

H-3

Geotextile Strength Calculations



Geotextile Strength Calculations

1. Purpose

Evaluate the strength properties of the geotextile cushion used in the leak detection sump

2. Conditions/Assumptions

A 10 oz/yd² geotextile will be placed above the 60-mil HDPE liner for protection

- ♦ Maximum leachate stone size ~ 3/4", average stone size ~ 3/8"
- ♦ Assume maximum truck tire pressure ~ 100 psi

3. Analysis

Evaluate the geotextile strength for the following conditions:

1. Burst resistance
2. Tensile strength
3. Tear resistance

1) Burst Resistance

Using extreme 100 psi tire pressure at geotextile interface, required burst resistance using a factor of safety of 3 is:

$$F.S. = \frac{3.6 * P_{test}}{d_a * 100} \quad (\text{Koerner, Designing with Geosynthetics})$$

where: F.S. = factor of safety = 3

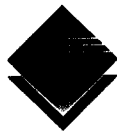
P_{test} = the burst test pressure

d_a = the average stone diameter = 3/8"

From attached Figure 1, the required burst strength is **31 lb/in²**.

From Reference 1, a 10 oz/yd² (Propex Fabrics) has a burst strength of 520 psi > 31 psi

F. S. allowable = 520/31 = 16.8; therefore, burst strength is acceptable

**2) Tensile strength**

Where:

$$T = p'(\varepsilon)^2 \text{ (Koerner, Designing with Geosynthetics)}$$

T = mobilized tensile force

p' = applied pressure

 ε = Geotextile strain

Assume 100 psi truck tire pressure on stone base of 3/4" max.

From Reference 1, grab strength = 250 lb

Calculate the max strain assuming 50% slippage at the stone/geotextile interface

$$\text{Where } \varepsilon = \frac{3(d/2)}{d + 2(d/2)} (100\%)$$

$$\text{for } d = 3/4" \quad \varepsilon = \frac{3(0.75"/2)}{1" + 2(0.75"/2)} (100\%) = 64\%$$

Assume 50% slippage

Then:

$$T = (100) (0.32)^2 = 10.2 \text{ lb}$$

$$\text{F.S.} = 250/10.2 = 24.4; \text{ therefore, tensile strength is acceptable}$$

3) Tear Resistance

Where:

$$T_{req} = (\pi da^2 p^1) s^1 \text{ (Koerner designing with Geosynthetics)}$$

da = average diameter of stone = 0.375"

p¹ = contact pressure (assume 100% of tire pressure) = 100 psiS¹ = shape factor = 0.4 (crushed rock) (Koerner, Design with Geosynthetics p 132)

$$T_{req} = (\pi 0.375^2 \times 100 \text{ lb/in}^2) 0.4$$

$$T_{req} = 17.7 \text{ lb}$$



From fabric chart, reference 1

Puncture strength = 155 lb

F.S. = $155/17.7 = 8.8$; therefore tear resistance is acceptable.

4. Conclusion

A summary of the strength calculations for a 10 oz/yd² geotextile is presented below:

<u>Analysis</u>	<u>Calculated F.S.</u>
Burst Resistance	16.8
Tensile Resistance	24.4
Tear Resistance	8.8

Based upon results of the analysis, proposed 10 oz/yd² geotextile will provide adequate protection for the underlying geomembrane liner.

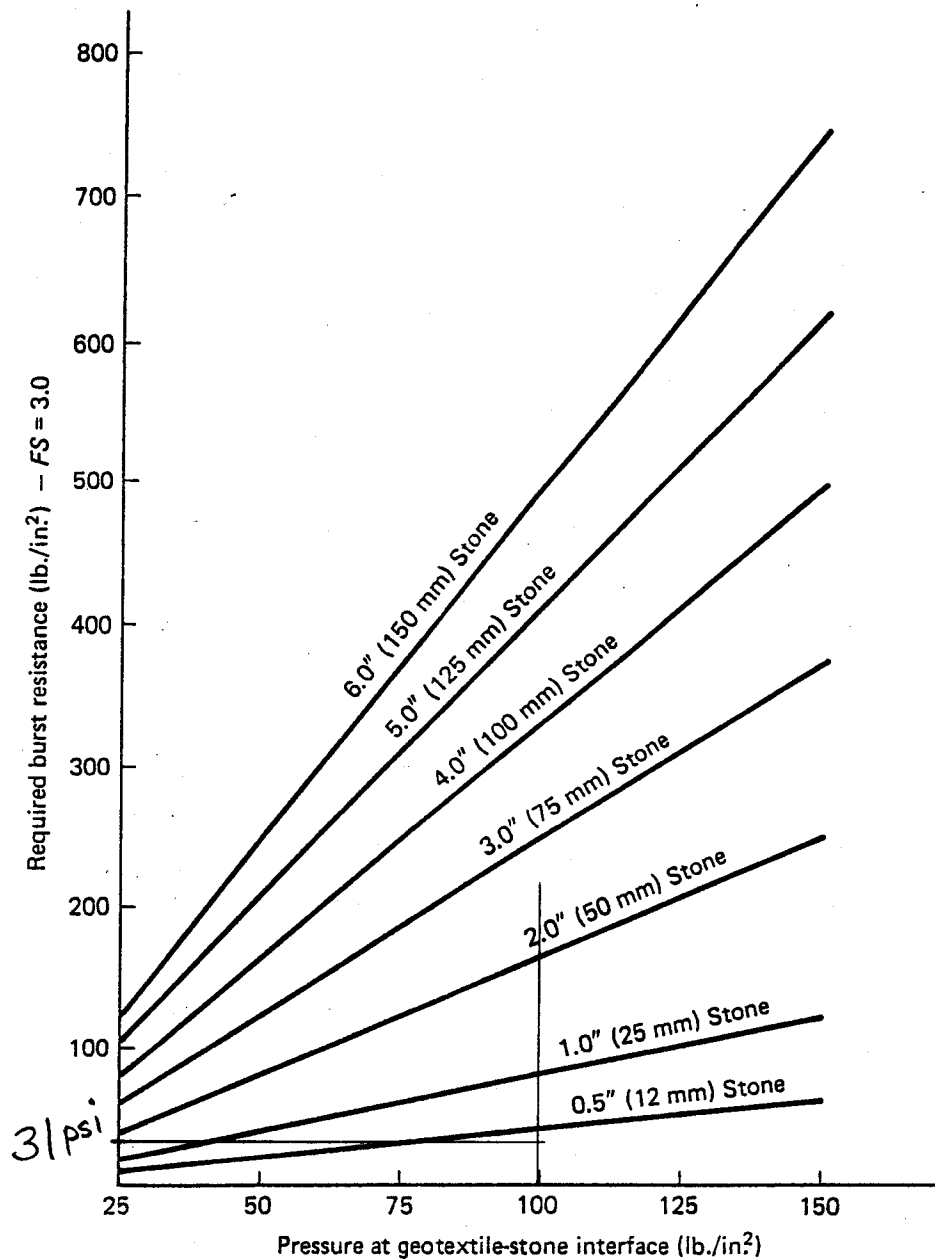


Figure 2.25 Design guide for burst analysis of geotextile used in a separation function based on an $FS = 3.0$.

FIGURE 1

Reference: Designing with Geosynthetics
Koerner, 1990

4510

Propex 4510 is a polypropylene nonwoven needlepunched fabric. This engineered geotextile is stabilized to resist degradation due to ultraviolet exposure. It is resistant to commonly encountered soil chemicals, mildew and insects, and is non-biodegradable. Polypropylene is stable within a pH range of 2 to 13, making it one of the most stable polymers available for geotextiles today. We wish to advise that **Propex 4510** meets the following minimum average roll values:

Property	Test Method	Minimum Average Roll Value (English)	Minimum Average Roll Value (Metric)
Unit Weight	ASTM-D-5261	10 oz/yd ²	339 g/m ²
Grab Tensile	ASTM-D-4632	250 lbs	1.11 kN
Grab Elongation	ASTM-D-4632	50 %	50 %
Mullen Burst	ASTM-D-3786	520 psi	3584 kPa
Puncture	ASTM-D-4833	155 lbs	0.689 kN
Trapezoidal Tear	ASTM-D-4533	100 lbs	0.445 kN
UV Resistance	ASTM-D-4355	70 % at 500 hrs	70 % at 500 hrs
AOS ⁽¹⁾	ASTM-D-4751	100 sieve	.15 mm
Permittivity	ASTM-D-4491	1.2 sec ⁻¹	1.2 sec ⁻¹
Flow Rate	ASTM-D-4491	85 gal/min/ft ²	3460 L/min/m ²
Coefficient of Permeability	ASTM-D-4491	0.20 cm/sec	0.20 cm/sec
Thickness	ASTM-D-5199	85 mils	2.15 mm

(1) max. average roll value

Propex Fabrics Inc. manufactures the nonwoven fabric indicated above. The values listed are a result of testing conducted in on-site laboratories.

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