STABILITY OF ROAD EMBANKMENT USING GEOTEXTILE WITH THE PLAXIS 2D

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ABSTRACT:

The primary goal of this study was to determine optimum strength of embankment with and without geotextile over a soft subsoil using FEM-based software (PLAXIS 2D v8) for the purpose of conducting a slope stability analysis of a highway embankment. Using geosynthetic products, such as geotextile, is one of the many ways to improve the ground. The purpose of this work is to calculate the safe height of an embankment built on soft ground using geotextile as a soil reinforcing material. A limited version of the road edge rigidity analysis was carried out with PLAXIS 2D. The successive modelling was done in this investigation. . More and more road barriers with softer surfaces are being reinforced using geotextiles. The overall stresses, total strain, total displacement, and effective stresses are all analysed. this paper looks at the results of a parametric analysis. The effects of slope inclination, geotextile modulus, geotextile effective length, and number of geotextile layers on the behaviour of a reinforced embankment on clay are ascertained. The ideal spacing for a geotextile layer is between an embankment and a bed. The least amount of displacement will occur if the geotextile layer entirely covers the embankment's bottom. The software's ability to anticipate possible slope breakdowns is demonstrated by the results, which improve the safety and resilience of road infrastructure. Offering insightful information.

Keywords: Road Stability, Plaxis 2D, Geotextile, Ground Improvement Techniques, Soil Property.

INTRODUCTION:

Many road embankments are built on soft soil due to the country's increased road traffic in recent years. Large settlements and slope instability present a common challenge for geotechnical engineers in this scenario. Geosynthetics have been used as reinforcement in embankments on soft soil, according to several studies. In soft soil areas, geotextiles are being used more and more as reinforcement for road embankments. geotextile is a permeable geosynthetic [4]. A suitable factor of safety and displacement should be included in the design of the geotextile reinforced embankment. Studies have been conducted about the use of geotextile reinforcement in soft soil. The goal of this study is to ascertain the ideal geotextile tensile strength for use as reinforcement in road embankments while taking the permitted safety and displacement factors into account. Using the finite element approach and PLAXIS, the road embankment's stability analysis was completed. [6]

OBJECTIVE:

- To analyze the stability of Road Embankment through detailed soil properties using Plaxis 2d software.
- Study and evaluate the Road Embankment in the Durg-Raipur Arang (Chhattisgarh) area under the given properties of soil condition.
- Propose effective mitigation and remediation measures based on the analysis results to reduce failure of roads.
- To study variation in the soil stability by varying depth of geotextile reinforced embankment.

GEOSYNTHETICS:

Soil contains geosynthetics, which are synthetic materials [1]. The following are the specific families of geosynthetic: Geomembranes, Geotextiles, Geogrids, and Geocomposite. "Geotextile" is the term used to describe a product manufactured from synthetic fibres that is woven and nonwoven together, or that is made into a flexible, porous fabric using ordinary weaving equipment. Polymers are shaped into an extremely open net-like structure called geogrids. For soil improvement, geotextiles and geogrids are typically utilized as reinforcing materials [1]. These reinforcing materials are flexible enough to withstand significant deformation, comparatively low in stiffness, and impervious to corrosion. They are better than steel reinforcing materials in soils because of these features. This work is an attempt to examine the suitability of the finite element method for assessing reinforced embankment on underlying soft soil, given the expanding use of geotextile in reinforcing embankments.

The applications of geosynthetic materials Several polymer fibre types, including as polyester and polypropylene, are used to create geosynthetic. The application of geosynthetic in civil engineering projects is expanding. They are specifically used for: i) Separation ii) Reinforcement iii) Drainage iv) Filtration v) Sealing [2]

PLAXIS 2D:

Software is a commonly used technology that was initially created in 1987 by the Technical University of Delft. Typically, Plaxis 2D analyses soft soil stability. It can be applied successfully to soil settlement research. A thorough presentation of the computational results is made possible by the improved output facilities made possible by the input procedures. With just a few hours of instruction, novice users can operate with Plaxis.

Plaxis 2D functionality:

- The Plaxis input module is used to give data input.
- Plaxis input is given according on material qualities, load circumstances, and dimensions.
- Material properties include information on the groundwater table in the event that a soil structure study is necessary.
- By selecting the mesh option, a mesh is created and an output window is created for the purpose of computing wheel loads.
- The computation is also verified to account for the deformations of the embankment caused by wheel loads.
- The result achieved inside each soil element's perimeter

METHOD OF ANALYSIS :

The tensile strength of the geotextile reinforcement is varied from 100 to 1000 kN/m to find the ideal tensile strength for embankment reinforcement. Using the finite element approach and PLAXIS 2D, the road embankment's stability analysis was completed. The topic under consideration was first analysed using the Mohr-Coulomb model in a basic manner. All of the foundation's clay soil was modelled as being undrained, whereas the analysis for the sand mat and embankment was modelled as being drained. Three different kinds of sequence modelling were done in this investigation. The road embankment's stability in the absence of reinforcement was examined first. The purpose of the second modelling phase was to calculate the geotextile reinforcement length while taking the model road embankment's stability into account. [6]

GEOMETRY MODELLING:

Figure 1 shows a 6 m high embankment with slopes of 2.5H: 1V. was evaluated with a UDL of 70KN/m. The space between the embankment is filled with many layers of bonded geogrid spaced two meters apart. The study involved varying the tensile strength of geogrid reinforcement between 20KN/m and 50KN/m, and conducting an examination of different construction phases. [4]

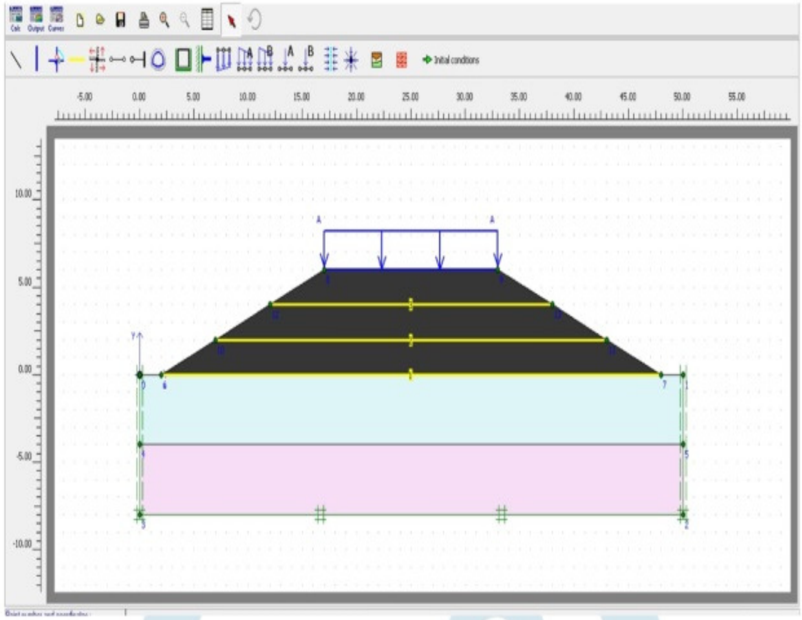

Fig -1: Geometry Model

RESULTS AND DISCUSSION

The process of designing a geotextile reinforced embankment involves calculating the factor of safety and modifying the reinforcement progressively until the desired factor of safety is reached. For the design of a stable slope, a value of 1.5 for the safety factor in relation to strength is often suitable. The safety factor for an embankment without reinforcement was 1.308. Table 2 presents the findings of an analysis of geotextile reinforced embankments using PLAXIS 2D, taking into account displacement along the embankment base and safety factor. [6]

Table -1: Factor of Safety and Displacement

Factor of Safety and Displacement		
Tensile strength	Factor of Safety	Displacement
0	1.3080	0.336
100	1.5996	0.336
150	1.6201	0.336
200	1.6355	0.335
300	1.6764	0.335
400	1.6848	0.335
600	1.7048	0.334
800	1.6136	0.333
1000	1.6142	0.333

There is very little heaving at the embankment's toe, but vertical settlement is unaffected along the embankment's edge. By adding more surcharge to the embankment's toe or placing a geotextile layer between the foundation and geotextile base, this heaving can be prevented. In addition to increased stiffness, deeper stress distribution is observed. [1]

For initial design research, this typical case model can offer a rapid assessment of the deformation behaviour and safety factors of reinforced embankments with a berm at the middle height of the embankment on challenging subsoil conditions. Based on the analysis's findings, it can be deduced that the geotextile-reinforced earth embankment's maximum horizontal and vertical displacement happened in a lower area than the unreinforced soil mass. This is likely due to the reinforcing effects of friction between the soil and the reinforcement. [1]

In order to achieve the goal of this work, a parametric analysis was conducted that involved two main analyses: determining the safe height of an embankment built on soft ground and determining the impact of spacing and geotextile reinforcement on deformation on an embankment in example. For the foundation soil in all analyses, the condition was undrained, while for the embankment, it was drained. [3]

CONCLUSION:

Reduce vertical and horizontal displacement by placing a single layer of geotextile between the underlying soft layer and the embankment base. The ideal location for the installation of a geotextile layer is between the embankment base and the soft layer underneath it, as reducing the horizontal displacements of the embankment plays a significant role in its stability. When building a high embankment or an embankment with a steeper slope on soft soil, we can use a geotextile with high rigidity. [5]

In Malaysia, the typical height range for an embankment to be built on soft terrain is between 4 and 5.5 meters. The deformation of an embankment is influenced by the height of the embankment and the distance between the geotextile reinforcement. The maximum height of an embankment on soft ground that is typically reported in this work is 4.9 meters. To ensure the stability of the embankment against excessive settlement, the spacing between the geotextile reinforcement should be roughly equivalent to less than one meter. [3]

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