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IMPROVEMENT OF THE SHEAR STRENGTH OF SOIL BY USING GLASS FIBRE

Ahsan Nabi Bhatt ,Er. Abhishek,Syed Sheroz Bukhari

M.Tech Geotechnical Engineering Galaxy Group of Colleges Dinarpur Ambala
Asst. Professor Department of Civil Engineering Galaxy Group of Colleges Dinarpur Ambala,
M.Tech Geotechnical Engineering Galaxy Group of Colleges Dinarpur Ambala,

Abstract:-Nowadays, soil strengthening is not a innovative idea; it was worn since ancient period to enhance the shear strength of soil. We know that, in ancient period, human were constructing dams which consists of mud reinforcement with grasses, tree trunks and stones to make sure the better depth in shallow streams. This material has capability to control the freezing of water in winter. The term plysoil has originated from fibre reinforced soil which consists of material obtained by adding randomly distributed discrete fibres to soil (RDFS). The methodused for fibre addition in soil, is general and similar to soil stabilization. The major compensations of randomly distributed discrete fibres be the ease in mixing and also maintaining the power of reinforced soil during extensive period of time. The reinforced soil be able to favourably used in civil engineering projects for improving the techniques related to soil, these techniques are used for providing sharp differences of level between two horizontal platforms, the horizontal platforms are providing on sloping ground, as quay walls, as bridge abutments, subgrade/sub-base and related to other problems. Glass which is an unbreakable material is used in todays world to enhance the shear strength of soil in adverse locations. Glass fibre is a non biodegradable material and it provides stability to reinforced soil. In present study, the physical properties of three different types of soils are as plastic limit, liquid limit, plasticity index, dry density, optimum moisture content etc. Addition of glass fibre having lengths 10 mm, 15 m and 20 mm to the soil with three different fibre content i.e. 0.5%, 1.0% and 1.5%,the mix of soil and glass fibre has done by hand and prepare homogenous mix with proper care. Then direct shear test has performed on both unreinforced and reinforced soil to study the behaviour of soil which is reinforced with glass fibre. After learn the results which clearly shows that the glass fibre used with increase in length and also fibre content increases the shear strength parameters of soil successfully.

Keywords— Clayey soil, Glass Fibre

I. INTRODUCTION

We know that, soil is the inexpensive and easily obtainable construction material, it has been admired with in civil engineers, yet it has inferior in mechanical properties.The soil has been steady application of research workers to put forward advance facts to enhance its mechanical properties and to suit the conditions of engineering structures.

A variety of soil enhancement methods have been recommended by the researchers, by which the shear strength or mechanical properties of soil can be altered by soil stabilization techniques such as physically or chemically used the soil particles mutually in such a method that the bond between the soil particles increases and it will affects the whole performance of soil. The techniques for stabilization of soil are broadly used in that areas where the properties of soil are very weak and not able to bear structural load. The binding agents (like bitumen, lime, cement, chemicals, fibres etc.) are must used in these cases to control the problem. For the period of the construction of dams or roads, when the locally accessible material which is not able to bear design load of structure, then the soil should be transported from some other adjoining area becomes uneconomical and the technique for soil stabilization becomes economical.

Between the latest improvement, the reinforcement in various forms is being used to enhance the whole behaviour of soil. To reduce or hold back the tensile strain,the reinforcement which is used in the form of sheets,strips,bars,grids or fabrics in soil mass. The soil which used above reinforced material is known as “reinforced soi” and it can be regarded as soil strengthens at the “macro-scale”. Stabilization of soil is efficient and dependable soil upgrading technique with admiration to retaining structures, embankments and subgrade under footings and pavements.

Nowadays study which involves addition of randomly distributed glass fibres to the soil and the soil strengthening technique investigated in the current study involves addition of randomly distributed discrete fibres to the soil.Mixing of soil-fibre is termed as "plysoil' and this concept was given by McGown et al, 1978. This technique is related to stabilization by admixtures, in its preparation i.e. discrete fibres,they are just added and mixed with soil, in same way as lime, cement, or other additive materials. But, the behaivoir of pysoil in engineering is related to the traditional reinforced soil.

II. EXPERIMENTAL INVESTIGATION

2.1 Material used

The three soil samples A, B & C which were collected from different locations. Sample A was collected from pampore in kashmir region whereas; Sample B and C were collected from river tawi in jammu region. The properties which are required for soil samples A, B and C were determined as shown below. Sample A is clayey in nature, sample B is coarse sand and sample C is fine sand, by using grain size analysis.

PROPERTIES OF SOIL SAMPLE A:

S.No.	Tests	Properties	Description	Relevent IS Codes
1.	Grain Size Analysis	Fines, < 75μ (%)	58.40	IS 2720 Part IV
		Sand (%)	41.60	IS 2720 Part IV
2.	Compaction Test	MDD (kN/m^3)	18.60	IS 2720 Part VIII
		OMC (%)	12%	IS 2720 Part VIII
3.	Casagrande Tests	Liquid Limit (%)	31	IS 2720 Part V
		Plastic Limit (%)	18	IS 2720 Part V
		Plasticity Index (%)	13	IS 2720 Part V
		Flow Index	26	IS 2720 Part V
		Toughness Index	0.51	IS 2720 Part V
4.		Classification	CL (Clay and silt with low compressibility	IS 1498-2007

Properties of Soil Sample B:

S.No.	Tests	Properties	Description	Relevent IS Codes
1.	Grain Size Analysis	Fines, < 75μ (%)	3.5	IS 2720 Part IV
		Sand (%)	96.5	IS 2720 Part IV
		Effective size (D_{10}) (mm)	0.19	IS 2720 Part IV
		D_{30} (mm)	0.33	IS 2720 Part IV
		D_{60} (mm)	0.53	IS 2720 Part IV
		Uniformity coefficient, C_u	2.78	IS 2720 Part IV
		Coefficient of curvature, C_c	1.08	IS 2720 Part IV
2.		Classification	Sand	IS 1498-2007

Properties of Soil Sample C:

S.No.	Tests	Properties	Description	Relevent IS Codes
1.	Grain Size Analysis	Fines, < 75μ (%)	0	IS 2720 Part IV
		Sand (%)	100	IS 2720 Part IV
		Effective size (D_{10}) (mm)	0.15	IS 2720 Part IV
		D_{30} (mm)	0.18	IS 2720 Part IV
		D_{60} (mm)	0.25	IS 2720 Part IV
		Uniformity coefficient, C_u	1.66	IS 2720 Part IV
		Coefficient of curvature, C_c	0.87	IS 2720 Part IV
2.		Classification	Sand	IS 1498-2007

Properties of glass fibre

Fibre Type	Diameter d (mm)	Aspect ratio L/d	Tensile strength (kPa)	Tensile modulus (kPa)	Ultimate strain
Glass	0.35	30, 45, 60	2.30	76	0.018

II. METHODOLOGY

1.Direct shear test:

This test is carried out for undisturbed samples or remoulded samples. To ease the remoulding purpose, the soil sample possibly compacted at optimum moisture content(OMC) in a mould. After that specimen for the procedure of direct shear test could be obtained by using the correct cutter provided.On the other hand, the sample can be placed in a dry state at a necessary density, in the assembled shear box.Normal load,which is applied to the specimen sample and the specimen is sheared crosswise the pre-determined horizontal plane between the two halves of the shear box. The measurements of shear load, shear displacement and normal displacement are recorded in a good manner. This test is repeated for two or more identical specimens under the different normal loads.The results can be determined the shear strength parameters.The strength of a soil,which is depends on resistance to shear stresses.

III.RESULTS AND DISSCUSSION

Direct shear test was conducted on various samples and the results obtained are as follows

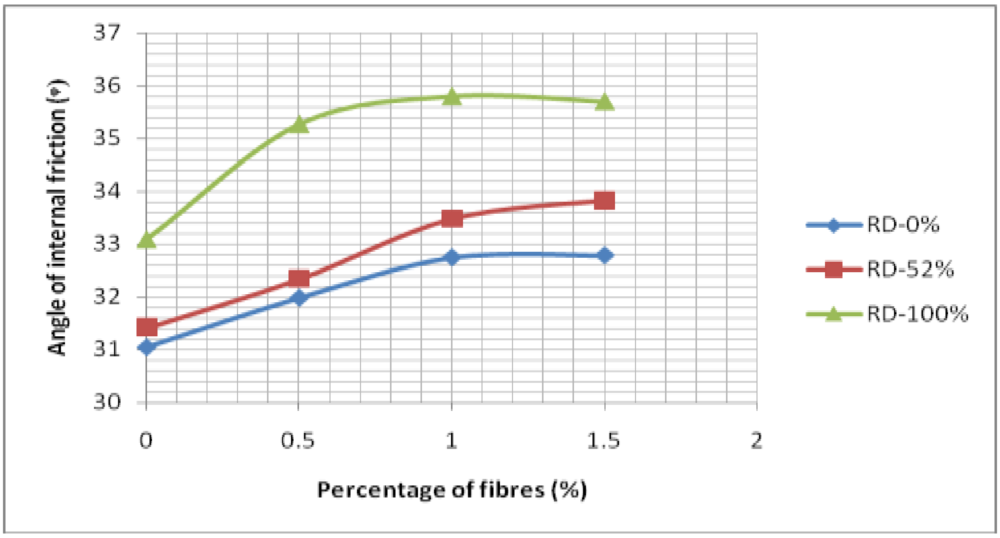

Figure : Variation of angle of internal friction vs. Percentages of fibre (L/d=30)

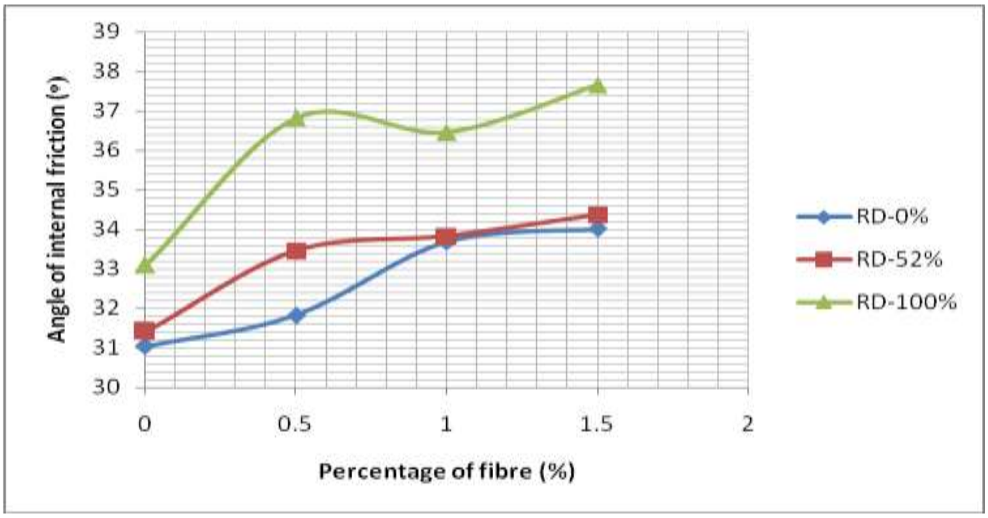

Figure : Variation of angle of internal friction vs. Percentages of fibre (L/d=45)

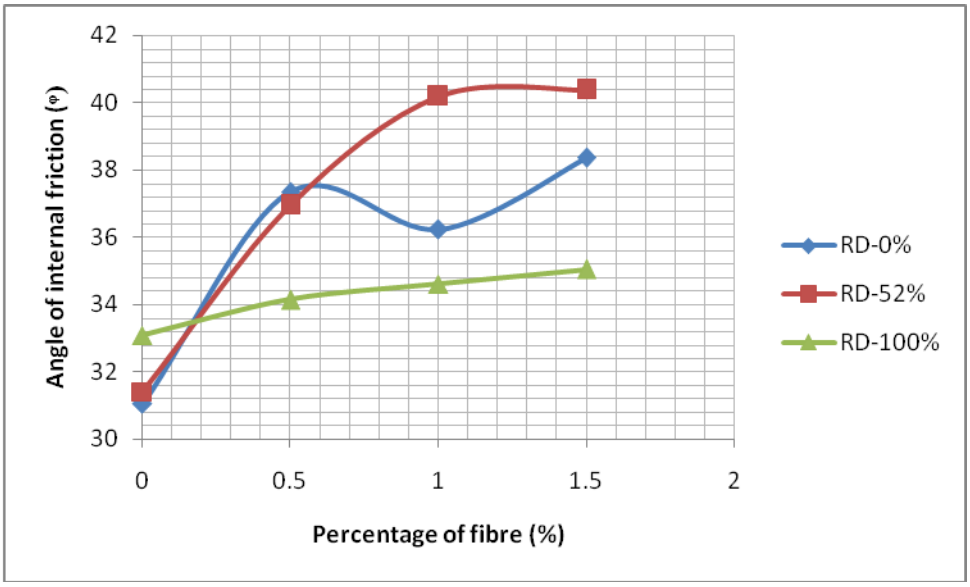

Figure Variation of angle of internal friction vs. Percentages of fibre (L/d=60)

In sample C, after conducting a series of direct shear test the minimum value of φ is 31.04^o at 0% fibre content and 0% relative density. And the maximum value of φ is 35.97^o at 1.5% fibre content and 100% relative density for aspect ratio i.e. L/d30. Percentage increase in φ value is 15.88%. Similarly for aspect ratio 45, the minimum value of φ is 31.04^o at 0% fibre content and 0% relative density. And the maximum value of φ is 37.65^o at 1.5% fibre content and 100% relative density. Percentage increase in φ value is 21.29%. Similarly for aspect ratio 60, the minimum value of φ is 31.04^o at 0% fibre content and 0% relative density. And the maximum value of φ is 35.05^o at 1.5% fibre content and 100% relative density. Percentage increase in φ value is 13%.

IV. CONCLUSION

Based on the experimental results of this study the following conclusions are drawn:-

1) In sandy soil, glass fibre can be used as a reinforcing material resulting an increase in shear strength of soil when glass fibres are randomly mixed.

2) The effect of increase in length from 10 mm to 20 mm and fibre content from 0% to 1.5% increases the shear strength parameters which are useful in geotechnical engineering structures.

3) In coarse sand, after conducting a series of direct shear test the maximum percentage increase in φ value is 26.00% for aspect ratio 30 and similarly for aspect ratio 45 and 60 the maximum percentage increase in φ value is 27.00% and 30.00% respectively.

4) In fine sand, after conducting a series of direct shear test the maximum percentage increase in φ value is 15.88% for aspect ratio 30 and similarly for aspect ratio 45 and 60 the maximum rcentage increase in φ value is 21.29% and 13.00% respectively.

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