ENGINEERING BULLETIN

GEOSYNTHETIC SEWN SEAMS

BACKGROUND

Geotextiles are fabricated in rolls of finite length and width. For installations requiring a large area of geotextile coverage, adjacent rolls must be overlapped or joined. In many cases the joint can be made by overlapping the rolls of geotextile. The amount of the overlap is dependent on the subgrade soil strength. Propex's Stabilization Application Guidelines addresses the applicability of overlapping versus joining. This Engineering Bulletin focuses on sewn seams, which is the most common method of joining geotextiles.

Some geotextile seams are created for nonstructural purposes, usually for the convenience of installation or to reduce costs. No significant stresses will be placed on these light duty seams beyond those that occur during installation and construction operations. All other seams are structural seams, which can carry some design structural load in tension. Seams are typically fabricated in independent shops or on construction sites. In these conditions the geotextile manufacturer has little control over the fabrication and typically will not be able to certify the seams.

The components and variables of sewn seam construction include the following:

- seam type,
- number of rows of stitching,
- seam location,
- stitch type,
- stitch count,
- thread type, and
- sewing equipment.

Each of these details has an effect on the tensile strength of the finished structural seam. Of course, the properties of the fabric being sewn also influence seam strength. This Engineering Bulletin addresses the components of sewn seams, laboratory testing of seam strength, and guidelines for field-sewn seams.

SEAM TYPE

Most field-sewn seams are superimposed seams (SS) or prayer seams, formed by placing two sections of fabric together and joining them with one or more rows of stitching. This is the simplest and most common seam in use and is shown in Figure 1a. The SSn or "J" seam is formed by superimposing two sections of fabric and folding them to create a thickness of four plies (see Figure 1b). When formed properly, this seam is stronger than the prayer seam; however, it is more difficult to construct correctly under field conditions.

NUMBER OF ROWS OF STITCHING

Seam type is also defined by the number of rows of stitching. Typically, one or two rows of stitching are used. As shown in Figure 1, the SS designation may be appended with the number of stitch rows to provide a complete description of the seam type.

Hand-held sewing machines are typically used to fabricate field seams. These machines sew only a single row of stitches. It is difficult to sew two parallel rows of stitches with a hand-held machine. In this case, the second row of stitching does not generally increase the strength of the seam significantly, but serves as a safety factor. Shop fabricated seams often use more sophisticated equipment which can sew the rows in parallel and when properly constructed can have significantly higher strengths than a single row of stitches.

SEAM LOCATION

The location of the seam relative to the edge of the fabric can also influence seam strength. Seams in nonwoven fabrics should be sewn 1 to 2 inches from the edge. Woven fabrics may have finished edges referred to a selvege. The selvege is created during manufacturing by tucking the ends of the yarns back into the woven fabric structure. Woven fabric seams should be sewn at least 1 to 1.5 inches from the edge of the fabric. If a woven geotextile has no factory-finished edge, the fabric should be folded back to create a double ply thickness. The seam should then be sewn within the double ply area a minimum of 1 to 1.5 inches from the edge.

STITCH TYPES

The most commonly used stitch types are illustrated in Figure 2. The Federal Stitch Type 101 Chainstitch (Figure 2a) is formed using a single thread. A broken stitch anywhere along the seam can threaten the integrity of the entire stitch line. The Federal Stitch Type 401 Chainstitch (Figure 2b) is a two-thread stitch that offers superior seam strength and will not unravel if the seam is cut.

STITCH COUNT

Stitch count is described in terms of stitches per inch (spi). Geotextiles are usually sewn with a stitch count of 3 to 7 spi. In general, setting the sewing machine for a higher stitch count creates a stronger seam up to an optimum point. Beyond this point, the additional stitches break more fibers in the structure of the fabric and can result in a lower seam strength.

THREAD TYPE

The sewing thread will be exposed to the same environmental conditions as the geotextile and must therefore have similar or better durability under those conditions. This can be important in landfill applications, for example, where both the fabric and thread must be resistant to chemical attack and ultraviolet degradation. Appropriate thread materials include polypropylene and polyester.

Proper selection of the thread size and type is important, since the seam can be no stronger than the thread used to form it. A thread manufacturer should be consulted for guidance in selecting thread for the specific sewing equipment and geotextile to be used. The geotextile distributor can provide lists of recommended thread suppliers.

SEWING EQUIPMENT

Geotextile seams can be sewn in the field or in an off-site fabrication plant.
In a fabrication plant, heavy duty sewing equipment allows the use of heavier threads and multiple rows of stitching, enhancing seam strength and durability. The controlled environment of a plant also permits more uniformity and control of seaming operations.

Field seaming is performed with sewing machines that are either hand-held or mounted on all terrain vehicles or other equipment capable of negotiating field conditions. The sewing machines are designed for pneumatic, hydraulic, or electrical operation. The stitch count (stitches per inch) and stitch tension are adjustable. These settings should be checked in the field, through trial runs, to be sure the stitches are uniform and tight. Although widely used, field seaming is a less tightly controlled operation than shop fabrication due to field conditions.

LABORATORY TESTING OF SEAM STRENGTH

Seam strength is typically evaluated in the laboratory using ASTM D4884, "Test Method for Seam Strength of Sewn or Thermally Bonded Seams of Geotextiles." This method tests an 8inch wide specimen, and the results have been shown to correlate accurately to anticipated field seam strength.

On some projects, the grab tensile test (ASTM D4632) has been used as an index strength test for routine seam construction quality control. The grab tensile test is quick, and easy to perform, but as an index test, the strength obtained can not be used in design.

GUIDELINES FOR SEWN SEAMS

Even with the wide range of variables that can affect seaming operations, some guidelines can be provided regarding expected seam strength. The efficiency of sewn seams is characterized as follows:

E (%) = (Tseam / Tgeotextile) x 100
where:
E = seam efficiency (percent)
Tseam = seam strength
Tgeotextile = specified fabric strength

Clearly, the geotextile itself must be properly specified for the application and imposed loads. In general, the stronger the fabric (Tgeotextile), the stronger the corresponding seam. It is rare that the seam efficiency approaches 100%.

Requirements for sewn seams are usually specified in terms of seam efficiency. Table 1 provides seam efficiencies obtained for Propex woven and nonwoven geotextiles. The details of the seam type and stitching are listed for each tested seam. Based on the Propex test results, seam efficiencies in the range of 60% to 90% can be expected with Propex geotextiles, with the higher efficiencies attainable with lighter weight fabrics. Table 1 can be used as a guide in designing seams to obtain a desired seam efficiency. The seam design should be confirmed by tests prior to construction.

ALTERNATIVES TO SEWN SEAMS

There are patented processes of seaming geotextiles using welded seams. The technologies use a heated wedge and pressure rollers to provide a thermal fusion seam. The BPR technology seals against a base of suspended tensioned geotextile material (over soft soil or uneven surfaces), compacted sub-soil or an external seaming board. The OPR technology seals against two opposing rollers. One advantage of utilizing the BPR technology is that the material remains flat (not raised) as it passes through the machine. The BPR design also permits welding on rough, uneven surfaces, whereas the OPR requires the upper and lower layers of geotextile material to be raised. The raising process can create equipment jams, material stretching and accumulation of dirt and other particles inside the roller mechanism. Wedge welding can produce seam strengths comparable to or better than sewn seams.

Table 1 - Typical Efficiencies Obtained With Propex Geosynthetics

Propex Geotextile	Seam Type	No. of Rows of Stitching	Seam Strength[2,3] (%)
Light Woven Geotex 135ST to 315ST	Prayer or J	1	50 to 70
		2	60 to 85
Heavy Woven Geotex 2x2 to 4x4	Prayer or J	1	40 to 75
		2	50 to 80
Nonwovens	Prayer	1	60 to 90

NOTES

(1) Values are representative of seams using Propex geotextiles sewn in a clean environment with type 401 stitch and a stitch count of 5 to 6 stitches per inch. Actual project seam strengths depend on sewing conditions, materials, and other variables discussed in this Engineering Bulletin.
(2) Strength values are reported in percent of Propex's specified product strength as measured in accordance with ASTM D4595.
(3) Seam strengths are measured in accordance with ASTM D4884.

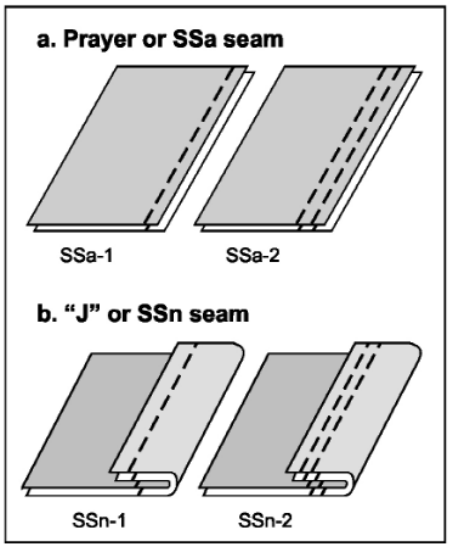

FIGURE 1 - COMMON SEAM TYPES

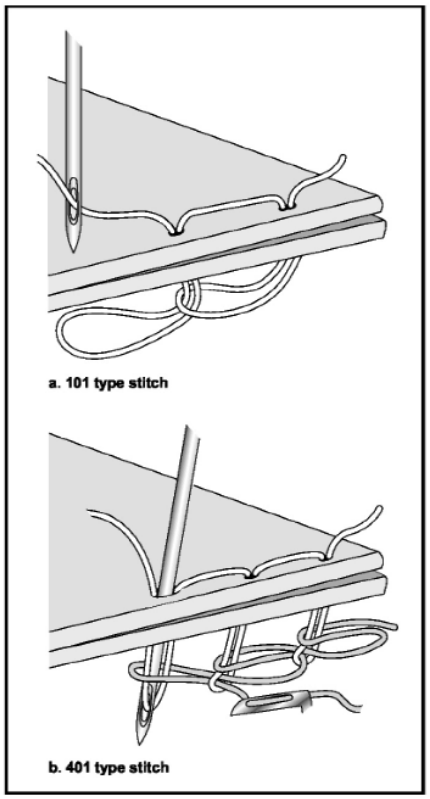

FIGURE 2 - COMMON STITCH TYPES

REFERENCES

ASTM D4884, "Standard Test Method for Strength of Sewn or Thermally Bonded Seams of Geotextiles," Annual Book of ASTM Standards, Vol. 4.13,ASTM International, West Conshohocken, PA, 2006, pp. 79-84.

Propex Inc., Stabilization Application Guidelines

Dia, V. Myles, B., "Field Sewing of Geotextiles", Industrial Fabrics Association International, St. Paul, MN, 1990, p 29.

Lippman, G. Frobel, R., "Alternate Seaming Methods for Nonwoven Geotextiles" Geotechnical Fabrics Report, October/November, 1996, pp. 24-27.

PROPEX | THE ADVANTAGE CREATORS.™
GEOSYNTHETICS

6025 Lee Highway, Suite 425 PH: 423 899 0444
PO Box 22788 PH: 800 621 1273
Chattanooga, TN 37422 FAX: 423 899 7619

www.geotextile.com

Geotex®, Landlok®, Pyramat®, X3®, SuperGro®, Petromat® and Petrotac® are registered trademarks of Propex Inc.

THIS PUBLICATION SHOULD NOT BE CONSTRUED AS ENGINEERING ADVICE. WHILE INFORMATION CONTAINED IN THIS PUBLICATION IS ACCURATE TO THE BEST OF OUR KNOWLEDGE, PROPEX DOES NOT WARRANT ITS ACCURACY OR COMPLETENESS. THE ULTIMATE CUSTOMER AND USER OF THE PRODUCTS SHOULD ASSUME SOLE RESPONSIBILITY FOR THE FINAL DETERMINATION OF THE SUITABILITY OF THE INFORMATION AND THE PRODUCTS FOR THE CONTEMPLATED AND ACTUAL USE. THE ONLY WARRANTY MADE BY PROPEX FOR ITS PRODUCTS IS SET FORTH IN OUR PRODUCT DATA SHEETS FOR THE PRODUCT, OR SUCH OTHER WRITTEN WARRANTY AS MAY BE AGREED BY PROPEX AND INDIVIDUAL CUSTOMERS. PROPEX SPECIFICALLY DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, OR ARISING FROM PROVISION OF SAMPLES, A COURSE OF DEALING OR USAGE OF TRADE.