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Interaction Extent of the Planar Geotextile Reinforcement Subgrade of Roads and Rail Routes

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Abstract

Horizontal means of reinforcement layers of soil substrates installed in roads and rail routes also the interaction of geotextiles reinforcement of the soil are the subject of discussion in this article. The effectiveness of friction is the main factor in the efficiency the immobilized planar reinforcement by vertical uniform load utility. Mechanism of occurrence of friction as the forces of adhesion reinforcement geotextile with the ground is apparent from the balance of forces and appointed experimental testing as well.

Keywords: subgrade reinforced , geotextiles, interface friction

1. Introduction

The horizontal arrangement of layers of geotextiles in the soil loaded with only vertical and static pressure is evenly distributed reinforcement planar case. It is strengthening and subgrade reinforcement of ground layers of the substrate surfaces of roads or surfaces ground earthworks. Load external layer in the substrate are the vertical forces load utility vehicle and the weight of the structure of the surface pavement. This method of reinforcement should be distinguished from the arms subject to direct shearing. In strengthening embankments of earth structures or ground water retaining structures. Geotextiles are produced as (fabric weave) fabric material of synthetic porous surface and cleats invoices. This is a separate group of products from the group of geosynthetics characterized by simple production technology and the weight of $1m^2$ as 200 to 400g (*short* gtx). Geotextiles to be distinguished from

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various types of genets and geogrids which are adapted for the reinforcement layers aggregates. In terms of technology, so that the reinforcement layers of the ground corresponds to the limit the possibilities of improving soil hydraulic binders. It can be used in both the substrate surface rail and automotive substrates surface of rigid and semi-rigid.

2. Nature of the loads reinforced ground layer base conditions

All structural layers substrate conditions are different deformations under service loads of geotextiles. Deformation consisting of a uniform and simultaneous settling do not cause adverse effects in the design of surface conditions of roads. It also includes micro deformation and slight shifts in horizontal planes of geotextiles. They are a source of friction mobilization and reinforce the interaction of soil-material of geotextiles. Deformation appearing residually in the form of small folds on the surface of geotextiles arranged in a layer of soil usually did not exceed 2cm of geotextiles. Static and overall system load uniformly distributed substitute $q = \gamma H$ and micro deformation of geotextiles planes shows diagram of Fig. 1.

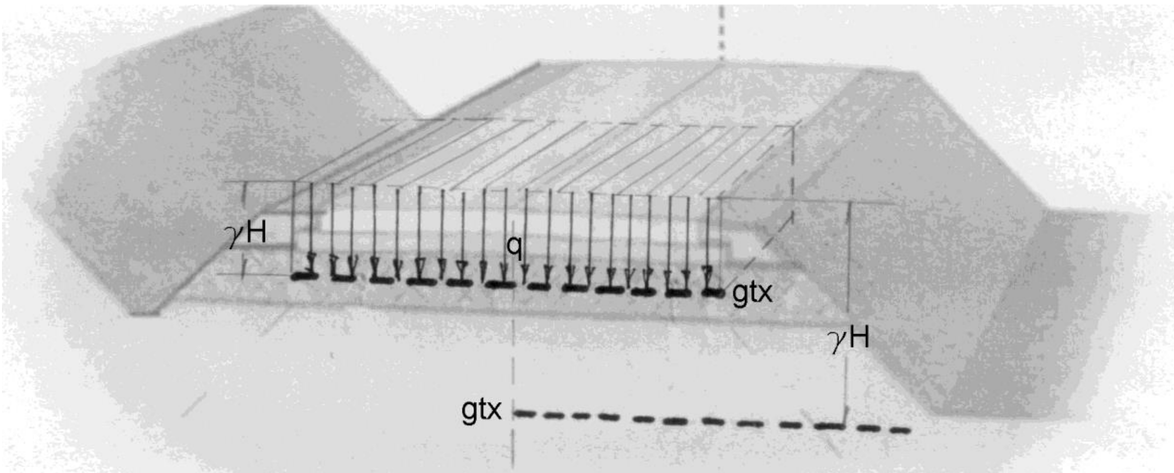

Fig.1. General scheme of loading reinforced layer of the ground substrate of roads

The basic assumption the planned of stability ground layer with geotextiles installed in a layer of soil are given in [1]. e. g

$$R_d = \frac{R_k}{\eta_m} \quad (1)$$

Where;
R_d – design resistance of the geotextile reinforcement,
R_k – short term tensile strength of the geotextile,
η_m – partial safety factor for the structural resistance of flexible reinforced elements.

3. Certain justification range of geotextiles interaction into ground

Given the tangential alignment of forces and load the extracted element reinforcement geotextile, see Fig.2. One can also assume schematically according to [1, 2], the equilibrium is maintained due to the horizontal force of friction in the ground reinforcement geotextile.

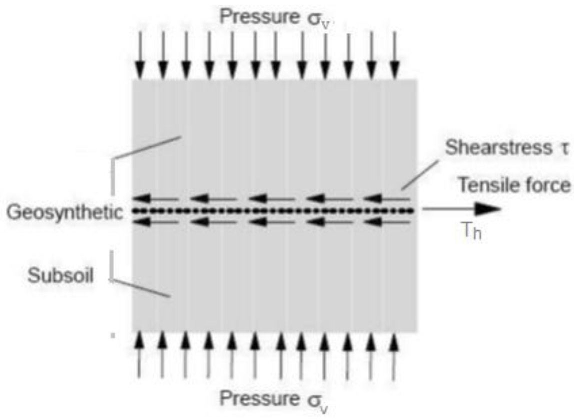

Fig. 2. Load diagram the layers of geotextiles

Output friction force in the ground reinforcement are being mobilized by the tensile stress due to the load and a vertical pressure accordance with the equation (2)

$$T_h = 2 \cdot \tan \mu \cdot \sigma_v \cdot l \tag{2}$$

Where;
T_h – strength of the frictional resistance of geotextiles [kN/m],
μ – angle of friction between the ground and geotextiles
σ_v – vertical stress at the insert of the geotextile [kN/m^2],
l – the length of the active load inserts geotextiles [m].

The coefficient of friction μ between the ground and the geotextile material is generally in the range *(0,6 to 0,7)·* $tan\varphi_z$, where φ_z – angle of internal soil friction. Into less cohesive soils can be taken into account also effects of soil cohesion.

According to the publication [2] the force equilibrium of differential segment of the confined geotextile shown in Fig.3 can be describe equation (3);

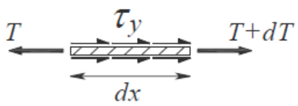

Fig.3. Force equilibrium for differential segment of geotextiles [2]

$$T - (T + dT) - 2 \cdot \tau \cdot dx = \tag{3}$$

Where;
dx – differential segment of the geotextiles
T – unit tension in the geotextiles
τ – interface shear between soil and the geotextiles

Solution of equations (2) shows unit tension in the active length is related to the local displacement of geotextiles as follows;

$$T \cdot x^2 = 4 \cdot J_c \cdot \tau_y \cdot u(x) \tag{4}$$

Where $4\ J_c\tau_y$ represents stiffness of soil-geotextiles interaction and *u(x)* real interface displacement at any location within length (0<x<L). Equations (3) suggest a parabolic relationship between T and u under small displacement regime.

Another example of the determination of the effect of the friction of the geotextile reinforcement of the ground soil is publication [3]. In determining baring capacity ratio (*BCR*) for reinforced base foundation footings loaded strip was used schematics, see Fig. 4.

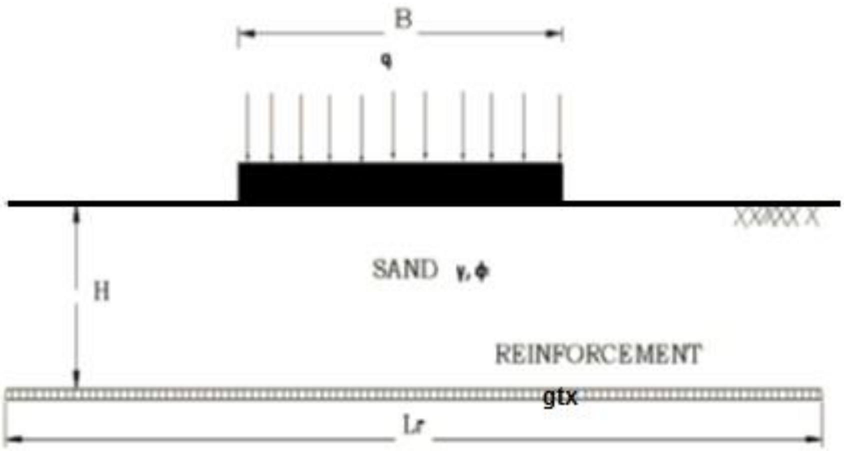

Fig.4. Scheme of the external load of strip footing

The development of reaction reinforcement essentially determined on the basis of the scheme fig.5 and according to the formula (5)

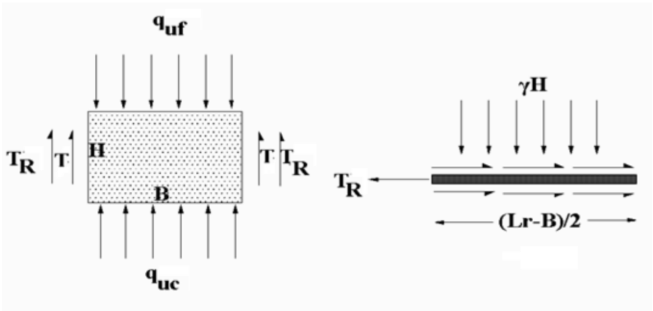

Fig.5. Reaction in ground and reinforcement of substrates under strip footing, ac. [3]

$$T_R = \frac{\gamma \cdot H}{B} \cdot \tan \cdot \varphi_r \cdot \frac{(L_r - B)}{2} \qquad (5)$$

Where;

γ - ground volumetric density
H –thickness of ground stratum
B – width of strip footing
φ_r – angle of friction between sand and reinforcement
L_r – length geotextile reinforcement

In research [3] found that after taking into account the frictional resistance of the geotextile reinforcement essentially takes almost a 20% increase bearing capacity ratio (*BCR*). Reduction of ground settlement reinforced and unreinforced is obvious. A similar range of growth *BCR* is determined by an assay described in the experimental work [4].

4. Conclusions

Reinforcement planar layers of land subsoil (horizontal) is carried out by the installation of a horizontal the geotextile layers in the soil substrates. Strengthening the function of the geotextile reinforcement is provided by the friction force of local deformations caused by static pressure load. Vertical load carrying a payload, depending on the position of the earthwork building layer is derived from the summed pressure transmitted by the road surface land (or rail vehicle) and the hydrostatic pressure depth of cover layer. Also, the above descriptions allow for determination;

- Feedback planar friction geotextiles with a tensile strength gives real effect of soil reinforcement.
- Surface friction force arising from the small axial deformation the layers geotextile create forces substantially less than the tensile strength of the geotextiles.
- Additional mobilization of friction is the propagation of vibration in the subsoil of roads, traffic coming from vehicles.
- Planar reinforcement of soil by the geotextile layers not exclude their functions as filter layers and separating the layers soil even similar type.

In general however, the effectiveness of the reinforcing layers of a planar reinforcement soil depends on the quality their assembly technology.

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