Optimum-Depth Method for Design of Fabric-Reinforced Unsurfaced Roads

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In recent years, the use of engineering fabric, when placed directly on the subgrade and covered with a single aggregate layer, has been a cost-effective alternative in unsurfaced road construction, especially on soft subgrades. Most fabric-reinforced unsurfaced road design criteria use Boussinesq stress-distribution theory to determine the amount of aggregate cover on the fabric. The research presented in this paper shows that placement of an optimum depth of aggregate on the fabric, when related to the width of the loaded area and independent of subgrade strength and wheel load, will increase strength and deformation resistance of the aggregate cover and produce significant Burmister-type modular ratio stress reductions at the subgrade surface. An alternate method for the design of fabric-reinforced unsurfaced roads, based on the described research, is presented. The method requires significantly less aggregate cover on the engineering fabric than predicted by other current methods of fabric-reinforced road design.

In recent years, engineering fabrics, or permeable artificial fiber textiles, have been widely used in the design and construction of unsurfaced low-volume or temporary unsurfaced roads, usually where soft subgrades are encountered. The fabric is placed directly on the subgrade or on a prepared working table and then covered with a single layer of cohesionless or low-plasticity aggregate base (fabric cover material). Such fabric-reinforced roads can be a cost-effective alternative to other methods of soft subgrade unsurfaced road construction.

Currently available design criteria for fabric-reinforced unsurfaced roads make use of the flexible-pavement-based physical distance separation concept; i.e., increasing the thickness of aggregate cover material with decreasing subgrade strength or increasing wheel load. Based on current research, an alternate design approach is presented in which the aggregate thickness is independent of subgrade strength or wheel load, is a constant, and is controlled by design vehicle tire size.

CONCEPTS IMPORTANT IN FABRIC-REINFORCED ROAD DESIGN

Three concepts are important when considering the use of fabrics in soft subgrade unsurfaced road construction: load-carrying ability of the subgrade and fabric cover material (base) road system, fabric survivability, and field workability of the fabric.

Load-Carrying Performance

Four mechanisms have been found to give improved performance for fabric-reinforced road systems on soft subgrade: material separation, subgrade restraint, lateral restraint reinforcement of cohesionless material placed above the fabric, and membrane-type support. Contributions from these four sources are summarized below.

1. Material separation: When placed between soft subgrade and overlying cohesionless material, engineering fabric prevents subgrade intrusion and mixing of the two soils, thus preserving the original design. Although the use of fabric for separation does not in itself strengthen the road system, it does allow dissipation of excess subgrade pore pressures and subgrade consolidation, which will cause long-term subgrade strength improvement. This factor allows the road to improve, rather than degrade, with time and number of load repetitions.

2. Subgrade restraint: Steward and others (1) found that the presence of fabric and cover material prevented punching or local shear failure of soft subgrade soils; instead, it caused such subgrades to fail in general shear when overloaded. The net effect of fabric-induced subgrade restraint is to increase allowable cohesive subgrade bearing capacity by a factor of approximately 1.8. This strength gain is available only for weak subgrades that would normally fail in local shear, and, according to Steward and others (1), improvement in load-carrying ability from subgrade restraint will occur only for subgrades with a California bearing ratio (CBR) of 3 or less.

3. Lateral restraint reinforcement of fabric cover material: Research by Haliburton and others (2) determined that maximum restraint reinforcement of cohesionless soil placed above a geotextile would occur when the geotextile was located to interfere with normal cover soil (base material) shear failure patterns. Placement of cover material to a depth of 0.33B over the geotextile [where B was the width of the loaded area (tire footprint)] was found to give optimum performance. Placement of the geotextile at shallower or deeper depths was found to cause a decrease in performance. Placement of the geotextile at the optimum depth was found to greatly increase the ultimate strength and deformation modulus of cohesionless material above the fabric, and there was potential for significant Burmister-type stress reduction at the subgrade surface below the geotextile.

4. Membrane-type support: If an engineering fabric is strained in place, normally through deformations associated with wheel-path rutting, it must develop tensile stress. The vertical component of such tensile stress will reduce the effective wheel load transmitted to the subgrade (3), with the amount of membrane support developed being proportional to fabric tensile stress-strain modulus.

Improvements in road performance from use of a fabric may accrue from one or all of the above factors, depending on the specific design criteria used.

Fabric Survivability

An engineering fabric cannot perform any function unless it survives initial placement and covering. Thus, fabric survivability is defined as resistance of the fabric to the destructive forces imposed during actual road construction and in-service operation. The magnitude of these forces will be dependent on existing subgrade conditions, type of prior site preparation conducted (if any), type and angularity of cover material, and type of equipment used for road construction. More detail is available elsewhere (4).

Field Workability of Fabric

The field workability of fabric is defined as the ability of the fabric to support the contractor's workmen in an uncovered state when laid directly on the subgrade and also support the contractor's equipment during initial placement of the cover

Figure 1. Use of engineering fabric to cause interference with normal soil shear deformation patterns.

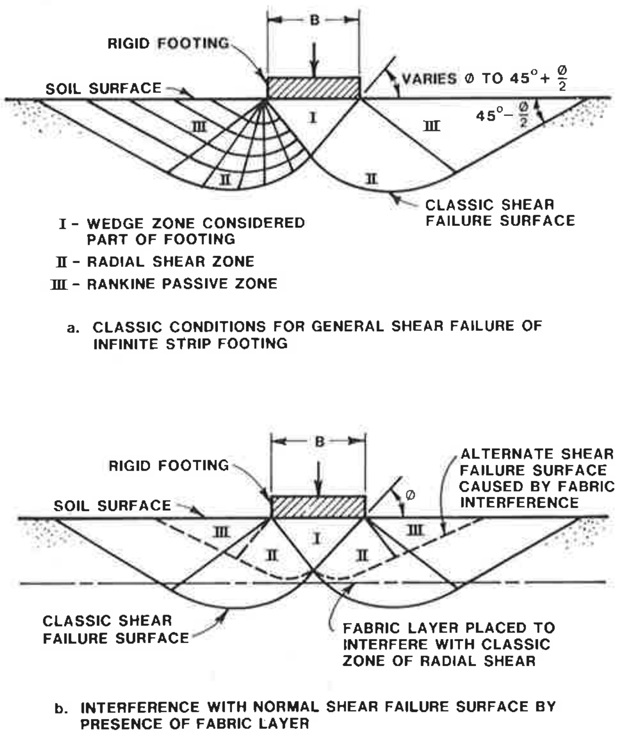
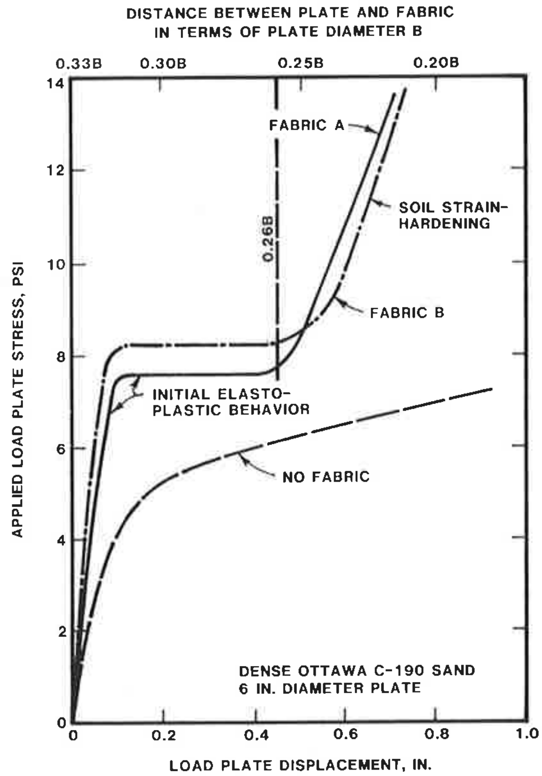


Figure 2. Effect of optimum-depth fabric placement on soil mass load-deformation behavior.



material. When construction on extremely soft soils is contemplated, such that mobility problems are encountered by both workmen and equipment on the existing soil and essentially all construction work must be conducted on the fabric, materials with high field workability or stiffness have been found to allow much more expedient and cost-effective construction. Field workability has been related to ASTM D-1388 fabric stiffness, and requirements increase as subgrade strength decreases. More detail is available elsewhere (4).

PREVIOUS RESEARCH ON OPTIMUM FABRIC DEPTH

In previous laboratory research conducted on model dense Ottawa sand (ASTM C-190) subgrade, Haliburton and Lawmaster (5) determined that covering the fabric with cohesionless material to an optimum depth of 0.5B tan ϕ (where B was the width of the loaded area and ϕ the angle of internal friction for the cohesionless fabric cover material) gave a marked increase in the load-deformation resistance of the cover material compared to similar test conditions when the fabric was omitted. They postulated that placement of the fabric [as shown in Figure 1 (5)] to interfere with normal shear deformation patterns for the fabric cover material, which caused increased lateral confinement in the zones of radial shear under the loaded area and forced development of a new shear failure surface above the fabric, was responsible for increased load-deformation resistance, such as that shown in Figure 2 (5). (Note: In Figure 2, there is one order of magnitude difference in strength and modulus of fabrics A and B.) Based on experimental measurements, an optimum depth of 0.33B was found to approximate the theoretical 0.5B tan ϕ optimum embedment depth.

In other experiments, where the fabric was initially placed at a distance beneath the cover material surface greater than approximately 0.33B, no improvement in load-deformation behavior (when compared to the no-fabric case) was noted until after cover material shear failure sinkage of the loaded area brought the load to within approximately 0.33B of the fabric. In extrapolating results of greater-than-optimum-depth fabric placement to unsurfaced airfield runway and roadway applications, Haliburton and Lawmaster (5) noted that tnis effect would cause excessive load sinkage (wheel-path rutting) to mobilize effects of fabric reinforcement.

The optimum-depth concept was verified by using various nonwoven and woven fabrics that had more than two orders of magnitude difference in tensile strength and tensile deformation modulus, with and without fabric prestressing. All load-deformation relations for fabric-reinforced soil were similar, which led to the conclusion that, for reinforcement of material above the fabric, position was more important than fabric type.

In all experiments, the effects of fabric subgrade restraint were eliminated because of the high-strength model subgrade, and the effects of membrane-type fabric support were eliminated because insignificant fabric deformations occurred during testing. By noting the marked improvement in load-deformation modulus obtained for the fabric-reinforced cover material, Haliburton and Lawmaster (5) postulated that a significant modular ratio might be developed between the fabric-reinforced cover material and softer subgrades, thereby causing a significant stress reduction at the subgrade surface from Burmister effects (6). They also concluded that classic bearing failure per se could not occur in the cohesionless material placed an optimum depth above the fabric. Thus, overload failure of a subgrade and fabric cover material system must occur in the subgrade.

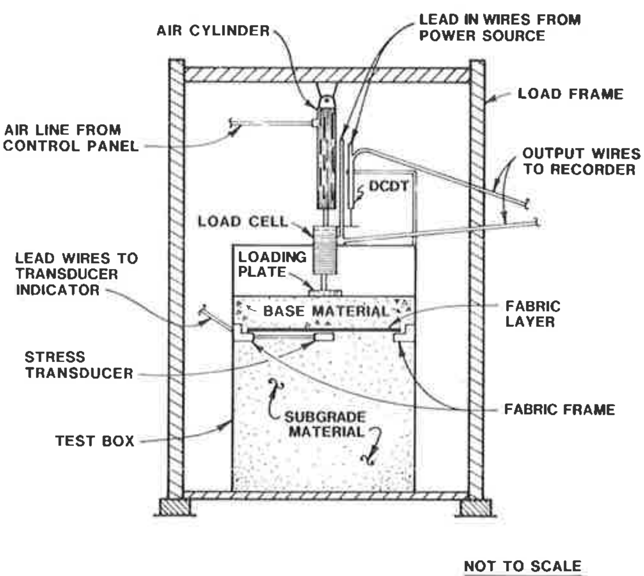
In order to extend the optimum-depth concept to

Table 1. Properties of engineering fabrics evaluated in test program.

Designation	Manufacturer Trade Name	Fabric Description	Fabric Direction Tested[a]	Secant Modulus at 5 Percent Strain[b] (lb/in.)	Ultimate Tensile Strength[b] (lb/in.)	Ultimate Tensile Strain[b] (%)
Fabric M	Geolon 200	Woven polypropylene;	M	460	160	34
		slit film	CM	1,100	162	22
Fabric S	Geolon 400	Woven polypropylene;	M	700	284	36
		monofilament	CM	900	185	26
Fabric VS	Geolon 1250	Woven polypropylene;	M	1,700	1,050	20
		multifilament	CM	460	238	15

[a]M = Machine direction and CM = cross-machine direction.
[b]Results of wide strip tensile tests (4).

Figure 3. Apparatus used in model subgrade, fabric, and base load testing program.



soft subgrade conditions, verify the significant Burmister stress reduction from optimum-depth reinforcement, and investigate effects of membrane-type support on soil-fabric system load-carrying performance, additional research was conducted.

EXTENSION OF OPTIMUM-DEPTH CONCEPT TO SOFT SUBGRADES

Engineering Fabrics Used in Test Program

Although previous research (5) had indicated that optimum-depth reinforcement effects were essentially independent of fabric type on good subgrades, three moderate to very high strength geotextiles were selected for use in the soft subgrade testing program to reverify the concept and also to facilitate an investigation of potential fabric membrane-type support. Table 1 summarizes data for the three woven engineering fabrics, including tensile strength and secant modulus at 10 percent elongation. Fabrics were supplied by the Nicolon Corporation of Atlanta, Georgia. As may be noted from Table 1, an approximate order of magnitude variation in tensile strength and tensile modulus occurred among the three fabrics, denoted hereafter as fabric M (moderate strength), fabric S (high strength), and fabric VS (very high strength).

Materials Used to Model Base and Subgrade

In order to determine the effect of varying base (fabric cover) material types on relatively soft subgrade, two soils were used to represent base materials commonly used in the construction of unsurfaced roads on soft subgrade. A well-graded nonplastic crushed limestone, which had 100 percent passing the No. 4 sieve, 100 percent retained on the No. 200 sieve, a uniform coefficient (C_u) of 18.3, and a compacted CBR of approximately 30, was chosen to represent a medium-quality base material. Dense Ottawa 20-30 (ASTM C-190) sand with a CBR of approximately 10 was chosen to represent a low-quality base material used in areas where better material is not available.

Selection of materials to represent soft subgrades was based on the need to obtain mediums that could be prepared with a minimal amount of effort so that many tests could be conducted and repeatable strength of subgrade achieved. The material selected to represent a low-strength subgrade included Perlite, which is a volcanic glass expanded by heat to form a lightweight aggregate that is commonly used in concrete and plaster and frequently mixed with soil for greenhouse applications. After conducting numerous tests, it was found that Perlite could be prepared as a subgrade by using a concrete vibrator, and CBR values of 1±0.1 were consistently measured. Load-deformation behavior of the Perlite model subgrade under plate bearing tests was found markedly similar to that of a soft cohesive soil.

Other materials used as test subgrade included a white Georgia Kaolinite clay that had a liquid limit of 70 and a plastic limit of 33, which was used (at varying water contents) to simulate subgrades with CBR values less than 1, and loose Ottawa C-190 sand, which was used to simulate subgrades with a CBR of approximately 2.

Experimental Design

Figure 3 shows a simplified drawing of the load-testing apparatus used in the soft subgrade test program. Test soil and soil-fabric systems were compacted and placed in 24-in.², 30-in.-deep reinforced Lucite test boxes. Load was supplied to 4- and 6-in.-diameter circular steel loading plates by Schraeder air cylinders with 2- or 6-in.-diameter pistons and 12-in. stroke. The air-loading system was chosen to allow rapid load following when bearing failure of either the fabric cover material or subgrade allowed rapid system deformations. Applied load was monitored with BLH Model U1 strain-gauge load cells of either 2,000- or 5,000-lb capacity, and vertical displacement of the loading plate was monitored by a Hewlett-Packard Model 3000 direct current displacement transducer. Loads and corresponding displacements were continuously recorded on a Sargent-Welch Model DSRG-2 dual-pen strip chart recorder.

Loading was applied by sequential incrementation

of air pressure controlled by a Western Pacific Micromaster Model WP6001 microprocessor controller. Stresses at various locations within the soil-fabric system were measured with Precision Instruments Model 156 miniature pressure transducers and a Model 8 strain indicator.

Test Procedures

Test procedures were designed to isolate the effects of fabric-caused Burmister-type modular ratio stress reduction and fabric membrane-type support. A testing matrix was developed for the three different fabric types (slit-film woven fabric M, monofilament woven fabric S, and multifilament woven fabric VS), three subgrade types (kaolinite, Perlite, and loose Ottawa sand), and the two different geotextile cover materials (well-graded crushed limestone and dense Ottawa sand). In general, three replicate tests were conducted for each cover material, fabric, and subgrade combination, with additional testing conducted if discrepancies were noted among test results.

Miniature pressure transducers were initially placed at various locations in the soil-fabric system, but after evaluation of initial test data, it was determined that the desired information could be obtained by placement of a single pressure transducer on the prepared model subgrade surface immediately beneath the fabric and centered directly under the load plate. Two sizes of circular steel load plate (4 and 6 in. diameter) were used during the initial portions of the test program. However, review of initial data indicated that consistent results were obtained between the two plate diameters; therefore, the majority of testing was conducted with a 6-in.-diameter load plate, which approximated the contact width of a standard passenger car tire.

Two types of testing were conducted sequentially for each model base, fabric, and subgrade system to monitor elastic and plastic behavior. In the elastic range before either subgrade or cover material bearing failure, initial testing was conducted by sequentially increasing the load plate stress while measuring corresponding load plate deformation and stress level at the subgrade surface to evaluate Burmister-type modular ratio effects caused by the three different types of fabrics. These data were compared with data obtained for homogeneous dense sand and similar thickness base and subgrade systems without fabric. Relations among applied load plate stress, load plate deformation, and stress at the subgrade surface were recorded until plastic bearing failure occurred in either the fabric cover material or the subgrade.

In general, and especially for the Perlite and kaolinite subgrades, system failure occurred in the subgrade, with resulting vertical subgrade displacement, elongation of the anchored fabric, and subsidence of the fabric cover material and load plate. Once plastic equilibrium conditions were established, loading was continued until a total deformation of approximately one-half the load plate diameter or more had been obtained. Average fabric elongation caused by plastic subgrade deformation was also estimated.

Test Results and Discussion

Typical modular ratio effects determined for elastic-type system behavior are shown in Figure 4 for low applied stress levels. A 6-in.-diameter load plate was used with a 2-in. fabric cover material thickness of dense Ottawa sand over Perlite (CBR = 1) subgrade. The figure shows the relation between stress applied to the load plate at the sand surface and stress measured experimentally at the top of the model subgrade (2-in. depth) for homogeneous dense sand, 2 in. of dense sand cover on Perlite without fabric, and 2 in. of dense sand cover with the three different fabrics. The Boussinesq theoretical stress relation calculated at the center of the circular loaded area 2 in. below the surface (of a homogeneous, isotropic material) is also plotted in Figure 4.

As may be noted from Figure 4, theoretical Boussinesq values agree reasonably well with the stress measured in homogeneous dense sand. Because of the difference in the modular ratio between the 2-in. dense sand cover and CBR 1 Perlite subgrade, some Burmister-type stress reduction is noted without fabric; but when the fabric is used to provide interference with cover material deformation patterns and give increased load-deformation resistance, a markedly greater Burmister-type stress reduction (amounting to approximately 50 percent of the Boussinesq theoretical value) is noted. Further, as may be noted in Figure 4, the Burmister-type stress reduction is essentially independent of fabric type. Similar results were obtained when the plate size was decreased to 4 in. diameter and a 1.33-in. dense sand cover was used. At higher stress levels similar results were also obtained, and slightly better than a 50 percent Boussinesq theoretical stress reduction was obtained for crushed limestone fabric cover material, as shown in Figure 5.

Similar results (with an approximate 50 percent Boussinesq theoretical stress reduction) were obtained for the CBR 2 loose sand model subgrade, and somewhat greater than 50 percent stress reduction was obtained for the CBR < 1 kaolinite model subgrade. These results tended to be more erratic because of variations in placement density and water content of the wet clay and the large system deformations measured, even during elastic behavior.

Model system loading was carried out until large deformations, on the order of 3 in. for the 6-in.-diameter plate, had been obtained. As shown in Figure 6, fabric-reinforced behavior was better than no-fabric behavior, but no marked difference was noted among the three fabrics tested, thereby indicating that the membrane-type support component contributed little to the total load-carrying ability of the model base, fabric, and subgrade system. When fabric strains were computed and fabric tensile modulus data from Table 1 used, calculations based on both fabric deformation conditions observed during model testing and the fabric road rutting model developed by Kinney and Barenberg (3) showed that even the highest tensile modulus fabric would offer only a small contribution to total load resistance, hence confirming the experimental data.

DEVELOPMENT OF OPTIMUM-DEPTH ROAD DESIGN CRITERIA

Based on obtained test data and previously known relations concerning fabric-reinforced behavior of unsurfaced roads, optimum-depth fabric-reinforced unsurfaced road design criteria were developed. Procedures used to evaluate expected vehicle performance are given below.

1. Determine the maximum vehicle tire pressure (P) and the wheel load (Q) to which the road will be subjected.
2. Knowing the real or equivalent tire footprint width (B), calculate the approximate length of the loaded area (L) by using the relation

$$L = Q/(PB) \quad (1)$$

3. Apply Boussinesq theory (7) and, by using Q,

B, and L, determine the predicted stress at a depth of 0.5B tan ϕ below the wheel load (where ϕ is the angle of internal friction for the cohesionless geotextile cover material). Alternatively, a depth of 0.33B may be used.

Figure 4. Burmister-type stress reduction measured at model subgrade surface for optimum-depth fabric-reinforced system with CBR 10 fabric cover material.

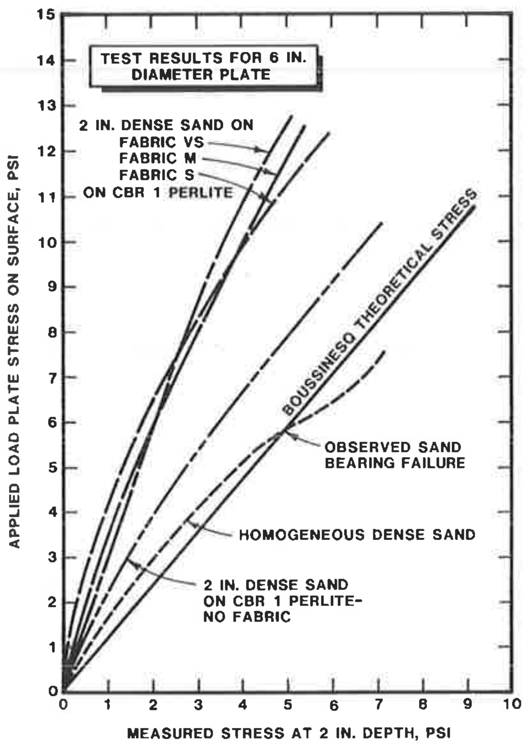
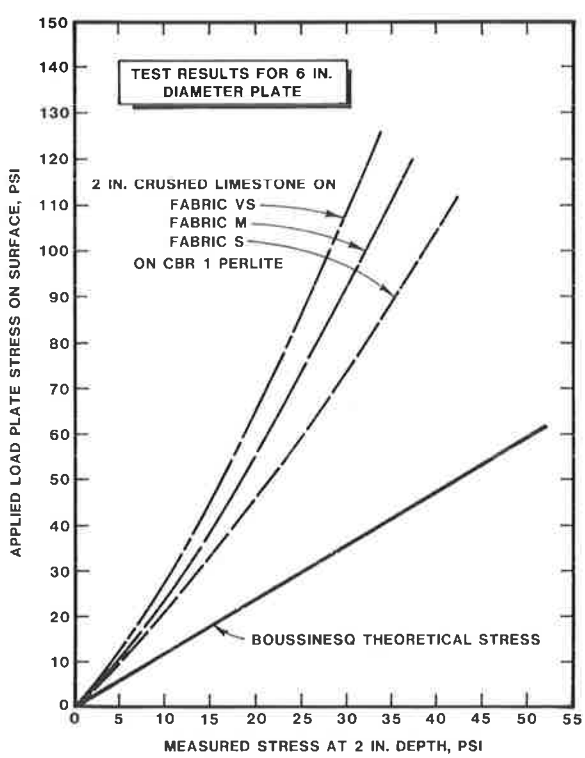


Figure 5. Burmister-type stress reduction measured at model subgrade surface for optimum-depth fabric-reinforced system with CBR 30 fabric cover material.



4. Multiply the predicted stress by 0.5 to obtain the 50 percent Burmister stress reduction from optimum-depth reinforcement, and compare this reduced stress to the allowable bearing capacity at the subgrade surface, based on ultimate bearing capacity considerations and by incorporating whatever factor of safety is desired.

5. If the predicted stress is less than the allowable stress for the subgrade, the optimum-depth road design criteria will perform satisfactorily. In this case, the design thickness of fabric cover material equals approximately 0.33B.

6. Conversely, if the predicted stress is greater than the allowable stress, unsatisfactory subgrade performance will result and an alternate method of fabric-reinforced unsurfaced road design, based on concepts of physical distance separation, must be used. In this case, use of the U.S. Forest Service road design criteria (3) is recommended. More detailed information on optimum-depth design theory is available elsewhere (4).

As a practical matter, optimum-depth design concepts will work for the majority of resonable design cases, with subgrade overstress occurring on weak (CBR < 1) subgrades and above design or legal load limits for trafficking vehicles.

Road design curves may also be produced by using the methodology. Typical curves are shown in Figure 7 for standard dual-tire, single- and tandem-axle trucks. The curves are used by constructing a vertical line from the horizontal subgrade strength axis (A) and a horizontal line from the vertical axle load axis (B), and then determining the maximum allowable vehicle tire pressure (C) at their intersection. If the maximum allowable tire pressure exceeds the operating pressure in the vehicle tires, the optimum-depth design criteria will provide sat-

Figure 6. Load-deformation behavior for model subgrade, fabric, and base system.

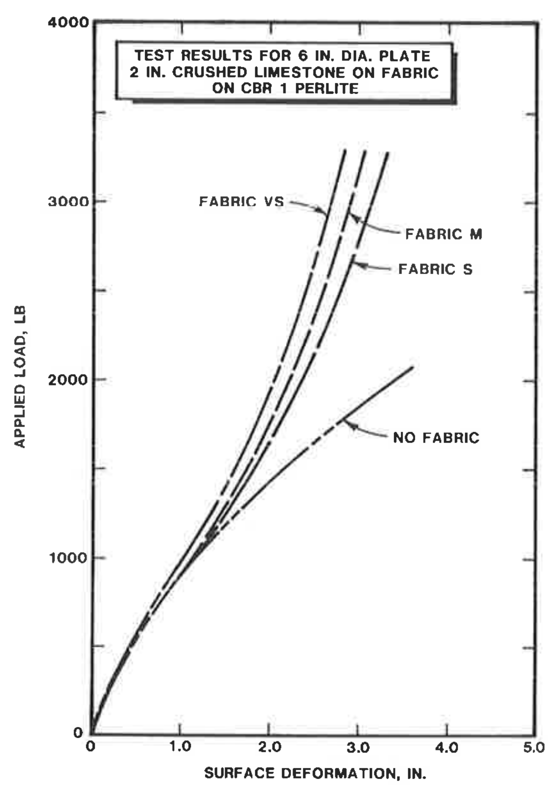
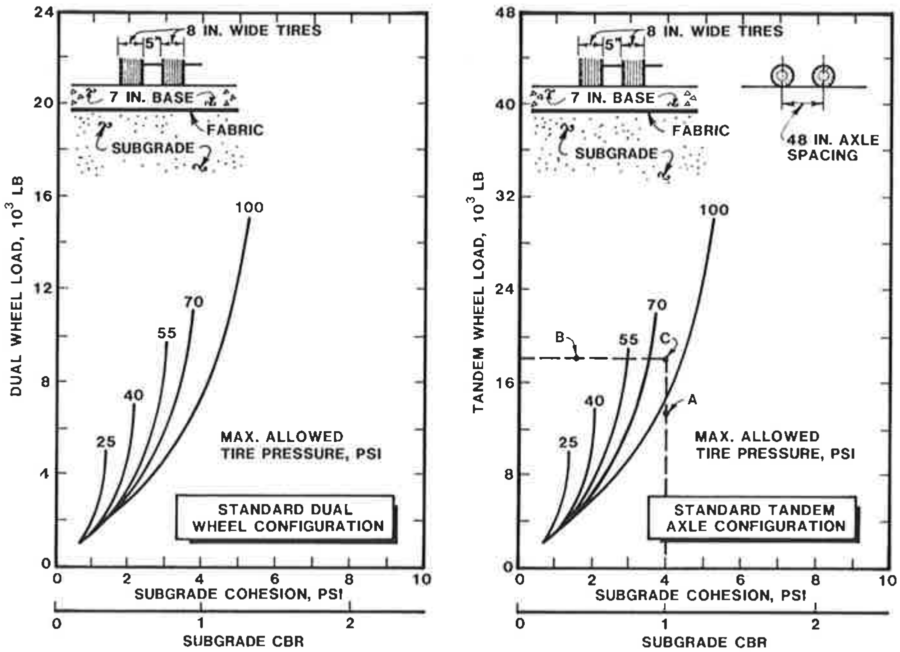


Figure 7. Typical unsurfaced road design curves using optimum-depth concept.



isfactory performance. The required thickness of aggregate cover on the fabric (7 in. of densely compacted cohesionless material) is shown in the upper portions of the figure. Similar curves for other actual or equivalent tire sizes are available elsewhere (4,8), as are data and procedures for fabric cover material selection, road construction procedures, and fabric selection criteria based on site-specific fabric survivability and field workability considerations.

The presented optimum-depth design method for unsurfaced fabric-reinforced roads has two obvious advantages. First, it is simplistic in that the depth of the aggregate cover on the fabric remains at a constant thickness necessary to provide reinforcement and produces a maximum Burmister-type stress reduction. Use of a less-than-optimum thickness will reduce fabric anchorage away from the loaded area and increase stress on the subgrade. Use of a greater-than-optimum thickness will cause loss of the Burmister-type stress reduction and also result in subgrade overstress. Second, for soft subgrades, the optimum-depth thickness of fabric cover is some 30 to 100 percent less than predicted as necessary by other fabric-included unsurfaced road design methods that do not consider Burmister-type effects (4).

CONCLUSIONS

Based on the results of research presented herein, the following may be concluded.

1. Optimum-depth engineering-fabric-reinforcement concepts that were originally developed for strong materials beneath the fabric may be extended to cases where weak materials underlie the fabric.
2. When the fabric is placed on weak material and overlain by an optimum depth of densely compacted cohesionless material, Burmister-type modular ratio effects cause a stress reduction, such that the actual stress immediately beneath the fabric is approximately 50 percent of that predicted by Boussinesq theory. The optimum depth is approximately one-third the width of the loaded area.
3. Even at large deformations, the amount of membrane-type support obtained from the fabrics tested, including the very high tensile modulus fabric, was small compared to the total load capacity of the model systems.
4. The optimum-depth road design criteria for construction of fabric-reinforced unsurfaced roads on soft subgrade can be developed, where the optimum fabric cover depth is approximately equal to one-third of the real or equivalent vehicle tire footprint width, independent of subgrade strength. This design method requires considerably less aggregate cover over the fabric than other currently available unsurfaced road design criteria that incorporate engineering fabrics.

ACKNOWLEDGMENT

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Dynamic Test to Predict Field Behavior of Filter Fabrics Used in Pavement Subdrains

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A dynamic test that attempts to duplicate field conditions for filter fabrics used in pavement subdrains is described. A filter fabric sample under a saturated silty-sand test soil is subjected to repeated axial loading while water flow is maintained through the sample under a unit hydraulic gradient. Sample permeability is monitored continuously. Results are presented in the form of a plot of sample permeability versus accumulated loads, and plots that show the movement in soil after 1 million loads.

The use of engineering fabrics in filter applications has become widespread in the past 10 years. They can be effective in protecting soil from erosion while permitting water to pass through the fabric to the drain. However, with the large number of filter fabrics available, some means must be found to determine the fabrics best suited for each application. The fabric must not clog or in any way significantly decrease the rate of flow. At the same time, the fabric must not let too much material pass through it because clogging of the drainage material and loss of subgrade support could occur (1).

Various tests have been proposed to help evaluate filter fabrics for various uses. The U.S. Army Corps of Engineers employs a test in which the fabric is used as a dry sieve in order to determine the largest size of glass beads that pass through the fabric (2). The largest size opening that at least 5 percent of the beads pass through the fabric is called the equivalent opening size (EOS) (2).

Calhoun (3) developed a constant-head permeameter test to examine fabric clogging under constant-head water flow. The overall hydraulic gradient across the soil sample could be changed in order to evaluate clogging under differing hydraulic conditions. In addition, piezometric pressure taps were installed at various depths in order to measure the hydraulic gradient throughout the sample. The Corps of Engineers used the ratio of the hydraulic gradient in the 2.5 cm (1 in.) of the sample directly above the fabric to the hydraulic gradient in the next 5 cm (2 in.) of the sample as one criterion for accepting a filter fabric for a given filter application [see Figure 1 (2)].

In the actual soil and filter fabric interaction, a rather complex bridging or arching occurs in the soil next to the fabric that permits particles much smaller than the openings in the fabric to be retained. Copeland (4) provides a good discussion of this process along with results of tests she performed with various fabrics and soils under constant hydraulic gradients. She considers failure of the soil-fabric system as either excessive piping of soil particles through the fabric or as a substantial decrease in permeability through the fabric and adjacent soil. She also identifies the hydraulic gradient through the sample that causes the failure.

The use of filter fabrics in highway subdrains requires the consideration of an additional factor. A highway is subjected to repeated dynamic loading by traffic. Dempsey (5) found that this loading can lead to substantial pore-pressure pulses in a saturated pavement system.

A soil and filter fabric system at the pavement edge may be subjected not only to a possible unit hydraulic gradient during heavy rain, but also to an additional gradient caused by highway traffic loading. The fact that this gradient would be changing in magnitude rather than remaining constant means that any comparison with constant-gradient soil-fabric tests would be difficult. Instead, a test that duplicates the effects of repeated traffic loading would be useful in predicting filter fabric behavior in highway subdrain applications. The conditions to be duplicated should also include continuous water flow (as in a heavy rainfall) and the use of a test soil that would show any soil movement and cause clogging under test conditions.

OBJECTIVES

This study was conducted in order to determine the behavior of filter fabrics to be used in pavement subdrain systems in the field. Specific test objectives were to

1. Develop a repeated triaxial-loading test to simulate truck traffic on the pavement;
2. Develop a continuous water-flow system to provide a unit hydraulic gradient through the soil sample, such as would be caused by heavy rainfall;
3. Select a soil that will cover the size ranges expected to be the most likely to move under water pressures created by the combined water flow and dynamic loading; and
4. Develop a system for the test to permit continuous monitoring of the flow rate in order to evaluate filter performance.