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Behavior of Geotextile Reinforced Sand on Weak Subgrade

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Abstract. The use of nonwoven geotextiles in unpaved roads provides at least two basic contributions, namely separation and reinforcement functions, therefore reducing rutting and maintenance cost and greatly improves the overall performance of reinforced unpaved roads. Available results of studies on the resilient behavior of subgrade-geotextile-base system are limited and inconsistent. A series of cyclic triaxial tests were carried out to study the effect of nonwoven geotextile on the resilient and plastic behavior of a subgrade-geotextile-base system. The results suggest that the presence of the geotextile did not significantly increase the resilient modulus (increase of only 14%). However, there was a major reduction in the permanent deformation (50% reduction).

Introduction

Soft clayey and silty subgrades under cyclic loadings exhibit large deformations (rutting) leading to failure of pavement and the pumping of fine-grain subgrade soils into the graded base course. The use of geotextiles in the construction of roads on soft subgrade is widely practiced and becoming popular especially for unpaved roads. Several theoretical [1,2], laboratory [1–6] and field studies [7,8] are reported on the behavior of geotextile reinforced aggregate on soft subgrade under repeated or traffic loads. Geotextiles placed between soft subgrade soil and the aggregate base layer enhance the load-carrying capacity and improve the performance of unpaved roads essentially by providing separation and reinforcement benefits. The geotextile as separator prevents intermixing of the aggregate material and the subgrade under the action of repeated loads, where intermixing reduces the shear strength and stability of the aggregate layer. In the reinforcement function the geotextile affects the behavior of aggregate-geotextile-subgrade mainly by restraint of soft subgrade and confinement of aggregate layer. Robnett and Lai [9] reviewed the general performance characteristics of aggregate-geotextile-soil system. They concluded that use of an interlayer of aggregate-surface road can lead to either better performance or to substantial reductions in aggregate layer thickness. It is also shown that the behavior of aggregate-geotextile-soil is complex and difficult to analyze with theoretical models.

Different empirical design methods based on the performance of full scale road or laboratory studies have been proposed for unpaved roads reinforced with geotextile. Hausmann [10] has assessed and compared them to one another. The well known Giroud and Noiray's method [11] is based on Boussinesq elastic theory similar to flexible pavement design methods. To develop a more rational design method, the dynamic nonlinear stress-strain behavior of aggregate-geotextile soil system under repeated loads must be adequately predicted. The available literature dealing with soil-geotextile-aggregate system is limited and in some cases, results are even contradictory. Raad [12] performed finite-element analysis on a two-layer system that consists of a granular base over a soft clay subgrade, and found that prestressed geotextile would increase the resilient modulus of the subgrade below the geotextile. Friedli and Anderson [13] conducted cyclic triaxial tests to study the effects of placing two types of woven geotextiles between fine and coarse soils. Their results showed that the resilient moduli of samples with geotextile were higher by 10 to 50 percent than unreinforced samples. Rao [14] reported that nonwoven geotextile separating silt and sand significantly improved the resilient modulus in cyclic triaxial testing. Saxena and Chiu [15] carried out dynamic-K_o test on clay-geotextile-aggregate system, they reported that the presence of woven geotextile improved the resilient characteristics of the system.

Contrary to above, no significant increases in resilient modulus of soil-geotextile-aggregate due to the presence of the geotextile were noted by Anderson [16] testing soil-geotextile-aggregate system in CBR cylinders and by Brown, Pappin and Brodrick [17] employing large scale test in Nottingham pavement facility. Thompson and Laad [18] also demonstrated that there is no geotextile effect on the resilient behavior of soil-geotextile-aggregate system using a stress-dependent finite-element model.

The foregoing conflicting findings could be partially due to the fact that resilient modulus is very sensitive to the testing procedure [19]. This study was undertaken in an attempt to ascertain the resilient behavior of soil-geotextile-aggregate system employing the latest proposed AASHTO method of testing and using a haversine stress pulse that better represent the shape of truck load on pavement [20].

The principal objective of the current study is to investigate the repeated load-permanent and resilient behavior of a two-layer system that consists of a granular layer on a weak subgrade with and without a geotextile layer placed at the interface between the subgrade and the overlying granular layer. The investigations were conducted through repeated triaxial tests under various combinations of confining stress and cyclic principal stress difference.

Concept of Resilient Modulus

The standard method for resilient modulus testing is AASHTO T294 [21]. The objective of the test is to simulate the in-service behavior of unbound granular base/subbase materials and subgrade soils. AASHTO, in 1986 [22], recommended the use of resilient modulus as a fundamental property for characterizing subgrade soil and materials in the unbound layers of pavements. The resilient modulus (M_R) is determined for combination of deviator stress (σ_d) and confining stress (σ_3) by the following equation:

$$M_R = \sigma_d/\varepsilon_r$$

where ε_r = resilient (recoverable or elastic) axial strain

The AASHTO T-294 test procedure proposed separate steps for conditioning and testing of granular and cohesive soils as shown in Table 1.

Table 1. Summary of conditioning and loading sequences (AASHTO T-294)

Type 1 soil	**σ_3 (psi)**	**σ_d (psi)**	**No. of cycles**
Conditioning	15	15	1000
Testing	3	3, 6, 9	100 each
	5	5, 10,15	
	10	10, 20, 30	
	15	10, 15,30	
	20	15, 20, 40	
Type 2 soil	**σ_3 (psi)**	**σ_d (psi)**	**No. of cycles**
Conditioning	6	4	1000
Testing	6	2, 4, 6, 8, 10	100 each
	3	2, 4, 6, 8, 10	
	0	2, 4, 6, 8, 10	

1 psi = 6.89 kPa

Concept of Laboratory Testing Program

This study consists of repeated triaxial loading test carried out on specimens of 100 mm in diameter and 200 mm high. The lower half of the specimen was the soft subgrade soil and the upper half was the granular base layer. Although such specimen does not represent field conditions especially regarding scaling it represents an easy method to evaluate the resilient behavior of the system under repeated loading conditions, that represent the stresses in pavements subjected to moving loads. Due to the size of the specimen, it was decided to use scaled-down ‘model’ base material in the tests instead of aggregate material normally employed in the full scale roads in Saudi Arabia. A coarse sand from a wadi in Riyadh area was selected as a base material. The subgrade soil used in the test represent a typical soft subgrade type found beneath roads in Saudi Arabia. The subgrade soil was obtained from a site 240 km south of Riyadh.

Experimental Work

Testing apparatus

All experiments were conducted in resilient modulus testing apparatus with an electropneumatic loading frame. The apparatus was made by H&V materials Research and Development Inc. Specimens were subjected to a repeated deviator stress of fixed magnitude using a haversine shaped load pulse consisting of a 0.10 second load followed by a 0.90 second rest period. The deviator stress is measured with a load cell mounted within the triaxial cell, thereby eliminating load measuring errors caused by the friction between the load piston and the top of the triaxial cell.

Air was used as the confining fluid in the Plexiglas cell and pressure was measured by an air-pressure gauge mounted at the base of the triaxial cell. Externally mounted Linear Variable Differential Transducers (LVDTs) were used to measure recoverable axial deformations. Permanent axial deformations were measured by a dial gage and an LVDT mounted on opposite sides of the loading piston outside the triaxial cell. The resilient moduli were calculated for each loading sequence using a personal computer with a data reduction and analysis program. Figure 1 presents a photograph of the main components of the experimental setup.

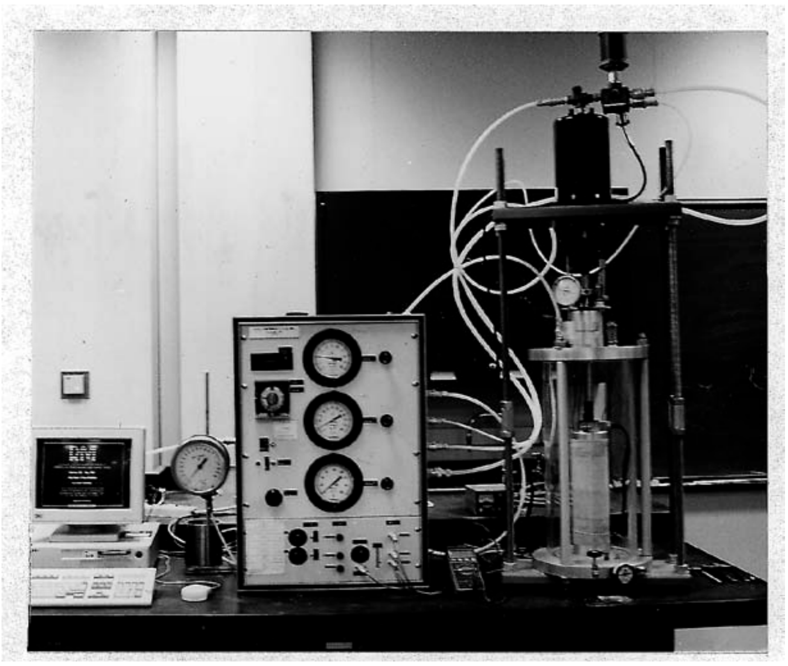

Fig. 1. Photograph of the experimental setup.

Soil and Geotextile Properties

Two different soils were employed in the study, a coarse sand (base material) and a clayey silty sand (subgrade material). Grain-size distribution curves for these materials are illustrated on Fig. 2. The characteristics of the two soils are summarized in Table 2. A nonwoven geotextile was used for all tests. The properties of this geotextile are given in Table 3.

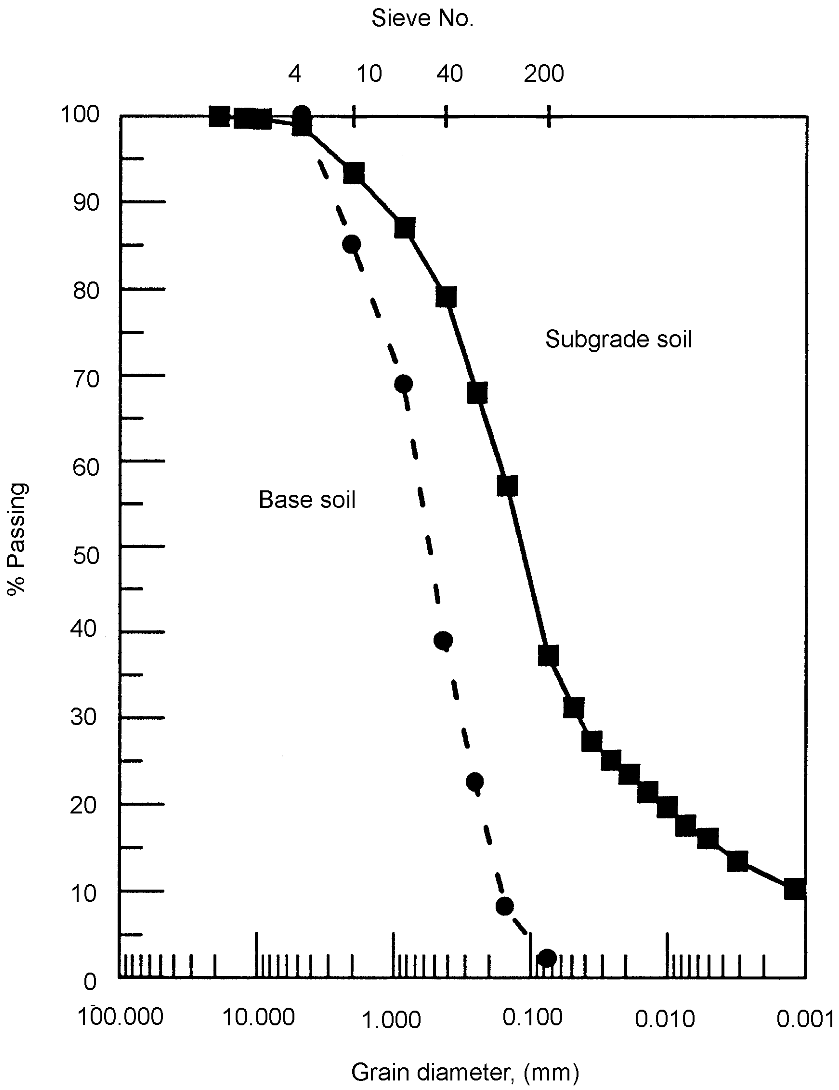

Fig. 2. Gradation of soils used in test program.

Table 2. Classification and index properties of soils used in testing program

Title	Base soil	Subgrade soil
Gravel (%)	-	1.1
Sand (%)	98.1	61.6
Silt (%)	1.9	26.3
Clay (%)	-	11.0
Liquid limit (%)	-	19.0
Plasticity index (%)	-	3.7
AASHTO classification	A-1-b	A-4
Unified classification	SP	SM
Specific gravity	2.76	2.72
Standard Proctor:	-	
MDD* (kN/m^3)	18.2	19.81
OMC**(%)	9.5	9.3
CBR at MDD & OMC	20	4

* MDD: Maximum dry density
** OMC: Optimum moisture content

Table 3. Engineering properties of geotextile tested

Parameter	Standard	Geotextile (F-2B)
Mass (g/m^2)	DIN 53854	140
Thickness (mm) at 2 kPa	DIN 53855	1.0
CBR-Test (N) (x-s)	DIN 54307	1200
Strip Test (kN/m)	ISO 10319	7/8
Elongation at break (%)		50/60
Grab-Test (N/2.5 cm)	DIN 53858	380/440
Elongation at break (%)		70/80
Tear Strength (N)	ASTM D-1117	160/160

Specimen Preparation

All samples were compacted into a split mold lined with a rubber membrane assembled on the triaxial cell base plate in layers of 25 mm thick with predetermined tamping compaction effort to achieve the maximum dry density at optimum moisture content. In order to attain a particular dry density, a trial and error procedure was adopted by which the number of blows by the tamper required per layer of soil to be compacted is predetermined. In preparing composite specimens of subgrade without geotextile, the subgrade soil was placed and compacted in the lower half, than the base material was placed and compacted in the upper half. In preparing the specimen with geotextile a geotextile disk having diameter of 98 mm was put horizontally on the top of the subgrade before compacting the base layer.

Specimen Conditioning and Loading Sequence

Each specimen was conditioned by applying 1000 cycles of 6 psi deviator stress at 4 psi confining stress. A complete test was then conducted starting with 6 psi deviator stress, 100 loading cycles were applied at confining stresses of 2, 4, 6, 8 and 10 psi. This loading process was than repeated for a deviator stresses of 4 and 2 psi. For each loading sequence the data was saved and reduced to obtain the mean resilient modulus. At the conclusion of each test, the permanent deformation was determined. All reported test values are averaged results from duplicate specimens.

It is important to note that according to AASHTO T-294 (21), base and subgrade soils used in this study should be classified as Type 2 materials for not meeting the criteria of less than 70% passing the No. 10 sieve and 20% maximum passing the No. 200 sieve. Exploratory tests conducted in this study indicated that AASHTO method of testing for Type 2 material, produced excessive deformation when using zero confining pressures. The present testing method has three combinations of confining stress levels of 6, 4 and 2 psi whereas AASHTO method of testing for Type 2 soil (Table 1) has 6, 3, and 0 psi, it is believed that the used method of testing is much appropriate for most practical purposes.

Results and Discussion

Resilient behavior

Two loading factors were investigated in this study, the deviator stress level and the confining stress. Plots of the averaged resilient moduli of subgrade soil as a function of cyclic deviator stress are shown in Fig. 3 for confining stresses of 41, 28 and 14 kPa. It is well known from the literature that fine grained soils usually exhibit stress-dependent behavior, it is evident from this figure that when increasing the deviator stress, the resilient modulus of subgrade soil decreased significantly especially at high confining stress. On the other hand, increasing confining pressure was found to increase the resilient modulus as shown in Fig. 3.

The resilient behavior of subgrade-base samples is shown in Fig. 4. The M_R values of composite samples (subgrade-base) were found to be higher than the subgrade samples alone. The typical curves presented in Fig. 4 show similar influence of the deviator stress obtained for subgrade samples. However, increasing confining stress can greatly increase the resilient modulus at any level of deviator stress. These results are logical, where resilient modulus of granular soil always increases with increasing confining stress which is referred to as ‘stress-hardening’ behavior.

The resilient behavior characteristics of subgrade-geotextile-base specimens were enhanced by the inclusion of a geotextile layer as shown in Fig. 5. Comparisons between subgrade-base system with and without geotextile show that inclusion of geotextile increases the resilient moduli and reduced the dependency of resilient moduli on the deviator stress. This behavior is attributed primarily to separation effect of geotextile between the granular layer and the soft subgrade soil and is partly attributed to the reinforcement effect in restraining the soft subgrade soil and confinement of the granular layer. A more detailed comparison will be illustrated when discussing the constants of the model for resilient modulus (Table 4).

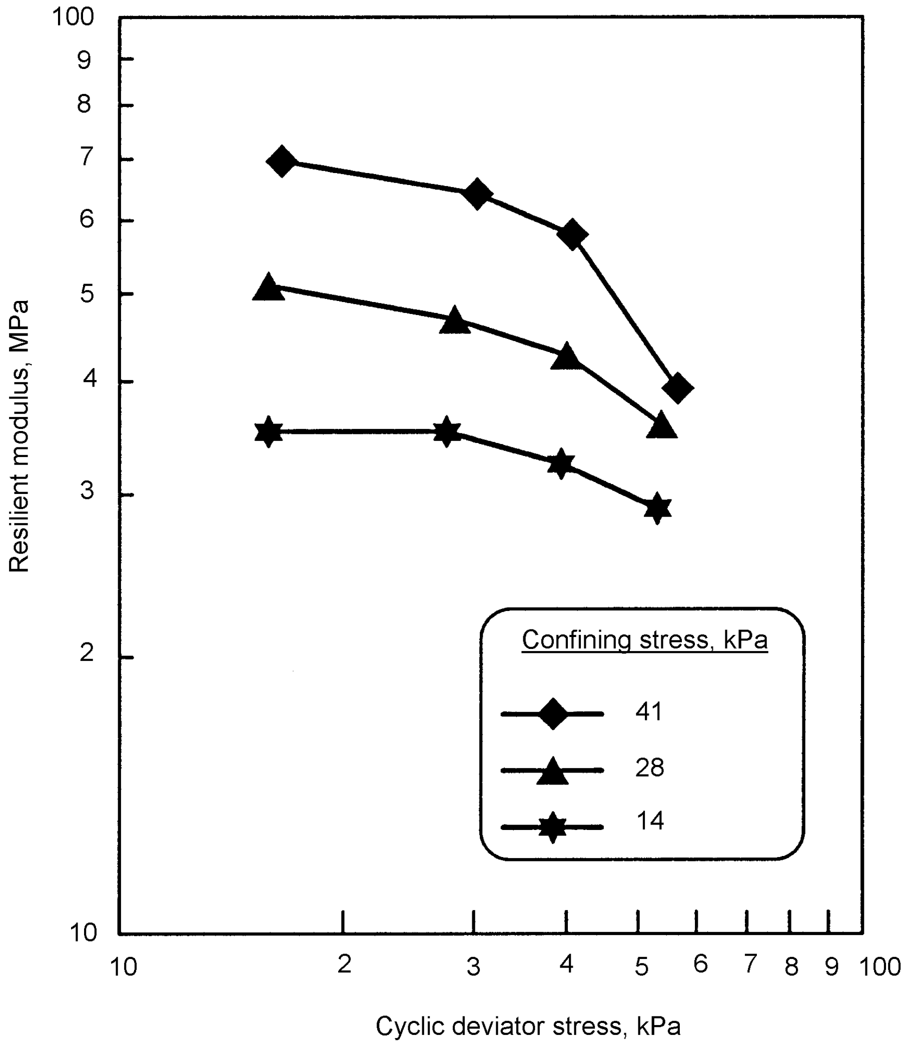

Fig. 3. Typical results of the resilient modulus vs. deviation stress for subgrade of soil sample.

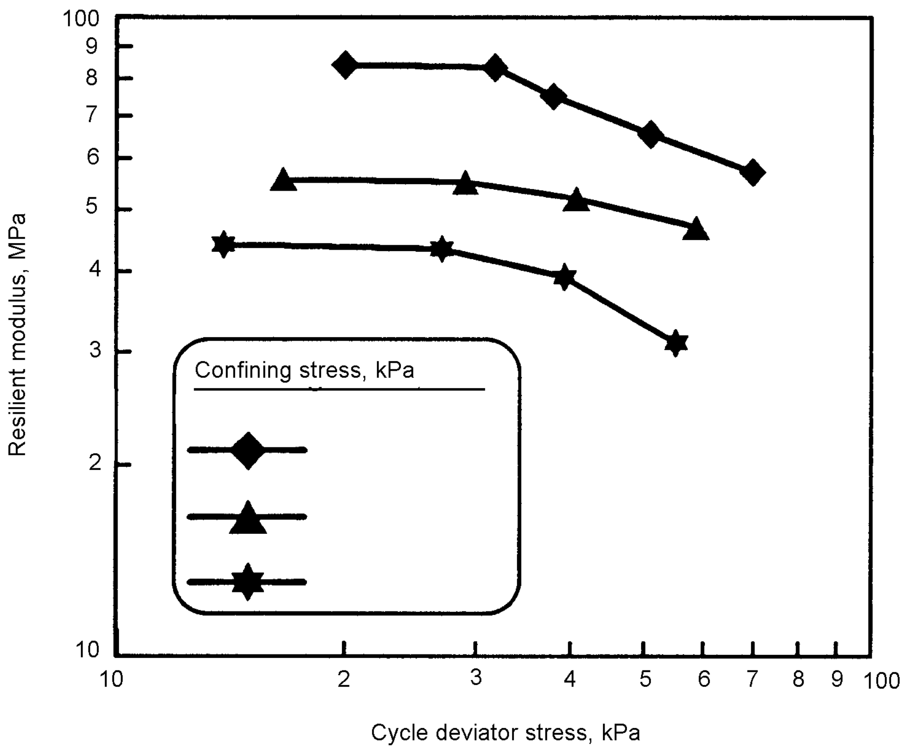

Fig. 4. Typical Results of the resilient modulus vs. deviator stress for subgrade-base sample.

Models for Resilient Modulus

In order to gain the most plentiful information from resilient modulus tests, several constitutive models have been proposed for describing the results of resilient modulus tests for cohesive and cohesionless soils. AASHTO proposed two models, the model recommended for cohesive soils is a relationship between resilient modulus and deviator stress (σ_d) and the model for granular soil describes M_R as a function of bulk stress ($\theta = \sigma_d + 2\sigma_3$) as shown in the following equations:

cohesive soil: $$M_R = k_1 (\sigma_d)^{k2} \quad (1)$$

granular soil $$M_R = k_3 (\theta)^{k2} \quad (2)$$

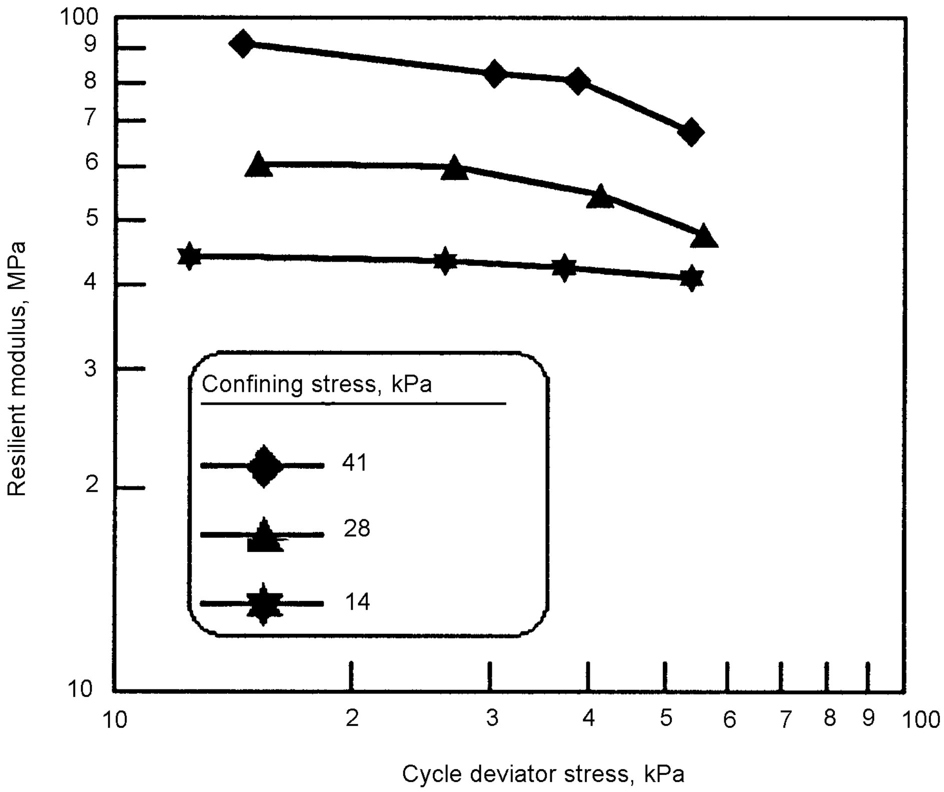

Fig. 5. Typical Results of the resilient modulus vs. deviator stress for subgrade- geotextile- base sample.

The resilient modulus of fine-grained soil according to equation (1) is mainly a function of the applied deviator stress, when single confining stress level is considered. The main disadvantage of Eq. (2) is that it does not adequately model the effect of deviator stress.

The results of resilient modulus test in this study are presented in a mathematical model that, directly, incorporates the stress sensitivity of the resilient modulus value in terms of both confining and deviator stresses regardless of the soil type. Pezo (23) defined this model by the following relationship:

$$M_R = k_1 \, (\sigma_d)^{k2} \, (\sigma_3)^{k3} \qquad (3)$$

where k_1, k_2 and k_3 are the material constants to be obtained from tests performed on the given soil.

Through non-linear regression analysis, using SPSS (24) software, values of k_1, k_2 and k_3 were determined for each set of data. A summary of these values with the coefficient of determination (R^2) is shown in Table 4.

Table 4 Summary of model parameters and typical M_R values

Specimen Type	**k_1**	**k_2**	**k_3**	**R^2**	**M_R* (kPa)**
Subgrade	19.799	-0.291	0.555	0.89	35.10
Subgrade-base	13.969	-0.225	0.658	0.91	49.40
Subgrade-geotextile-base	13.193	-0.167	0.632	0.92	56.40

* at σ_3 = 36 kPa and σ_d = 130 kPa

The value of k_1, represents resilient modulus value (kPa) at unit deviator and confining stresses. As k_2 approaches a value of zero, the soil is truly linear (constant M_R value for a given confining stress level), whereas larger negative values imply high sensitivity (stress-softening). For small values of k_3, the resilient modulus is less sensitive to change in confining stress, whereas large values indicate a greater degree of nonlinearity (stress-hardening).

As shown in Table 4, the weak subgrade soil, being highly nonlinear, shows relatively large reduction in M_R attributable to an increase in deviatoric stress. Inclusion of geotextile in the subgrade-base system greatly improved the resilient behavior of the system by reducing the tendency of stress-softening behavior as the value of k_2 increases from –0.225 to –0.167. There appears to be little change in k_3 due to geotextile inclusion, where the value of k_3 appears to decrease slightly. Thus the relative sensitivity for the confining stress is less pronounced with the inclusion of the geotextile.

A more convenient way of presenting the changes in resilient modulus with the inclusion of the geotextile is to evaluate the M_R values for a typical unpaved road section in Saudi Arabia. The load used in this study was a 40 kN single wheel load and a tire pressure of 550 kPa. Analysis using the multilayer elastic computer program, ELSYM5 (25) indicates that the subgrade confining pressure is typically 36 kPa and the deviator stress is around 130 kPa. A typical low-traffic-volume road section (203 mm of crushed stone) and a very soft subgrade were assumed. The predicted field values of confining and deviator stresses were substituted in the model, then using the values of laboratory k_1, k_2 and k_3 constants, the expected field resilient modulus values were calculated and summarized in Table 4. Inclusion of geotextile slightly increased the resilient modulus of subgrade-base system by about 14%. The magnitudes of change in resilient modulus obtained in this study confirm the finding of previous studies (16, 17) that the resilient modulus of subgrade-geotextile-base system is not significantly influenced by the presence of a geotextile.

Permanent Deformation

Unpaved roads when built over weak subgrade soils, are subjected to severe rutting, aggregate loss, and costly maintenance. Thus, increasing resistance to rutting which is a manifestation of improved plastic behavior could be of major significance to the overall performance of unpaved roads under applied traffic loads.

A comparison of accumulated plastic strain for the investigated samples is shown in Table 5. Inclusion of geotextile significantly reduced the permanent strain of the aggregate-subgrade system by about 50%. This behavior was substantiated from all previous research investigations. This behavior is probably due, at least in part, to the restraint of the granular layer by the geotextile, which significantly improve strength, stiffness and permanent deformation behavior of the granular layer. With separation effect of the geotextile, integrity of the granular layer is maintained, which distribute evenly the stress imposed on the subgrade, compared to that without geotextile.

Table 5 Summary of permanent strain

Specimen type	Permanent strain (%)
Subgrade	10.32
Subgrade base	7.44
Subgrade-geotextile-base	3.91

Conclusion

This study has been undertaken with the aim of understanding the resilient behavior of geotextile reinforced granular layer resting on weak subgrade soil. Particular emphasis has been placed on the effect of confining and deviator stresses on the resilient behavior of base-subgrade system reinforced with a nonwoven geotextile layer. Based on the results of this laboratory study, the following conclusions can be drawn, which are applicable to the materials used and the test conditions adopted:

1. The resilient modulus of subgrade-geotextile-base system increases as the confining stress increases and decreases as a deviator stress increases.
2. The regression analysis demonstrated that it is possible to determine the resilient modulus of subgrade-geotextile-base system using the relationship suggested by Pezo (23).
3. In contrast to the relatively minor influence of geotextile inclusion on k_3, the influence of geotextile on k_2 is significant, thus the relative sensitivity of subgrade-geotextile-base system for changes in deviator stress is less pronounced than for subgrade-base system.

4. The models proposed by AASHTO (equations 1 and 2) may not be capable of predicting the change of resilient modulus of subgrade-geotextile-base system due to variation of confining and deviator stresses.
5. The inclusion of nonwoven geotextile in subgrade-geotextile-base system showed only minor increase that amounts to about 14% in the resilient modulus of the system.
6. The presence of geotextile improved the plastic behavior and reduced the permanent deformation of subgrade-geotextile-base system by about 50%.

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References

[1] Bender, D.A. and Barenberg, E.J. "Design and Behavior of Soil-Fabric-Aggregate System". *Transportation Research Record,* 671 (1978), 64-75.
[2] Nishigata, T. and Yamooka "Ultimate Bearing Capacity of Unpaved Road Reinforced by Geotextile". *Proceedings of the International Symposium on Earth Reinforcement Practice*. Fukuoka: Japan, 1 (1992), 659-664.
[3] Kinney, T. "Small Scale Load Test on a Soil-Geotextile-Aggregate System". *Proceedings of Second International Conference on Geotextiles*. Los Vegas: USA, 2 (1982), 405-409.
[4] Haliburton T.A. and Barron, J.V. "Optimum-Depth Method for Design of Fabric-Reinforced Unsurfaced Roads". *Transportation Research Record,* 916 (1983), 26-32.
[5] Yasuhara, K., Hiroo, K., Miura, N., Yamanouchi, T. and Ryokai, K. "The Use of Geotextile Against Settlement of Soft Clay Under Cyclic Loading". *Proceedings of the Third International Conference on Geotextiles*, Vienna: Austria, 1 (1986), 193-198.
[6] Nishigata, T. and Yamaoka, I. "Ultimate Bearing Capacity of Unpaved Road Reinforced by Geotextile". *Proceedings of the International Symposium on Earth Reinforcement Practice*, Fukuoka, 1 (1992), 659-664.
[7] Sowers, G.F., Collins, S.A. and Miller, D.G. "Mechanism of Geotextile-Aggregate Support in Low-Cost Roads". *Proceedings of Second International Conference on Geotextiles,* Los Vegas: USA, 2 (1982), 341-346.
[8] Fannin, R.J. and Sigurdsson, O. "Field Observations on Stabilization of Unpaved Roads with Geosynthetics". *Journal of Geotechnical Engineering, ASCE*, 122, No. 7 (1996), 544-553.
[9] Robnett, Q.L. and Lai, J.S. "Fabric-Reinforced Aggregate Roads – Overview". *Transportation Research Record,* 875 (1982), 42-50.
[10] Hausmann, M.R. "Fabric Reinforced Unpaved Road Design Methods – Parametric Study". *Proceedings of Third International Conference on Geotextiles*, Vienna: Austria, 1 (1986), 19-24.
[11] Giroud, J.P. and Noiray, L. "Geotextile-Reinforced Unpaved Road Design". *Journal of Geotechnical Engineering Division, ASCE*, 107, GT9 (1981), 1233-1254.
[12] Raad, L. "Reinforcement of Transportation Support Systems Through Fabric Prestressing". *Transportation Research Record,* 755 (1980), 49-51.
[13] Friedli, P. and Anderson, D.G. "Behavior of Woven Fabrics Under Simulated Railway Loading". *Proceedings of Second International Conference on Geotextiles*, Los Vegas: USA, 2 (1982), 473-478.

[14] Rao, G.V. "Use of Geosynthetics in Roads". *Proceedings of Thirteenth International Conference on Soil Mechanics and Foundation Engineering*, New Delhi: India, 5 (1994), 327-328.

[15] Saxna, S.K. and Chiu, D., "Evaluation of Fabric Performance in a Rail-Road Systems". *Proceedings of Second International Conference on Geotextiles*, Los Vegas: USA, 2 (1982), 485-490.

[16] Andersson, O. "The Use of Plastic Fabric for Pavement Protection During Frost Break". *Proceedings of International Conference on the Use of Fabrics in Geotechnics*, Paris: 1 (1977), 143-149.

[17] Brown, S.F, Pappin, J.W. and Brodrick, B.V. "Permanent Deformation of Flexible Pavements". *European Research Office, U.S. Army, Univ. of Nottingham*, Nottingham: England, Final Report, 1980.

[18] Thompson, M.R. and Raad, L. "Fabric Use in Low-Deformation Transportation Support System". *Transportation Research Record,* 810 (1981), 57-60.

[19] Barksdale, R.D., *et. al.* "Laboratory Determination of Resilient Modulus for Flexible Pavement Design". *NCHRP Report* 1-28, Georgia Institute of Technology, 1990.

[20] Thompson, M.R. and Robnett, Q.L. "Resilient Properties of Subgrade Soils". Final Report, Illinois Cooperative Highway and Transportation Series 160. Department of Civil Engineering, Univ. of Illinois at Urbana-Champaign, (1976).

[21] American Association of State Highway and Transportation (AASHTO). AASHTO Interim Method of Test for Resilient Modulus of Unbound Granular Base/Subbase Materials and Subgrade Soils – SHRP Protocol P46". AASHTO designation: T-294-92, Washington, D.C., 1992.

[22] AASHTO Guide for Design of Pavement. American Association of State Highway and Transportation Officials, Washington, D.C., 1986.

[23] Pezo, R.F. "A General Method of Reporting Resilient Modulus Test of Soil. A Pavement Engineer's Point of View". *Transportation Research Board*, 72nd Annual Meeting, Washington, D.C., 1993.

[24] SPSS Inc. Statistical Analysis Computer Program, SPSS for Windows, Release 6.0, Chicago, Illinois, 1993.

[25] Kopperman, S., Tiller, G, and Tseng, M. "ELSYM5 Interactive Microcomputer Version, User's Manual, IBM-PC Compatible Version, Report No. FHWA-TS-(1986), 87-206.

سلوك الرمال المقوّاة بالأنسجة فوق طبقة أساس ضعيفة

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(استلم في ١٩٩٩/٥/١م؛ وقبل للنشر في ١٩٩٩/٩/٢٩م)

ملخص البحث. يؤدي استخدام الأنسجة في الطرق غير المعبّدة إلى توفير عدّة إسهامات منها الفصل والتسليح حيث يمكن تقليل التخدد، تكاليف الصيانة وتحسين الأداء العام لتلك الطرق. نتائج الدراسات المتوافرة حول سلوك الطرق غير المعبّدة باستخدام الأنسجة محدودة ومتضاربة.أجريت في هذه الدراسة عدّة اختبارات دورية ثلاثية المحور لمعرفة السلوك المرن واللدن للنظام المكوّن من قاعدة الرصف، النسيج و قاعدة الأساس.

دلّت النتائج على أن وجود النسيج لم يؤدي إلى زيادة مؤثرة لمعامل الرجوعية (زيادة في حدود ١٤% فقط) بينما انخفض مقدار الهبوط الدائم بنسبة ٥٠%.