to produce flow able fills that flow like liquid and set up Like a solid. Other fly ash applications that have been reported include use in grouts, fast track Concrete pavements as structural fills and backfills.

2.4.1 Fly Ash in Portland cement Concrete

Fly ash can be used like admixture to improve the properties of concrete. In cement up to 60 percentages it contains lime. If hydration process going on less amount of lime will be free. When fly ash is present with free lime, it will react property of concrete will increase [7].

Benefits to Fresh Concrete:

if u decrease the water percentage in concrete then the properties of concrete will increase because of concrete will flow like paste.

The consequential uses are as below:

- **Improved workability***:* if u add fly ash in concrete it will serve as lubricant effect to concrete because of the spherical shaped particles of fly ash .due this shape the pumping of concrete and also decrease the friction losses.
- **Decreased water demand***:* due to the fly ash adding to concrete. Then we can add less amount of water for given slump. If uses fly ash up to 20% volume of the cement then u can reduce almost 10% water.

- **Reduced heat of hydration***:* heat of hydration is serious problem in concrete mainly in terms of durability and strength. Mainly it causes problems in mass concrete placements. This problem u can overcome by replacing cement with fly ash.
- **Benefits to Hardened Concrete:** the main advantage of fly ash if u adds with concrete it is also act as a cementations material.
- **Increased ultimate strength***:* The extra cover processed by the fly fiery debris response with accessible lime permits fly powder solid to keep on gaining quality about whether. Mixtures intended to transform proportional quality at right on time ages (short of what 90 days) will at last surpass the quality of straight bond solid blends.
- **Reduced permeability***:* The reduction in water substance joined together with the creation of extra cementations mixes diminishes the pore interconnectivity of cement, in this way diminishing penetrability. The lessened penetrability brings about enhanced long haul toughness and imperviousness to different types of decay.
- **Improved durability***:* The reduction in free lime and the ensuing expand in cementations mixes, joined with the lessening in porousness improve cement durability.[7]

2.4.2 Fly Ash Properties affecting use in PPC [7]

- **Fineness***:* The fineness of fly fiery remains is essential in light of the fact that it influences the rate of pozzolanic movement and the workability of the cement.
- **Specific gravity***:* although particular gravity does not specifically influence solid quality, it has esteem in recognizing changes in other fly fiery debris attributes.
- **Chemical composition***:* The touchy alumina silicate and calcium alumina silicate segments of fly ash debris are routinely spoken to in their oxide terminologies, for example, silicon dioxide, aluminum oxide and calcium oxide.

2.4.3 Fly Ash in Stabilized Base Course

For the better stabilized base course we have mix Fly ash and lime and aggregates. Above roads referred as pozzolanic roads (PSMs). We have added 14% fly ash with respect to lime. If u use lime in Portland cement the early strength of cement will increase. Material obtained from from above procedure better for placing and looks like as aggregate like stabilized cement.

Benefits

- Pozzolanic stabilized mixture advantages:
- we can use here the materials available in local places
- it will give tough, durable mix
- We can get these very less cost
- Autogenously curative
- psmc increased competence
- In this method we can use used base materials.

Specification Requirements

- **Strength:** Time and temperature are the two factories effect the strength. For the better strength we have to control the curing condition.
- **Durability:** If u gets enough strength and resistance before colder month the durability will be higher.

2.4.4 Fly Ash in Flow able Fill

If u adds fly ash and water and cement and cement must be flowing condition that means if u apply load or pressure on cement it should not be compact. If u uses maximum density then only u will get above condition. Besides that profit, a correctly intended flow able pack will be excavating soon. In addition to fly ash in some mixes we will add the bottom ash and fine sand or other filler materials. It is also named to inhibit less strength material, flow able mortar, or inhibited density load. It was planned to task in the place of predictable backfill materials such soil, gravel, sand, fly ash and to improve effort as well as limitations causally allied among the materials.[7]

Benefits:

- u can place any weather condition it may be very freezing condition or hot temperature
- Without compaction we can get 100% density.
- u can fill anywhere in the structure like around Fills and under the structure.
- Due to this we can increase the bearing capacity of soil
- We can overcome the post settlement problems.
- if u these fill speed of backfilling will increase.
- we can reduce the difference of density of backfill
- Due this safety will increase and reduce cost of labour.

2.4.5 Fly Ash in Structural Fills/Embankments

Fly ash remains may be uses like scavenge matter to develop fills and dikes. At the point when fly slag is compacted in lifts, a structural fill is built that is fit for supporting thruway structures or different structures. Fly slag has been utilized within the development of structural fills/banks that run from little fills for street shoulders to extensive fills for interstate parkway embankments.[7]

Benefits:

When used in structural fills and embankments, fly ash offers several advantages over soil and rock:

- if use largeness quantities cost will be less
- Eliminate require to buy, allow, work a use ditch
- it is very useful in soils which have low bearing strength

2.4.6 Fly Ash in Soil Improvement

For chemical and mechanical stabilization soils fly ash and successful agent. Density and moisture content, plasticity will important for soils . applications

Contain: stabilization of soil, drying of soil

Uses: fly ash gives below benefits for improving properties of soil

- it will remove borrow materials which are costly
- expedite building by recovering very wet or uneven sub grade
- It is very economical like improve the sub grade conditions [7].

2.4.7 Soil Stabilization to Improve Soil Strength

In many soils fly ash is using for improving the strength of the soils and improve the properties. Fly ash may be use to steady bases and sub grades, we can stabilize the back fill due to the the lateral earth pressure will decrease due to this process stability of soil will increase. Generally depth of fill is 14 to 45 centimetres. The reason behind use of fly ash in the soils for the stabilization application because due to fly ash compressive and shearing properties [6]

The compressive strength of fly ash treat soils is dependent relative on:

- Soil properties
- hold-up time
- water content
- amount of fly ash

2.4.8 Developments in Fly Ash Utilization

Due to AASHTO and ASTM specifications due many important techniques are developed of fly ash used in the concrete.

As the fly ash consumption commerce have established, excellence control, excellence assurance, better produce show have more and more turn into significant. Technique has been commercialized to get better and promise fly ash excellence intended for straight concrete application [6].

2.4.9 Other Developments*:*

Ultra fine fly ash: contrast with trademark fly ash, by a connote molecule dia shift starting 25-35 micrometers, fine fly ash will be shaped by a mean molecule width of 2-6 microns. The smaller molecule size assets that pozzolanic response, which is ordinarily a moderate procedure, is quicken. Extra better particles may more completely react than the coarser particles of fly ash. If the use late age fly ash the sturdiness and quality profits will expand [6].

High volume fly ash concrete (HVFAC*).*

By and large if the rate of fly ash more than 30 in cementations materials then it will called like high volume fly ash solid(HVFAC). High volume fly ash solid(HVFAC) lesser expense and more strong than ordinary solid and it will offer imperviousness to sulfate strike. Numerous flourishing field requisition has been done. Satisfactory early qualities and set times are gotten by with high extend dampness reduction to accomplish a low concrete degree. Admissible bond substitution rates are confined by state transportation division stipulation [4].

2.5* PHYSICAL, ENGINEERING, AND CHEMICAL PROPERTIES OF THE ASH*:

The properties like grain size, water-density relation, shear strength, compressibility and permeability above mention physical and engineering properties are very useful determine the behaviour of the embankment.

The tests are used for the soil in the lab we can also use for the fly ash. Due to the chemical properties of fly ash physical properties also change and class of the leach ate formed beside the fly ash. The physical and chemical and engineering properties of fly ash will be different in different power plants. Leach ate characterise of fly ash also will change according to the power plants [3].

2.6 ENVIRONMENTAL IMPACTS*:*

One of the similarity u can observe between fly ash and soils. The concentrations of trace element are same. Though leach ate of some fly ashes might have trace element

Concentrations go beyond consumption water excellence standards; this also applies in soils. Generally the water quality standards guide the State environmental authoritarian. The quantity of leach ate formed will be inhibited next to assure sufficient compaction, grade to help outside runoff, daily evidence-rising and falling of the over sub grade to hinder penetration. Infiltration will reduce if construction is over, because right soil bay will decrease the infiltration [3].

2.7 FLY ASH REUSE:

Fly ash used in concrete and it also used as a alternate material for cement and sand

- It is used in Embankments , structural fills
- It is also used like grout and fill.
- It can be used for stabilization of waste.
- Fly ash used as a alternate material for clay
- Mine reclamation
- Used for the soft soils in stabilization
- It also used Roads for the sub grade.
- Used as alternative material for aggregates
- Used in fill in concrete.
- It is alo used in agricultural .like fertilizer
- movable uses on rivers
- It is also used for ice control in roads.

It is also used in tooth paste, kitchens ,floor tiles , bowling, frames auto bodies and boat hulls, cellular concrete, geopolymers, roofing tiles, roofing granule, deck, fireside mantle, cinder slab, doors, window frames. And also use for house hold materials ,benches, chairs, toys. It is also used like paintings and under coatings. It is used like filler wood , plastic things. [1]

2.8 REINFORCED SOIL SLOPES

If used Steepened slopes u can increase the land use minimize the land develop cost. So it is desire now using steep slope. if use tensile reinforcement in the steepened slopes the strength of slope will increase . Steepened slopes reinforced with geo textile materials will increase land usage considerably even as long as a natural appearance.

The main advantage of the reinforced fly ash slope decreases the erosion of soil slope due to water run-off and waves assault. Slope face erosion might generate rills and gully, and consequence in exterior sloughing failure (Berg.1994). Erosion manages and re-vegetation procedures have to, consequently essential division of all reinforced soil slope system design. The sort of erosion manage facing alternative chosen depends resting on the completed slope face angle [11].

2.8.1 Applications

- Highway embankments
- dike and Levees
- Landslide fix
- Residential development
- Office works
- Landfills

2.9 REINFORCED STEEPENED SLOPE SYSTEM ON A FIRM FOUNDATION

Applications of a Reinforced Steepened Slope System

Slopes are generally positioned beside of the highway and it is also serving as margin for the buildings in maximum areas of country. Generally the flat areas wish for the construction of buildings, highways. Those areas should be dig out of the available land, frequently departure major grade change at the limits of the excavation. The financial possibility of construct a exacting highway alignment the improvement of a pack of land might be resolute through the faculty to produce sufficient flat, , or access requirements. Reinforced steepened slopes provide commercial earnings to attain more capable grade change than is likely with unreinforced slopes [12].

Figure 2 illustrates some of the applications of reinforced steepened slopes.

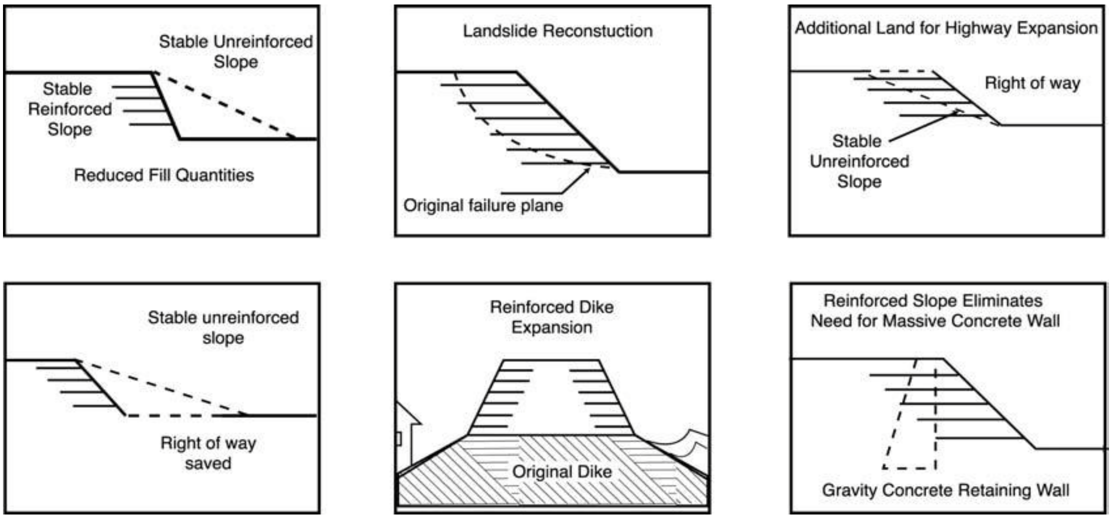


Figure 2 applications of reinforced slopes

2.9.1 Overview:

Generally the Geo textile reinforced steepened slopes are constructed with slope angle more than 65^0 in general the unreinforced fly ash slopes are limed up to 20-25 degrees degrees or less, depending on the slope soil. So if provide reinforcement to slopes we can minimize the land use because the slope resistance angle will increase and it also provides protection for surface for the erosion.

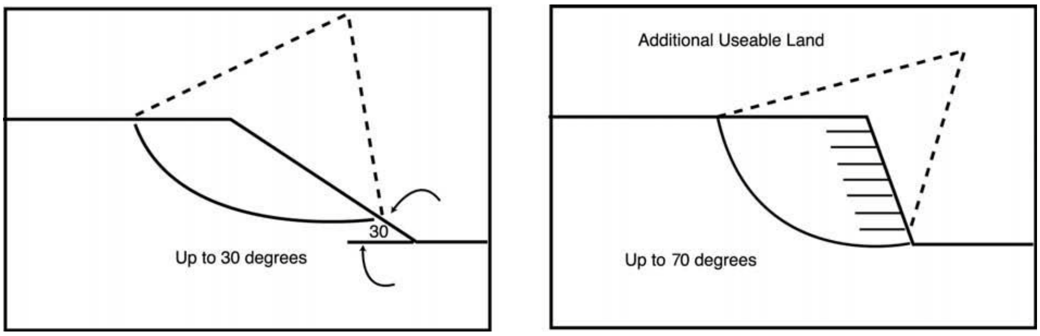


Figure 3: Reinforced and unreinforced soil slopes

Both usual soil slopes and reinforced slopes were constructed by compact fly ash in different layer while uneven the face of the slope rear to produce the beloved angle. Consequently the face was confined from attrition by vegetation. Further geo textile elements might be included addicted to reinforced steepened slopes to decrease ground water leakage and growth the constancy steepened slope resistance of the facing. The subsequent are the typical apparatus a geo textile reinforced steepened slope system [14].

- Foundation – this is base of the slope construction. it may be stable soil or rock .

• Retained Soil – the soil is placed ahead of limits of digging.

• Subsurface Drainage – geo textile drainage medium installed in limits of the reinforced fly ash zone to control, collect, and route ground water discharge.

• Reinforced Soil - the soil which is reinforced with geo textile materials due to minimization of the land use.

• Primary Reinforcement- it may be geo grid or geo textile it will give strength to soil from erosion .

• Secondary Reinforcement: it uses locally to stabilize the slope face after the construction of slope.

• Surface Protection - The erosion resistant layer of the finished slope surface.

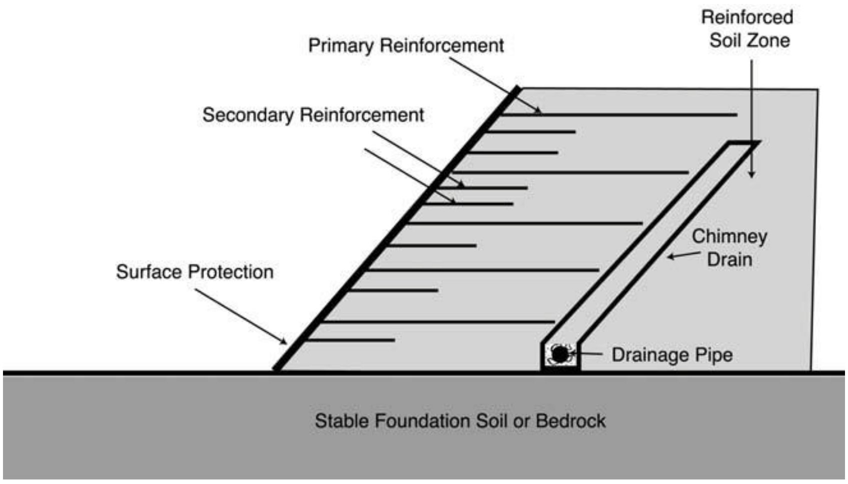


Figure 4: stable foundation with reinforcement

2.10 STABILITY ANALYSIS FOR STEEPENED SLOPES AND EMBANKMENTS OVER STABLE FOUNDATIONS

2.10.1 Two-part Wedge Analysis

This method adopted soil slope or embankment over a fixed foundation. It shows below figure. A trial failure apparatus was define through potential linear breakdown surfaces that were implicit to spread from a point on the slope (A) to breakpoint (B) and then exit at the slope surface at point (C) located at or beyond the slope crest. Generally the break down zone formed between two soil masses. It is also called potential failure zone. If a support layer intersects a possible breakdown face then it was provide a horizontal warning force that was included in the total calculation of horizontal strength equilibrium [13].

The two –part wedge generally provide less factory of safety for the slope failure. For the It was clear that the only practical method of identifying the critical failure mechanism is to use a computer program. Computer programs RSS, available from Federal Highway Administration by ADAMA (FHWA NH1-00-043) engineering should live use to take out two as well as three part wedge study for slopes with unstable geometrics, soil properties, and groundwater elevations [13].

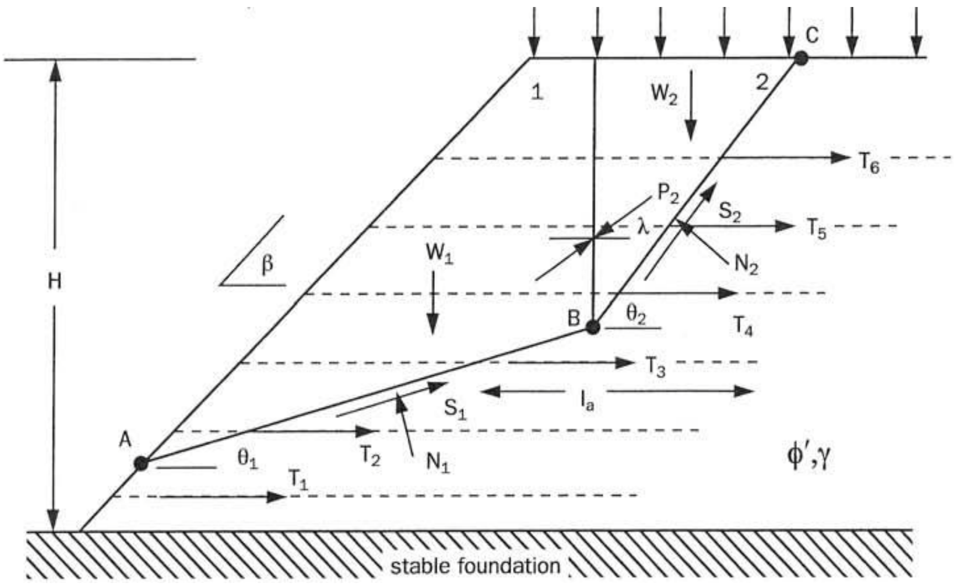


Figure 5: Two part wedge failure mechanism

2.10.2 Stability Calculations

From Figure 5 we may get calculations for stability for the two part wedge failure mechanism.

From above picture we can get procedure. In above figure one failure wedge taken for the calculation purpose we took a section in failure wedge and that section limited up to the slope of reinforced section part by uniform and cohesion less soils. If u considers the ground water condition it must be below the toe altitude [13].

If u observe the above failure wedge total three forces acting on it. The forces acting on that slope includes self weight of trail wedges W1 and W2 and uniform distributed load q. for the resistance of the wedge the resisting forces must be there for the driving loads or forces. Here the total two type of resisting forces acting one shear forces formed along top and bottom of the wedge and the second resisting force horizontal forces here S1, S2 are the two horizontal forces acting both top and bottom of failure zones. The resisting shear force along the zones AB and BC are Coulomb type with $S_1 = N_1 \times \tan\varphi'_f$ and $S_2 = N_2 \times \tan\varphi'_f$. The friction angle of soil use in this calculation (φ'_f) computed according to Equation [13].

In the figure 5 the amount P_2 was the unbalanced force. The P_2 force will be used to keep the wedge in equilibrium state. Generally, the direction of the inter slice friction angle should be $0 < \lambda < \varphi'_f$. A conventional guess is $\lambda = 0$. This assumption used for the safety design [13].

The minimum value that will be useful to the higher soil friction is The factor-of-safety (FS) against failure of a trial two-part wedge coefficient so that the horizontal resistance force equal to the horizontal destabilize force P. The sum of tensile forces was found as of the tensile capabilities of the reinforcement layers they were intersect through the trial failure wedge [13].

2.10.3 Factor-of-Safety

For the reinforced slopes we have provide minimum factory of safety. In general from the experiments we found minimum factor of safety is 1.5. But sometimes the factor of safety changes for the different sites. So for the factor of safety calculation we have take recommendation from the geo technical engineer who is well known about that site and loading conditions, method construction [12].

2.10.4 Circular Slip Analysis:

For the design and analysis of the slopes we have take care about that circular slip method. But it is applied only stable foundation. Thorough they lied on normal soils foundation but we have take are while design and computing purpose the slopes are seated over stable foundation i.e. rocks or incompressible soils. From this analysis we can found possible failure surface are found and it is restricted by the foundation which are stable.

In Bishop's simplified method the circular slip analysis method was described and analogized here how to find factory of safety described against slope failure. The procedure of factor of safety is it is ratio between resisting forces to causing moments and these are found using two part wedge method of slices. The force which are causing for the slice driven is due to the weight of the soil and surface loadings. If the resisting moments increase if soil shear resistance will increase are proportional to the mobilized soil shearing resistance developed along the failure surface. This method is very easy to use for the analysis because we can easily modified the values to include the resisting moment suitable to any reinforcement layer that intersect a failure surface. The Bishops method describe in this section follows the recommendation have in the FHWA guidelines for reinforced slopes [13].

In the examples to follow the soils are assumed to be granular materials and stability calculations are based on an effective stress analysis. The analysis are therefore appropriate for drained soils.

Unreinforced Slope:

The factor-of-safety FS_u for an unr0einforced slope is expressed as:

Factor-of-safety= resisting moment / driving moment

2.11 INSTALLATION GUIDELINES FOR GEOSYNTHETIC REINFORCED

STEEPENED SLOPES

This file is ready to help make sure that the geo synthetic reinforced fly ash slope, one time installed, shall achieve its proposed design function. For the first we have to find geo synthetic and it should be handle, store, installed correctly. The geo synthetic physical properties will not effect for the design in steeped slope condition. This file gives idea how to handle and storage the geo synthetic and identification and it gives guidelines for the geo synthetic materials [17].

Figure 6: Geo grid application in china

2.11.1 Material Identification, Storage and Handling:

The geo synthetic will be roll on core have potency enough to evade fall down or other damages as of normal utilize. Every roll will be wrapping by a plastic casing to give protection to the geo synthetic from damage while transportation and handling, we have to attach the durable label which clearly mention its properties we have attach this label outside of the roll. The label must have the name of the manufacture and its style number and its weight and its dimensions. Roll categorization identical to the designed place of the roll as exposed on the structure drawing and it must be approved by the engineer.

We have protect against damage of geo textile materials while transporting the geo textile materials we have take care damage due to wrapping and label and material itself. We have take care of the geo textile while storing many days in the same place for this we have take care of the material and label. we also protect against sun light and acids and temperatures and animal and human destruction [9].

2.11.2 Foundation Soil/Sub grade Preparation

First we have to prepare surface before geo textile place so we can decrease the damage to geo textile while placing on the surface. Before the placing the geo textile we have remove the soil like sub grade soil with reference of construction drawing. If the some areas are over excavated we have to place the soil again by the recommendations given by the engineer. Before the instillation of the geo textile we have to remove the pebbles and unwanted materials on the ground should be removing. The permissible case for soils should not more than 15 cm in depth. Before the placement geo textile the soils must be smooth roiled. The above procedure we have to follow before the instillation of the every layer of geo textile.

The sub grade soils will be compacted up to 95% of dry density will achieve. For the optimum case it may vary plus or minus 2 % by the procedure given in the ASTM D698. It also gives suggestion for the cohesive soils may compact up to 14 to 19 cm. And for the granular soils it may vary 24ccm to 31cm. [9].

2.12 GEO SYNTHETIC INSTALLATION:

We have to take care of the geo textile material length and dimensions and direction with reference of the construction drawing. While installation of geo textile we have to see the damages occur in the materials. The damages which were occur transportation storage will be repaired by site itself.

Maximum numbers of rubber-tired vehicles will be driven in less speed like it may less than 10 mph and it is also driven in straight so it won’t cause any damage to geo textile materials. We have reduce sudden breakage and sudden turning of vehicle. We have to give minimum fill the soil up to 14cm for the tracking of vehicles in the geo textile materials [17].

2.12.1 Drainage

If the ground water penetrates in the reinforced soil or runoff water cause diffusion in soil cause reduce the strength of the soil. Due the stability slope also will decrease. So we have to provide drainage system in order to overcome the problems from the ground water and runoff water [17].

2.12.2 Protection of the Slope Face

If the reinforce slopes are 1 vertical to1 horizontal for this type slope we can cover the slope by vegetation will protect soil particles. If the slope face is more than 1:1 protection of soil particle somewhat difficult [17].

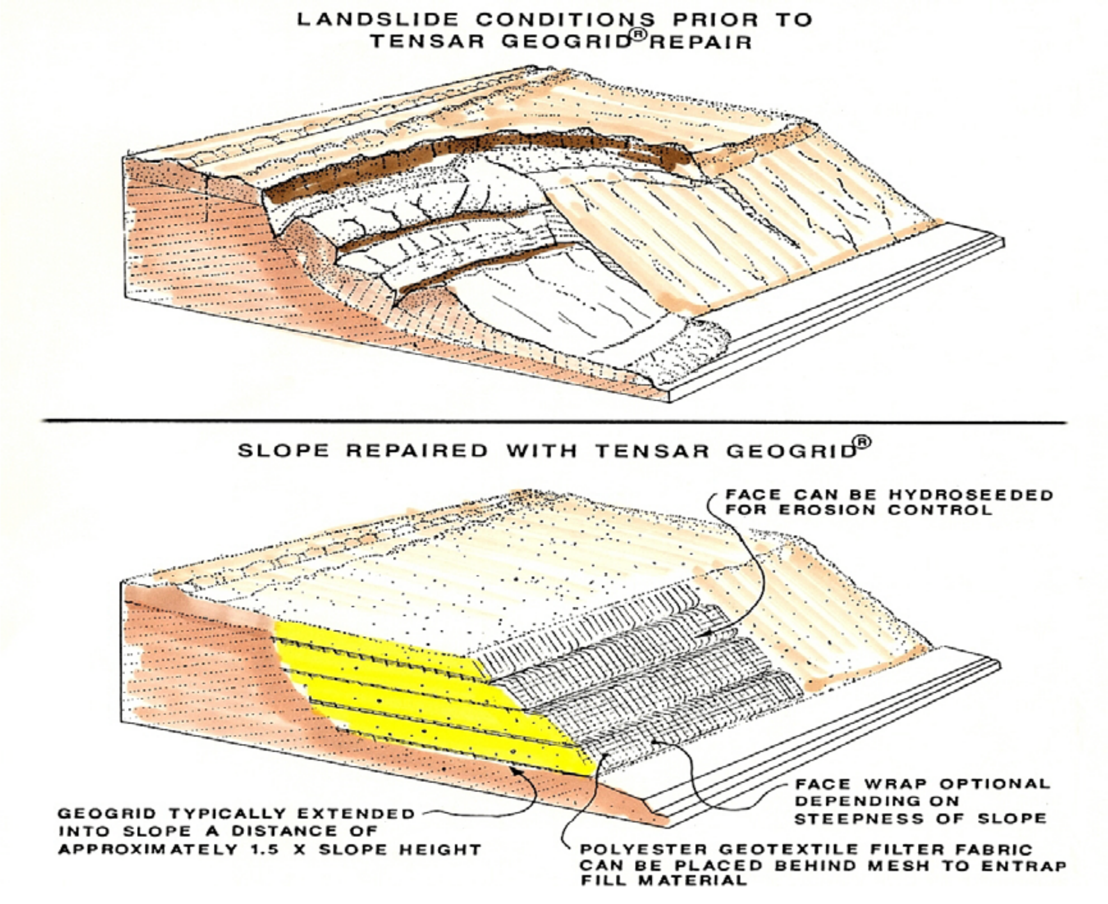
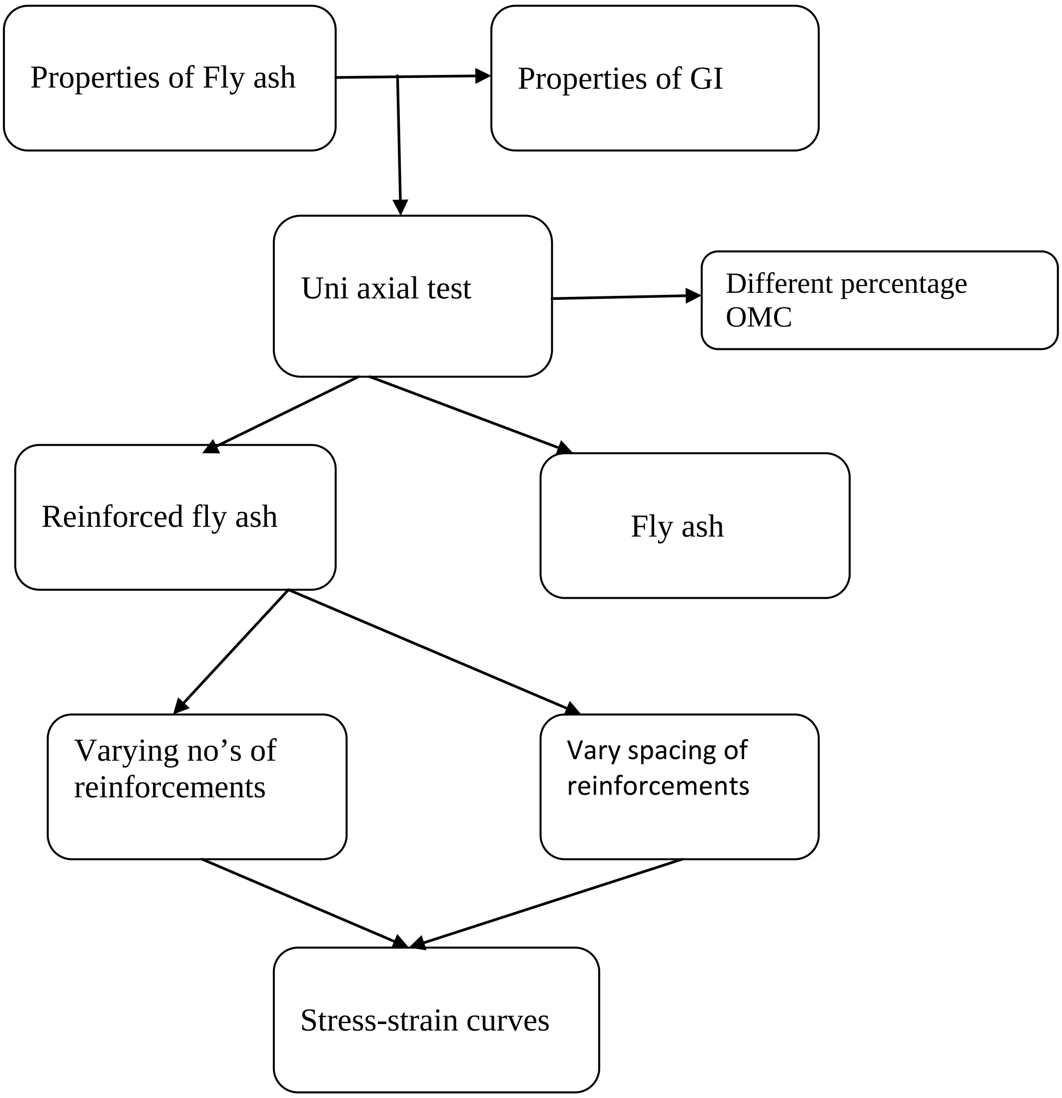


Figure 7: slope repaired with tenser geo grid

CHAPTER 3

METHODOLOGY

3. METHODOLOGY:



CHAPTER 4

GEOTECHENICAL PROPERITES

4.0 GEOTECHENICAL PROPERITES:

IS: 2720(part-III/sec-I) 1980.

4.1 DETERMINATION OF SPECIFIC GRAVITY:

Objective: find the specific gravity of fly ash

Use of this test:

We may know that about specific gravity and what there uses; where we used this test like find the fly ash properties void ratio, degree of saturation etc.

Apparatus Required

1. Glass bottle of 60 ml with hole.
2. Weighing machine
3. Cleaning bottle with good water.

Procedure

1. Remove the waste from bottle and wash with good water and dried it.

   It followed 3 steps below

(a) Clean the bottle with water and dry it

(b) Clean the bottle with alchol.

(c) Clean the bottle again with water and dry it.

2. Note down the weight of the empty glass bottle (w1)
3. After that take the 15 grams of fly ash and fly ash must be passing 4.75 mm and fill in the bottle. Measure the weight of the glass bottle which is filled with fly ash (w2).
4. Next take water nearly 25 ml and pour into glass bottle. It is sued for the soaking fly ash in glass bottle. Don’t disturb this sample up to 30 min .
5. Next fill the water in glass bottle completely .
6. Take the bottle outside and clean the outside edges and measure the weight (w3)

Observation & Calculation:

Specific gravity of flyash

$$= \frac{W_2 - W_1}{(W_2 - W_1) - (W_3 - W_4)}$$

Results:

Specific gravity of the sample =2.43

4.2 COMPACTION TEST

IS 2720(VII):1980.

4.2.1 Standard Proctor Test

To determine maximum dry density (M.D.D.) and optimum moisture content (O.M.C.) of Fly ash by the standard proctor method.

THEORY: -

This procedure find the most favorable quantity of water be diverse with a flyash Sequentially to acquire maximum compaction a given comp active effect. This will enable the field engineering to plan field compaction of the soil to a degree comparable to that obtain in the lab by properly varying the effective raise or amount of passes with the existing roller. Maximum energy lead to maximum dry density and hence the buckle and force distinctiveness of the fly ash turn out to be finest probable value.

The test named as standard proctor test because of R.R. Proctor (1933). This test gives satisfy result for the cohesive soils like fly ash but we can't get proper result if use for the cohesion less soils like gravels because we can't compact properly with hammer because the gravel displaces while compacting. if u want higher density u have to use max energy for compaction. For this modified proctor test is adopted:

1. for this test we have take mould in cylindrical shape metal mould, dimension mould 100cm diameter having and height 125 mm volume 1000 ml.
2. Detachable bottom platter.
3. Neck 5 cm in efficient height
4. Rammer 2500 grams in collection declining from a height of 305 mm.

For this test we have to compact the soil in in 3 different layers with same height of fall hammer 305mm, same hammer with weight 2500grms. We have compact each layer by 25 blows. Here for the finding the dry density for every test we have to calculate mass of compacted fly ash and water content. The comp active power worn meant for this test is 6066 kg 100 ml of fly ash. For this test we have take approximately 2.4 kg of fly ash which are passing 4.75mm sieve. Next take approximate amount of water and mix the fly ash with water properly. The amount of water to be added different from different soils. For fly ash we used 20% water initially. The vacant mould close with the bottom cover is weighted lacking lapel. The collar is then close the mould. The flyash with water mixture positioned in the cast and compacted by generous 25 blow the rammer

consistently circulated over the outside, such that the packed in height of the soil is about 1/3 the height of the mould. The same procedure followed for 2 and 3 rd layers also .after that remove collar and top layer extra soil is remove it upto level of mould.
The bulk density, dry density are found by below using relations.

$\rho = M/V$ g/cc

$\rho_d = \rho / (1+W)$ g/cc

Where, ρ = Bulk density of fly ash (g/cc)

ρ_d = Dry density of fly ash(g/cc)

M= mass of fly ash with water and mould (g)

W= water content ratio (%)

V= volume of the mould (1000 ml)

After this test we have to plot curve by taking water content on x axis, and dry density on y axis in order to find the maximum dry density and optimum moisture content .optimum moisture content can be found using maximum dry density . This density is called maximum dry density (MDD) and the corresponding moisture content is called optimum moisture content (OMC).

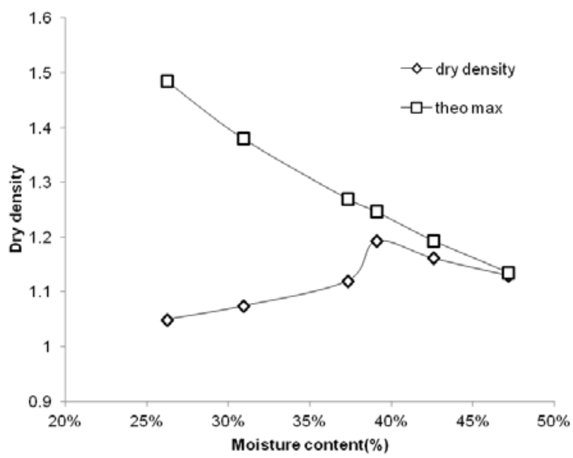


Figure8: Graph between dry density and moisture content using standard proctor test
Maximum Dry density:1.193(g/cc), OMC :39.06%

4.2.2 Modified proctor test

We have to plot curve by taking water content on x axis, and dry density on y axis in order to find the maximum dry density and optimum moisture content .optimum moisture content can be found using maximum dry density. This density is called maximum dry density (MDD) and the corresponding moisture content is called optimum moisture content (OMC).

Sl.No	density	water cont	dry density
1	1.336	16.96	1.1423
2	1.437	20.88	1.1887
3	1.554	25.37	1.239
4	1.72	27.45	1.284
5	1.656	33	1.245

Table 2 : modified proctor test results

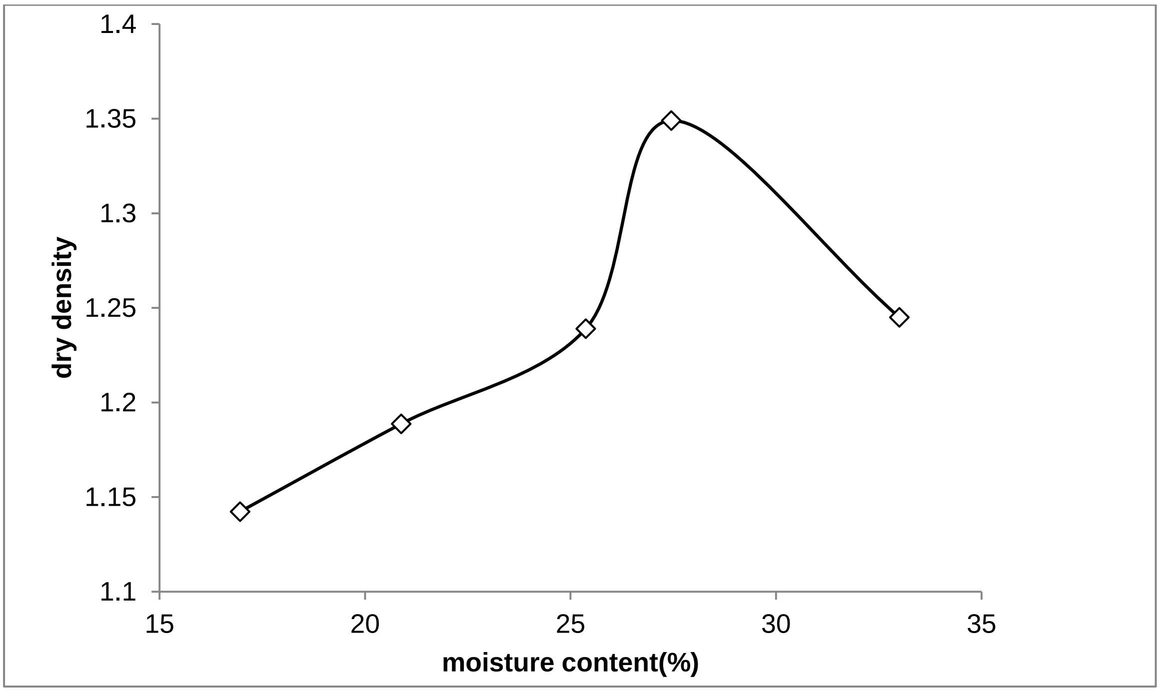


Figure 9: Graph between dry density and moisture content using modified proctor test

Maximum Dry density:1.349(g/cc), OMC :27.45%

4.3 DIRECT SHEAR TEST:

IS 2720(XIII):1986

Objective

To find out the shearing force of the sample, by direct shear apparatus.

Need and Scope of the Experiment

It is used many engineering applications like foundation dimensions, sheet pile walls, retaining walls, bridges for this type structures design internal friction ,cohesion necessary . using direct shear test we can easily find the these parameters.

Apparatus Required

1. Direct shear box apparatus
2. loading device
3. Dial gauge.
4. Proving ring.
5. Tamper.
6. Straight edge.
7. weighing machine .
8. Container

Knowledge of Equipment:

The shear box generally inhibited by strain it consist of loading device, soil mould, Proving ring, dial gauge to gauge shear buckle and volume changes. square shear box is one type of soil container used. A proving ring is used to point towards the sheer weight taken by the soil initiate in the shearing even.

Procedure

1. First find the dimensions of the soil container.
2. Fill the fly ash in the container .
3. Find the weight of the mould& volume of the mould.
4. Place the soil in smooth layers (approximately 10 mm thick). After that trim the remaining fly ash

General Remarks

In the shear box test, the sample is not worsening beside its weakest flat but along a encoded or induce failure plane i.e. horizontal level surface freeing the two halve of the shear box. This is the main draw back of this test. Moreover, through load, the state of stress cannot be evaluated. It can be evaluate only at failure condition i.e Mohr's circle can be drawn at the failure condition only. Also failure is progressive.

Direct shear test is straightforward and quicker to control. As thinner specimens are used in shear box, they facilitate drainage of pore water from a saturated sample in less time. This test is also useful to study friction between two materials – one material in lower half of box and another material in the upper half of box.

angle of shear resistance of fly ash mainly due to on type of compaction, size of the particles, shape of the particles, roughness and surface are of grain particles.

Observation and Calculation

We have noted the shear stress for the max normal stress i.e. for the max compaction of the fly ash in the shear box The values of shear stresses are noted down for a particular normal stress provided to the specimen compacted into the shear box. A graph is then plotted between the normal and the shear stresses involved in the procedure and from the graph the cohesive force and the friction angle of the fly ash is calculated. The representation of the relation between the shear stress, cohesive force, the normal stress and the angle of internal friction is given below.

$$S=C+\sigma\tan\phi$$

Where S = shear strength of the sample

C = cohesion of the sample

Φ= Angle of internal friction.

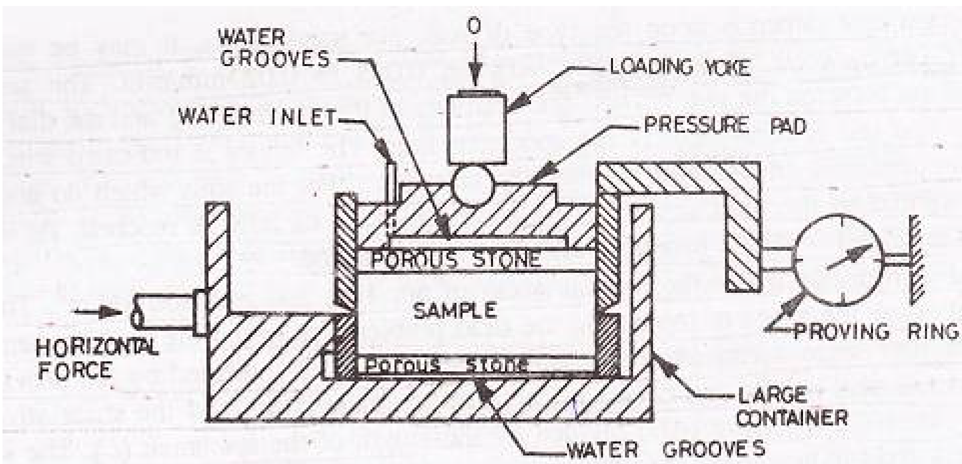


Figure 10: direct shear apparatus

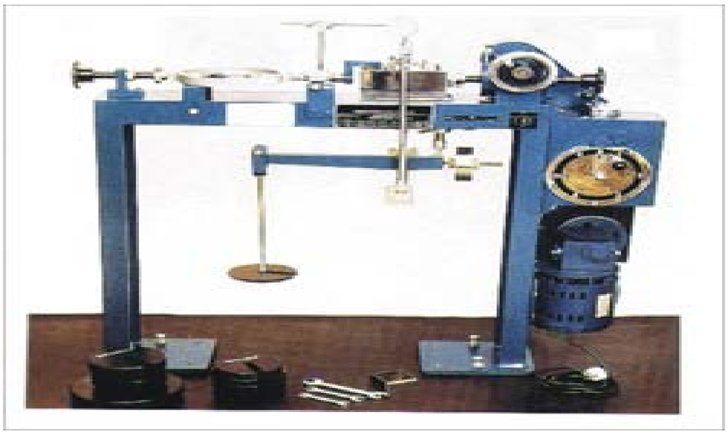


Figure 11: direct shear equipment

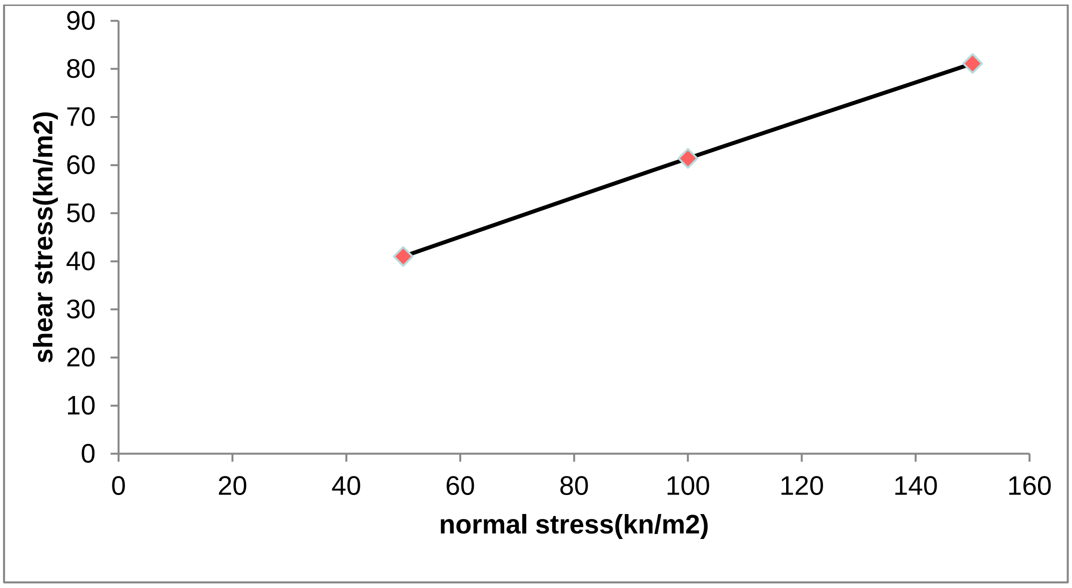


Figure12: Graph between shear stress and normal stress

C=21kN/m^2   Φ =22.13

4.4 Grain Size Distributions using Hydrometer Analysis:

IS 2720(part-IV)-1985.

Test procedure:

- To find the particle-mass allocation of a given fly ash model given the division that is more than 0.075 mm. The minor limit the particle-mass gritty by this method is up to 0.001 mm.
- In the hydrometer procedure, a fly ash specimen is diffuse in water. In diffuse state in the water, the fly ash particles will resolve at dissimilar velocities over time.
- Hydrometer measures the specific gravity of the fly ash-water deferment.
- Hydrometer values taken at explicit time interval to analyse the percentage of fly ash till in deferment at time T.
- This data the percentage of fly ash by mass finer than diameters (D) of the fly ash particles at their entity time reading can be planned.
- Next draw the graph between diameter and percent finer can be plotting to expand a particle-size division curve.

APPLICATIONS:

- Several cases, result of the sieve testing and hydrometer research of a given fly ash sample are collective on one graph. When these results are combined on one graph, a discontinuity occurs because fly ash particles are generally irregular in shape.
- Hydrometer analysis is used to determine type of clay is predominant in a given fly ash sample.

APPARATUS REQUIRED:

1. hydrometer
2. Mixing
3. Two 110-cc graduate cylinder
4. Thermometer
5. Even temperature soak

6. Deflocculating manager

7. Spatula

8. glass

9. Balance

10. Plastic grip bottle

11. Distilled water

12. Rubber stopper

Test procedure:

Note: This test is worn when further 90 percent the fly ash is finer than 75 micron

1. First we have to Take 60 grams of fly ash well graded after that we have to put fly ash in glass beaker.

2. Plan a deflocculating means. Usually a 4% solution of sodium hexametaphosphate (Calgon) is used. This can be prepared by adding 40 g of Calgon in 1000 cc of distilled water and mixing it thoroughly.

3. Take 125 cc of the mixture ready in tread 2 and adjoin it to the fly ash in use in Step 1. This must be permissible to infuse for about 9 to 13 hours.

4. Take 1000-cc graduate cylinder and add 876 cc of distilled water pluts 125 cc of deflocculating agent in it. Mix the solution fit.

5. Set the cylinder (from Step 4) in the even temperature soak. Trace the temperature of the bath, T (in °C).

6. Put in hydrometer the cylinder (Step 5). Note the reading. (Note: The top of the meniscus must be read.) This is the zero rectification (Fz), which can be +ve or -ve. Also study the meniscus modification (Fm).

7. By a spatula, thoroughly mix the fly ash equipped in Step 3. Transfer it into the mixer5 cup. Note: During this process, some soil may stick to the side of the beaker. Using the plastic wring bottle full with distilled water, wash all the remaining fly ash in the beaker into the mixer cup.

8. Add distilled water to the cup to make it about two-thirds full. Mix it for about two Minutes using the mixer.

9. Give out the mix into the second graduate 1000-cc cylinder. Create positive that all of the fly ash solids are washed out of the mixer cup. Fill the graduated cylinder with distilled water to carry the water level up to the 1000-cc mark

10. Put the cylinder in the steady temperature soak next to the cylinder describe in Step 5. Note the time immediately. This is the increasing time t=0. Introduce the Hydrometer in the cylinder containing the soil-water suspension.

12. Remove the hydrometer after two minutes and place in glass cylinder

13. Hydrometer readings are to be taken at time t=4 min., 8 min., 15 min., 30 min., 1 hr.2 hr., 4 hr., 8 hr., 24 hr., and 48 hr. For each reading, insert the hydrometer into the cylinder contain the fly ash-water deferral about 30 seconds before the reading is due. After the reading is taken, remove the hydrometer and put it back into the cylinder next to it Step5

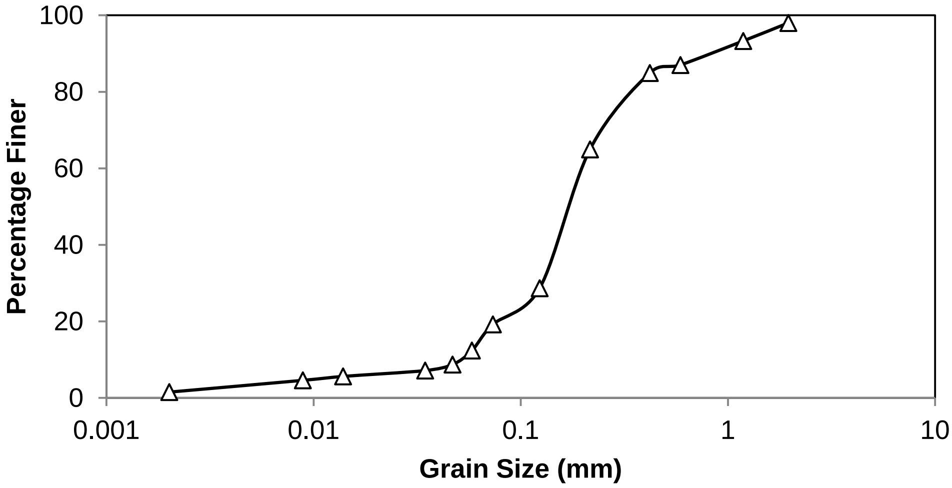


Figure 13 Graph draw between percentage of finer and grain size(mm)

Coefficient of curvature (c_u) $=D_{30}^2/D_{10} * D_{60}$ =1.25

Coefficient of uniformity (c_c) = D_{60}/D_{10} =4.2

4.5 PROPERITES OF GI REINFORCMENT:

Sl. No	Sample id	values
1	structure	Biaxial
2	Aperture shape	square
3	Aperture size (mm x mm)	22.9*22.9
4	Roll Dimensions (Width(m) x Length(m)	1.8*55.7
5	Weight per Roll (kilograms)	15.9
6	Polyester type	SG-150
7	Ultimate Tensile strength at 10% strain(kN/m)	27.5

Table3: properties of GI reinforcement

CHAPTER 5

RESULT AND DISCUSSIONS

5. RESULT AND DISCUSSIONS:

The parameters dry density γ_d and OMC obtained from standard proctor test. Unconfined compression test, was conducted using the obtained OMC and γ_d values, and stress-strain curves obtained. The typical stress-strain curves for unreinforced and reinforced sample with different number of reinforcement and different locations under 80% and 90% 100% OMC have been shown in Figs. 1-3.

Table 4: stress-strain values for different no have and position of GI reinforcement at 100% OMC using standard proctor values

			STRESS					
SL. No	strain(%)	Area	No reinforcement	reinforcement in middle	reinforcement in bottom	reinforcement in top	2reinforcements	3 reinforcements
1	0	4415.63	0	0	0	0	0	0
2	0.033	4417.08	2.96	1.06	1.62	0.42	2.04	4.30
3	0.066	4418.54	5.99	5.36	5.14	3.31	6.34	8.10
4	0.1	4420.05	9.088	7.89	8.59	6.83	10.15	12.19
5	0.1333	4421.52	12.88	11.76	12.25	10.10	14.79	16.83
6	0.1666	4422.99	16.68	15.77	16.34	14.08	19.50	21.05
7	0.2	4424.47	20.13	20.13	20.48	18.23	23.65	25.76
8	0.2333	4425.95	22.65	24.20	24.20	21.59	28.77	30.82
9	0.2466	4426.54	23.88	25.39	25.68	22.86	30.95	33.77
10	0.2666	4427.43	22.80	28.98	28.13	25.60	33.83	35.66
11	0.2866	4428.32	-	32.42	29.04	26.37	37.13	37.69
12	0.3	4428.91	-	30.79	30.30	27.35	37.55	39.51
13	0.3133	4429.50	-	-	29.17	27.69	37.54	38.38
14	0.32	4429.80	-	-	-	28.19	37.26	39.37
15	0.3333	4430.39	-	-	-	27.55	37.18	39.35

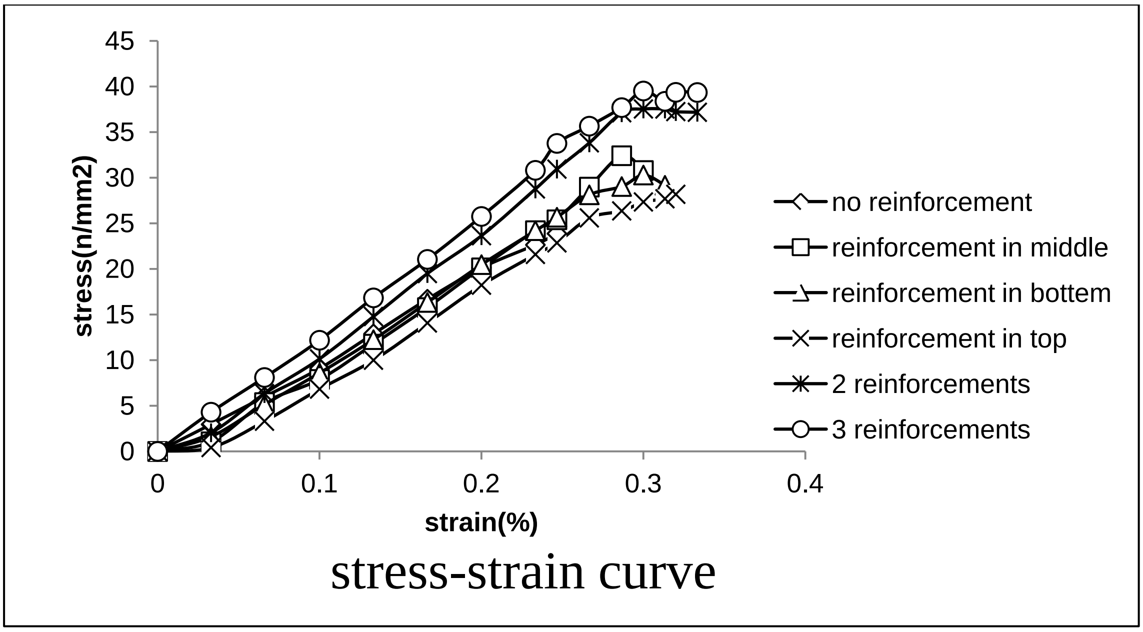


Figure 14: Stress-Strain curve (100%OMC)

Table 5: Stress-Strain values for different no have and position of GI reinforcement at 90% OMC using standard proctor values

			STRESS					
SL. No	Strain (%)	area	No reinforcement	reinforcement in middle	reinforcement in bottom	reinforcement in top	2reinforcements	3reinforcemens
1	0	4415.6	0	0	0	0	0	0
2	0.0333	4417.1	2.59	2.514	1.923	1.55	3.11	3.69
3	0.0666	4418.5	6.22	6.137	5.18	3.92	7.47	8.72
4	0.1	4420.1	10.13	9.534	8.79	6.8	11.46	14.7
5	0.1333	4421.5	13.15	13.45	12.56	9.61	16.034	16.4
7	0.2	4424.5	19.72	20.16	20.97	17.87	23.85	25.03
8	0.233	4425.9	22.89	24.36	26.28	23.03	27.61	28.5
9	0.2666	4427.4	26.19	28.114	30.62	26.42	31.95	32.47
10	0.2866	4428.3	24.55	31.72	32.53	28.03	33.94	34.9
11	0.3	4428.9	-	29.8	34.96	30.47	36.22	37.47
12	0.3133	4429.5	-	-	33.66	29	40.05	40.79
13	0.3333	4430.4	-	-	-	-	38.55	41.22

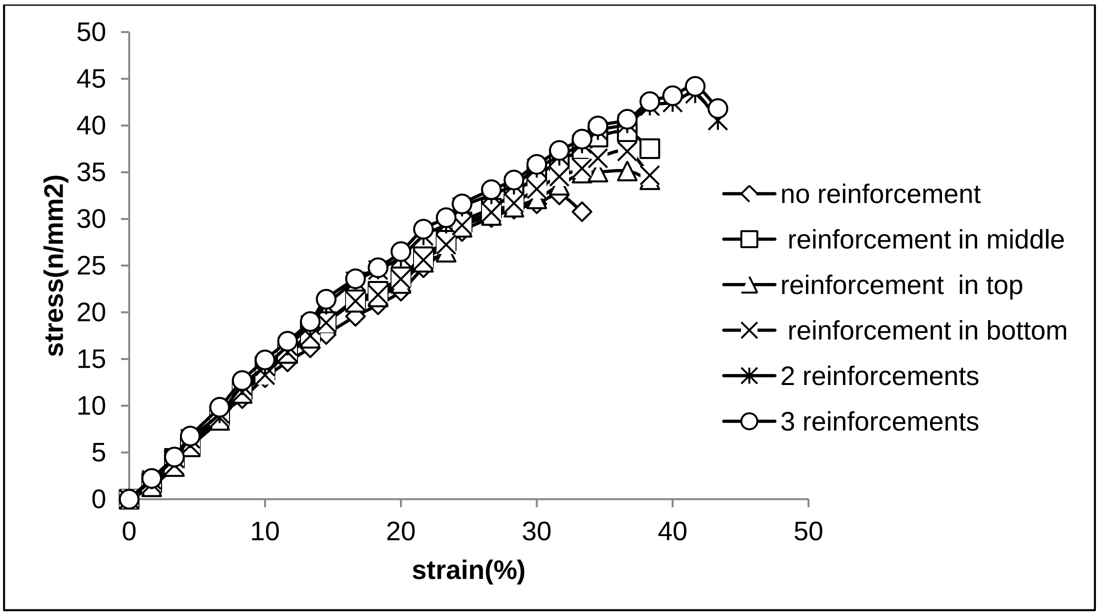


Figure 15: Stress-Strain curve (90% OMC)

			STRESS					
SL. No	strain(%)	Area(mm^2)	No reinforcement	reinforcement in middle	reinforcement in bottom	reinforcement in top	2reinforcements	3 reinforcements
1	0	4415.63	0	0	0	0	0	0
2	0.0333	4417.09	2.74	3.62	3.33	1.48	3.41	3.62
3	0.0666	4418.55	6.36	7.17	7.17	5.25	6.95	7.39
4	0.1	4420.05	9.83	9.83	10.79	8.65	11.16	11.53
5	0.1333	4421.52	13.59	13.59	14.78	12.93	15.59	16.03
6	0.1666	4423.00	16.25	17.14	17.73	17.35	18.83	19.20
7	0.2	4424.48	20.01	20.97	21.34	20.60	23.03	23.85
8	0.2333	4425.96	23.24	24.87	25.47	24.43	26.06	27.75
9	0.2666	4428.32	25.45	28.03	28.85	26.56	30.54	30.69
10	0.3	4428.92	27.44	31.27	31.72	29.43	33.42	34.23
11	0.3133	4429.51	26.20	33.19	34.67	30.83	37.17	37.39
12	0.32	4430.20	-	32.50	35.54	30	41.29	40.04
13	0.3333	4430.40	-	-	34.00	-	39.50	42.10
14	0.3466	4431.50	-	-	-	-		41.00

Table 6: Stress-Strain values for different no have and position of GI reinforcement at 80% OMC using standard proctor values

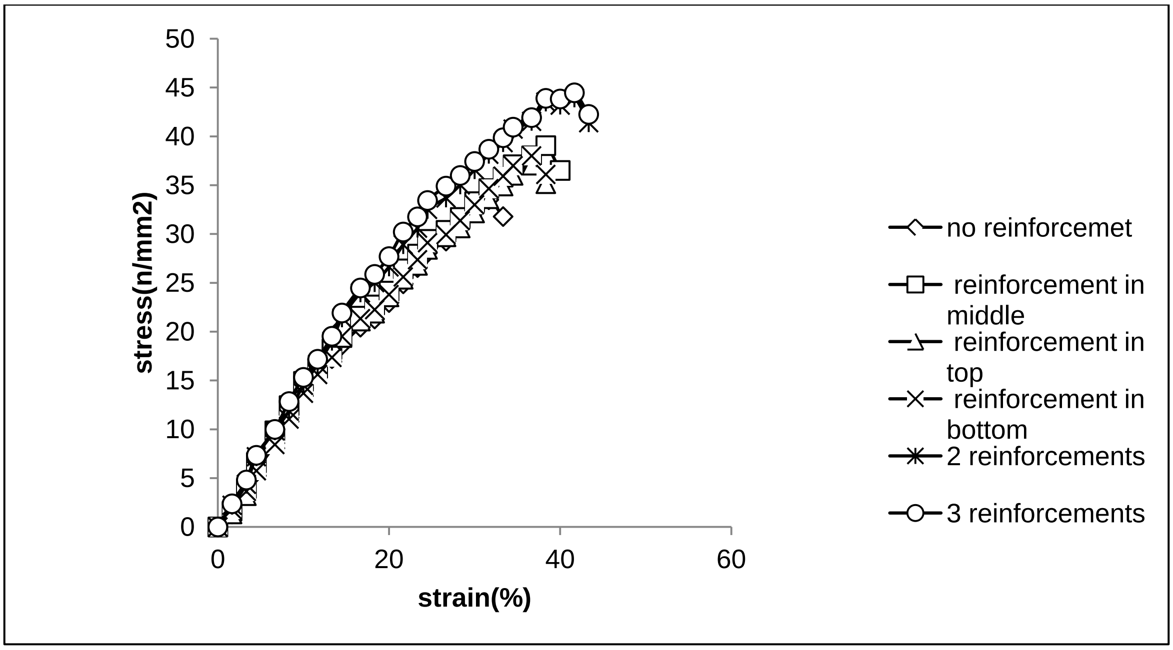


Figure 16: Stress-Strain curve (80% OMC)

The above experimental procedure is repeated using the parameters dry density $_{d}$ and optimum moisture content (OMC) obtained from Modified proctor test. The results are shown in Fig 17-19.

Modified proctor test

Table 7: stress-strain values for different no have and position of GI reinforcement at 100% OMC using modified proctor values

			STRESS					
Sl. No	Strain (%)	Area (mm^2)	No reinforcement	reinforcement in middle	reinforcement in bottom	reinforcement in top	2reinforcements	3reinforcemens
1	0	4415.6	0	0	0	0	0	0
2	1.66	4490.2	1.333	1.48	1.63	1.18	2.073	2.37
3	3.33	4566.3	3.350	3.64	3.49	2.47	4.22	4.37
4	4.5	4623.7	5.465	5.60	5.46	5.034	6.47	6.76
5	6.66	4727.6	8.440	8.15	8.02	8.02	8.86	8.44
6	8.32	4816.3	11.046	10.76	10.63	10.35	11.32	11.18
7	10	4906.3	13.419	13.28	13.15	12.61	13.96	14.23
8	11.66	5111.6	14.701	14.83	14.70	14.71	15.74	15.87
9	13.33	5210.1	15.954	16.08	16.33	15.95	17.87	18.12
10	14.5	5281.4	17.376	17.63	17.62	17.50	20.02	20.15
12	18	5355.6	20.449	21.05	20.44	20.81	23.45	24.06
13	19.66	5499	21.796	22.62	22.38	22.38	24.51	26.04
14	21.66	5636.5	23.950	24.77	24.77	24.68	27.14	28.32
15	23.33	5759.3	25.634	26.44	26.55	26.21	28.87	30.02
16	24.5	5848.5	27.403	28.43	28.54	27.85	30.59	31.95
17	26.66	6020.8	28.496	29.82	29.82	29.93	32.031	33.47
18	28.32	6189.6	29.009	31.16	31.16	31.16	33.41	34.92
19	30	6308.0	30.572	32.15	32.68	32.89	34.99	36.58
20	31.66	6430.2	31.543	33.51	34.43	34.13	36.19	38.16
21	33.33	6590.4	29.767	34.72	35.52	34.31	37.33	39.55
22	34.5	6741.0	-	36.01	35.52	34.53	38.57	40.94
23	36.66	6964.7	-	36.76	36.18	31.98	39.43	41.72
24	38.32	7000.0	-	38.45	34.67	-	41.32	43.60
25	40	7359.3	-	-	-	-	42.02	43.55
26	41.66	7568.7	-	-	-	-	42.96	43.93
27	43.33	7791.8	-	-	-	-	40.54	41.39

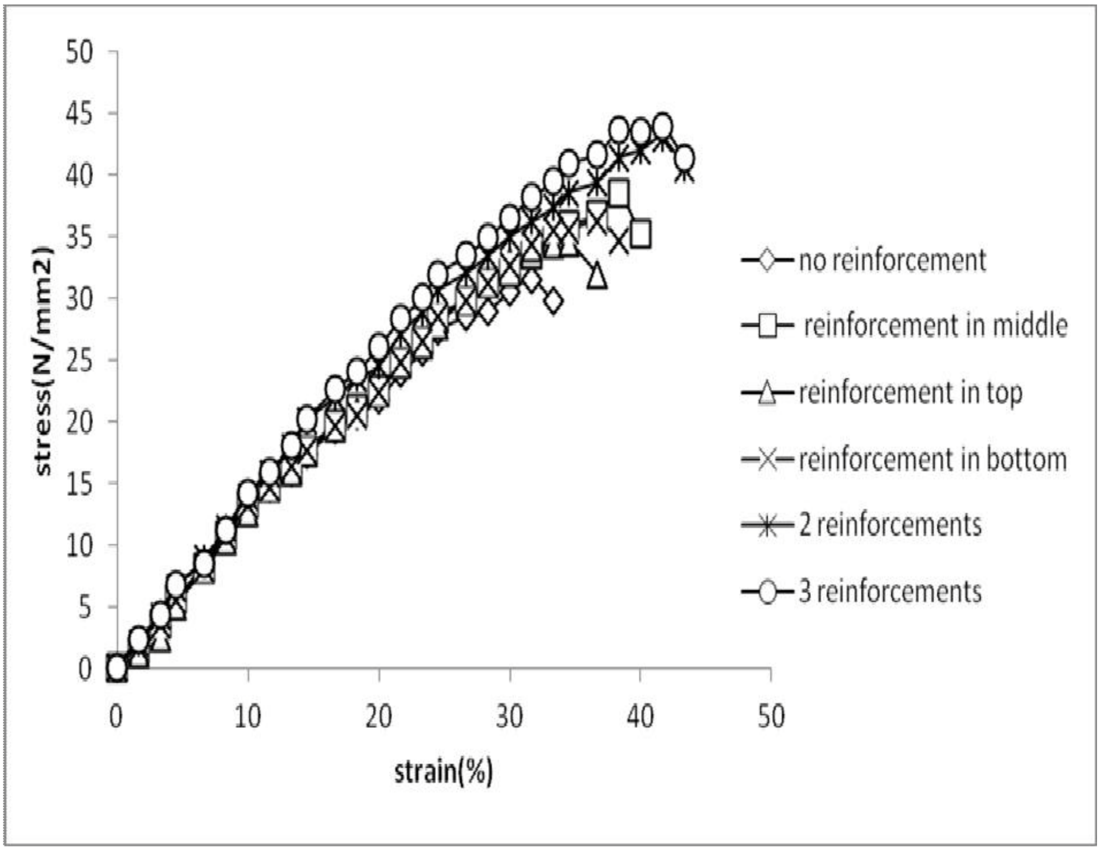


Figure 17: stress-strain curve (100%omc)

Table 7: stress-strain values for different no have and position of GI reinforcement at 90% OMC using modified proctor values

			STRESS					
SL.No	Strain(%)	Area (mm^2)	no reinforcement	reinforcement in middle	reinforcement in bottom	reinforcement in top	2reinforcements	3reinforcemens
1	0	4415.6	0	0	0	0	0	0
2	1.66	4490.2	1.48	1.74	1.62	1.33	2.07	2.36
3	3.33	4566.3	3.64	4.31	3.64	3.49	4.36	4.36
4	4.5	4623.7	5.75	5.62	5.75	5.61	6.47	6.75
5	6.66	4727.6	9.00	8.83	8.72	8.44	9.14	8.43
6	8.32	4816.3	10.77	11.52	11.46	11.32	12.15	11.18
7	10	4906.3	13.01	13.66	13.28	13.82	14.23	14.23
8	11.66	5111.6	14.70	15.31	15.74	15.61	16.39	15.87
9	13.33	5210.1	16.21	17.62	17.48	17.23	18.63	18.12
11	16.66	5299.0	19.57	20.44	21.20	21.08	23.34	22.58
14	21.66	5636.5	24.77	25.40	25.6	25.36	28.19	24.06
15	23.33	5759.3	26.67	27.28	27.25	26.44	29.44	26.04
16	24.5	5848.5	28.65	28.82	29.33	29.10	31.26	28.31
17	26.66	6020.8	30.1	30.29	30.70	30.37	32.58	30.02
18	28.32	6189.6	31.05	32.15	31.69	31.2	33.62	31.95
19	30	6308.0	31.62	33.92	33.20	32.15	35.42	33.46
20	31.66	6430.2	32.57	35.31	34.54	33.61	36.71	34.91
21	33.33	6590.4	30.77	36.59	35.41	34.91	38.04	36.58
22	34.5	6741.0	-	37.52	36.50	35.02	39.46	38.16
23	36.66	6964.7	-	39.14	37.23	35.13	40.19	39.55
24	38.32	7000.0	-	35.69	34.67	34.20	42.08	40.94
25	40	7359.3	-	-	-	-	42.47	41.73
26	41.66	7568.7	-	-	-	-	43.40	43.60
27	43.33	7791.8	-	-	-	-	40.53	43.55

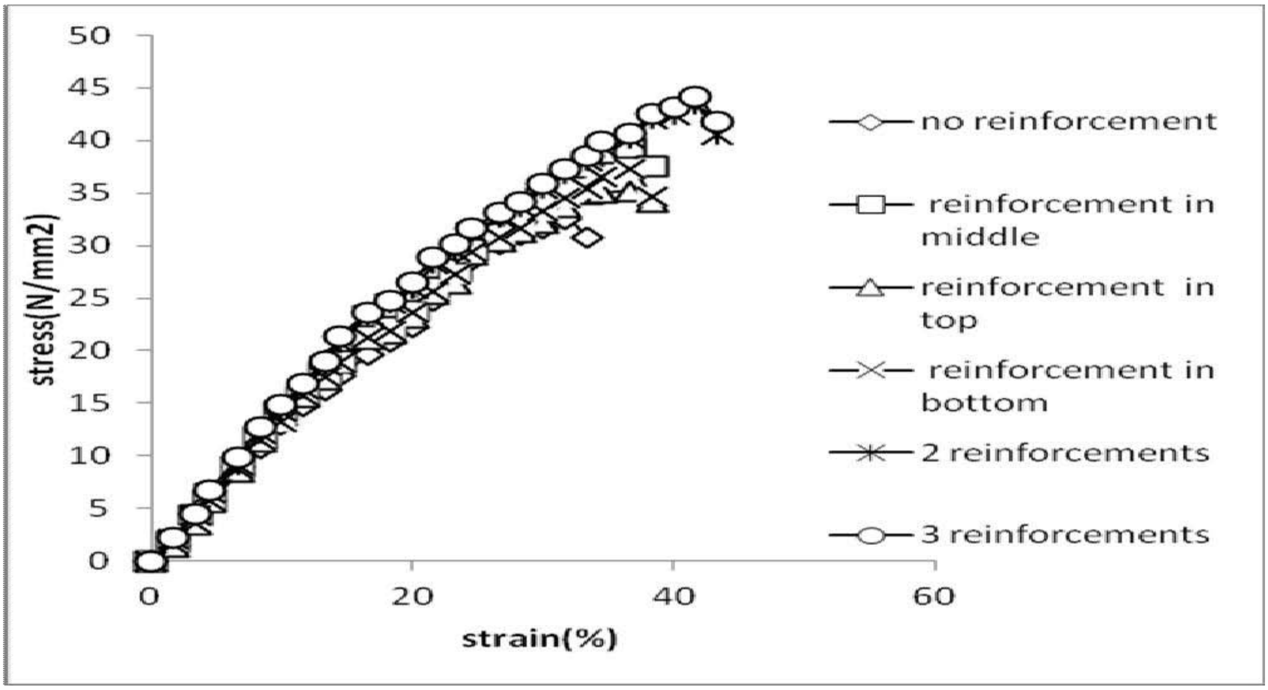


Figure18: Stress-Strain curve (90% OMC)

Table 9: Stress-Strain values for different no have and position of GI reinforcement at 80% OMC using modified proctor values

			STRESS					
Sl. No	Strain (%)	Area (mm^2)	no reinforcement	reinforcement in middle	reinforcement in bottom	reinforcement in top	2reinforcements	3reinforcemens
1	0	4415.62	0.00	0.000	0.000	0	0.000	0.000
2	1.66	4490.16	1.33	1.622	1.777	1.333	2.222	2.370
3	3.33	4566.32	3.50	3.914	3.641	3.204	4.369	4.806
4	4.5	4623.68	5.61	6.586	5.753	6.184	7.191	7.335
5	6.66	4727.6	8.58	9.802	8.440	9.002	9.846	9.987
6	8.32	4816.34	11.18	12.370	11.046	11.736	11.874	12.841
7	10	4906.25	14.23	14.842	13.690	14.367	14.503	15.316
8	11.66	5111.63	15.74	16.189	15.611	16.262	16.652	17.173
9	13.33	5210.13	17.23	18.170	17.358	17.869	19.018	19.528
10	14.5	5281.42	18.64	19.303	19.517	19.517	21.405	21.909
11	16.66	5298.96	20.46	21.488	21.334	21.083	23.970	24.472
14	18.32	5528.4	21.29	22.632	22.253	21.892	25.020	25.862
15	20	5644.5	22.97	24.043	23.798	23.563	26.626	27.686
16	21.66	5636.45	24.89	26.309	25.602	25.366	28.906	30.203
17	23.33	5759.26	26.56	27.817	27.365	26.788	30.599	31.753
18	24.5	5848.5	28.08	29.317	29.108	28.426	32.519	33.429
19	26.66	6020.76	29.27	30.237	29.932	29.711	33.688	34.903
20	28.32	6189.55	30.62	31.552	31.372	30.620	35.025	35.992
21	30	6308.04	32.26	33.163	32.997	32.153	36.581	37.424
22	31.66	6430.21	33.51	34.489	34.645	33.611	38.161	38.678
23	33.33	6590.4	31.78	35.659	35.922	34.913	39.353	39.857
24	34.5	6741	-	36.925	36.994	36.007	40.742	40.940
25	36.66	6964.7	-	37.830	38.002	37.047	41.534	41.916
26	38.32	7000	-	38.869	36.100	35.150	43.510	43.890
27	40	7359.33	-	36.341	-	-	43.193	43.825
28	41.66	7568.7	-	-	-	-	43.931	44.458
29	43.33	7791.8	-	-	-	-	41.393	42.246

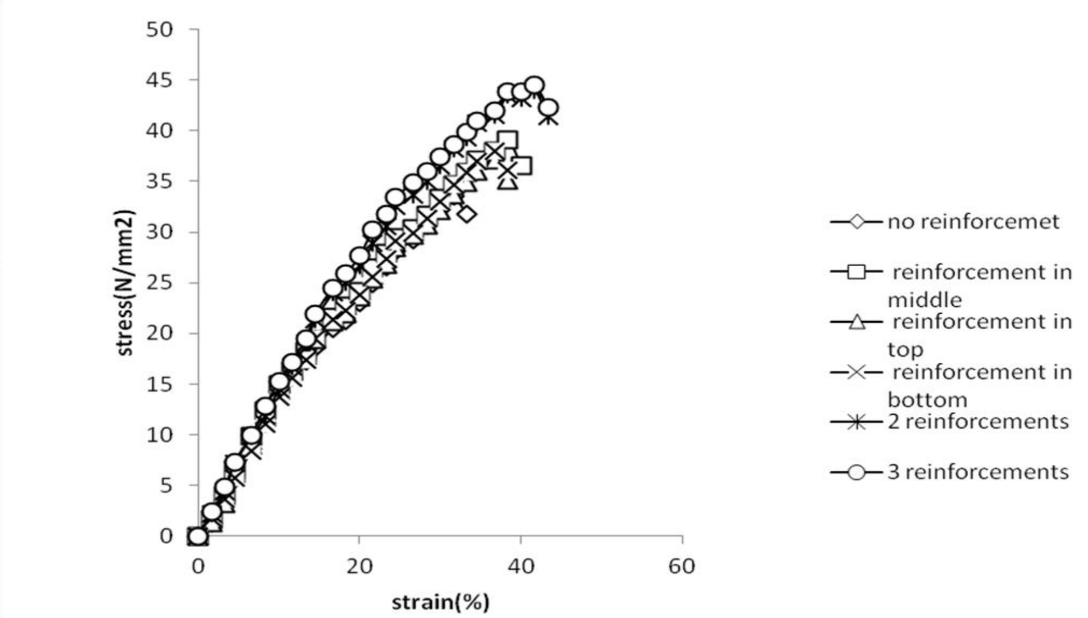


Figure 19: stress-strain curve (80% OMC)

Comparison of different percentage OMC effect (both standard & modified proctor tests) shown infig7. These figures indicate that the reinforcement increases the stress and shear strength of the samples considerably, compared with unreinforced samples and Significant variations are observed on changing the location and numbers of GI reinforcement, where as effective results are observed when a single reinforcement is placed on the middle compared to other locations, whereas, as the numbers of reinforcement are increasing at different places, the strength acquired also increasing, and achieved the constant state. In Fig 8, stress comparisons between unreinforced and reinforce fly ash at various percentage of OMC (both Standard & Modified proctor tests).

Hence from experiments we came to know that providing GI reinforcement in middle give better result compare to other locations and increase the no’s GI reinforcement, we can decrease the thickness of layer and with decrease of moisture content the effect GI reinforcement on stress -strain behavior is decreasing.

Table 10: Peak Stress for Different Reinforcement position and no's

Sl. no	OMC (%)	no reinforcement	reinforcement in middle	reinforcement in top	reinforcement in bottom	2reinforcement	3reinforcemens	No reinforcement	reinforcement in middle	reinforcement in top	reinforcement in bottom	2reinforcements	3reinforcemens
1	80	33.51	38.87	37	38	43.93	44. 5	27.44	30.83	33.19	35.54	41.3	42.1
2	90	32.57	38.4	36	37.23	43.4	44.2	26.15	30.47	31.72	34.96	40.1	41.22
3	100	31.54	38	35	36.5	42.96	43.9	22.83	28.19	30.31	30.79	37.6	39.52

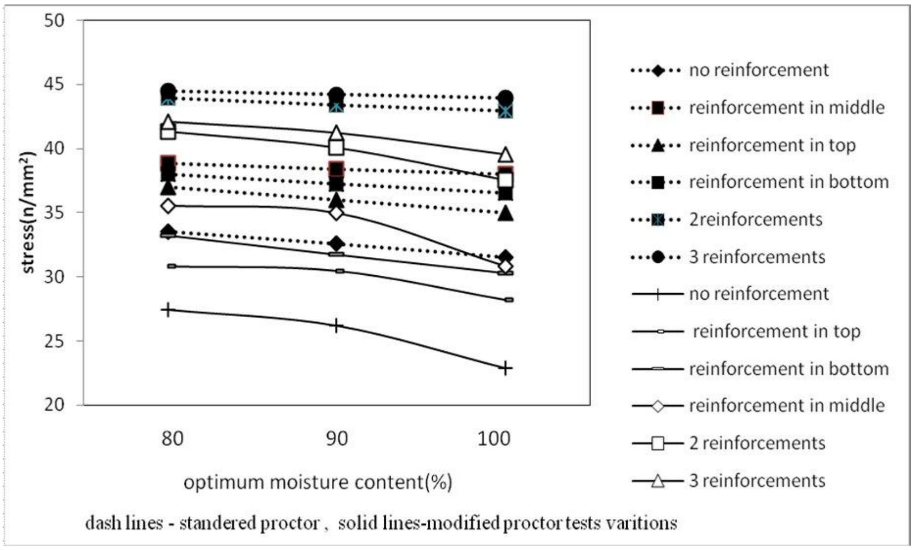


Figure 20: Comparison of different peak stress at OMC

Table 11: difference between peak stress reinforced and unreinforced fly ash

Sl. no	OMC (%)	reinforcement in middle	reinforcement in top	reinforcement in bottom	2reinforcement	3reinforcemens	reinforcement in middle	reinforcement in top	reinforcement in bottom	2reinforcements	3reinforcemens
1	80	16%	10.41%	13.40%	31.1%	32.6%	12.35%	20.95%	29.52%	50.5%	53.43%
2	90	17.90%	10.53%	14.30%	33.2%	35.7%	16.31%	21.09%	33.46%	52.9%	57.36%
3	100	20.48%	10.97%	15.72%	36.2%	39.2%	23.19%	32.43%	44.03%	63.9%	72.68%

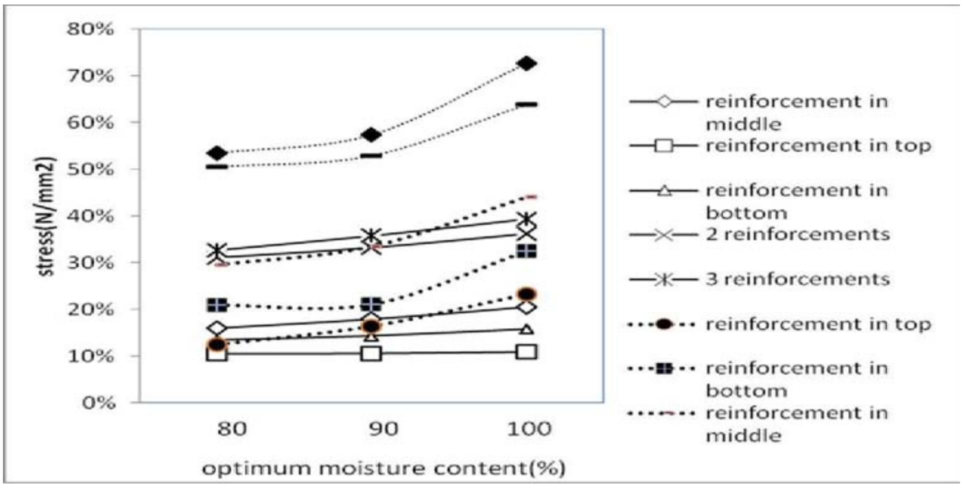


Fig 21: Comparison stress between unreinforced & reinforced fly ash (locations& no's)

The optimum no of GI reinforcement are 3 for the parameters dry density γ_d and OMC 80%obtained from the Modified proctor test. It can be observed that, there were no pronounced failure points in stress-strain behavior as increasing the number of reinforcement layers resulted in more ductility of the samples as clogging developed in shear band within specimens. The figures also shows that the beneficial effect of GI reinforcement to enhance the strength of reinforced samples appear in high strain. It means that, the high strain levels should be imposed to appear the effect of GI reinforcement layers to increase the strength of samples.

CHAPTER 6

CONCLUSION

6. CONCLUSION:

A series of uni-axial compression tests were performed on number of samples both reinforced and unreinforced condition. From the experimental results the following conclusions can be drawn as follows,

- It is noted that GI reinforcement inclusion considerably increases the peak strength, axial strain at failure and reduces post-peak loss of strength.

- The increase in peak stress in case of samples prepared at standard proctor density is found to be lower than the modified density. A similar pattern also observed for peak strain.

- It is also noted that the percent deviation of OMC in all the tested cases found to vary significantly.

CHAPTER 6

FUTURE SCOPE

FUTURE SCOPE:

The Future scope project includes:

1. The fly ash can be replaced by other materials like red mud, pond ash, and different other combinations.
2. An alternative reinforcement material can be replaced with GI reinforcement and the strength criteria can be studied.

The present study can also be modeled with the confining study cases to simulate with the field study

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