THE STRENGTH OF CERTAIN SEAMS AS INFLUENCED BY STITCH LENGTH, THREAD AND FABRIC

by

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B. A., Southwestern College, 1945

A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Clothing and Textiles

KANSAS STATE UNIVERSITY
OF AGRICULTURE AND APPLIED SCIENCE

1960

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INTRODUCTION

The basis of concepts for the use of certain seams in the construction of garments is factually unsupported. A seam should be strong enough to stand the strain to which it will be subjected in the wear of the garment of which it is a part.

Dressmaker standards of garment construction that prevailed at the beginning of the century have been largely replaced by those imposed by the trades. As a result the consumer has become accustomed to seams and seam finishes that can be executed quickly but are often lacking in durability.

Seams contribute to the serviceability of a garment as well as to its appearance. The fabric, the kind of thread, the length of stitch, and the grainline direction are interacting factors relating to the serviceability and appearance of seams.

Facts are lacking concerning many assumptions as to the quality and kinds of thread used. Mercerized thread, size 50, available in a wide range of colors, supplies the demand for colored cotton thread. Six-cord cotton thread, available in a variety of sizes, but limited in color to black and white contributes to other needs. Whether one is better than the other in specific instances is questionable.

The number of stitches per inch is another factor that warrants consideration. Many ready-made garments have relatively few stitches per inch in the construction of seams. Garments made of better quality fabric are more adequately cut and have

more stitches per inch in the construction of seams. Observations reveal that garment seams with the fewer stitches per inch often give way under slight strain, whereas, a greater number of stitches produces a seam of greater stability.

As students are guided into formulative practices of construction in the classroom, a certain amount of information pertaining to serviceability, as well as comfort and attractiveness is desirable. This guidance could be more effective if it were followed with facts and valid reasoning.

The wearing apparel standards of the general public are in the greatest measure set by the manufacturer. It has grown ever more so as an increasing number of garments are purchased ready-made and fewer are made in the home or are custom-made. The public tends to accept what is made available to them whether or not it meets previous standards of quality. However, the sacrifice of standards may not be necessary. Perhaps a re-evaluation of values is needed.

The purpose of this study was to ascertain the relative strength of a plain seam and a felled seam as controlled by certain variables, (1), fabric, one non-resin finished cotton fabric, one resin finished cotton fabric, and one cotton Dacron polyester blended fabric; (2), to compare the effectiveness of 15 stitches per inch and 9 stitches per inch in a plain seam and a felled seam on the same fabrics; (3), to compare the effectiveness of mercerized cotton thread and 6-cord cotton thread as used in the two seams on the three fabrics; (4), to compare the strength of the two seams in relation to lengthwise, crosswise and off-grain directions of the fabrics.

REVIEW OF LITERATURE

The literature revealed that little research has been conducted in the study of seams used in construction of garments in the home.

The United States Bureau of Human Nutrition and Home Economics in cooperation with The Ohio State University and the Ohio Agricultural Experiment Station (4), conducted research on certain features of cotton housework dresses. Seams, patch pockets and buttonholes were studied in relation to fabric, thread and number of stitches per inch.

In reporting results of this study, the direction of the yarn of the fabric in relation to the seams had the greater influence on breaking strength. The other variants, in decending importance, were length of stitch and kind of thread.

Considering all variables, stitched fell seams or flat felled seams as they are also known were the strongest of those studied. The degree of superiority was influenced by the grainline direction, that is, the relative location of the warp and the filling yarns to the seam. The plain seam, the lapped seam, and the French seam were not significantly different in strength, but the standing fell seams were somewhat weaker. This weakness was associated with the tendency of the narrow edge of the seam to pull from the stitching.

The distribution of breaking strengths of seams made with stitches of various sizes revealed the influence of the size of the stitch. The higher breaking strengths were associated with

the greater number of stitches per inch.

Only approximately one fourth of the tests showed significant difference in seam strengths associated with the kind of thread used. Seams stitched with 6-cord unmercerized size 50 thread were stronger than those stitched with 3-cord size 50 or 2-cord size 00 mercerized threads.

Results of research have shown that it is the cleansing rather than wear that causes seam and seam finish deterioration. Shelden (3), prepared samples of hems and seams for tests. The results were reported in generalizations, due partially to the great number of variables. One significant conclusion was the fact that teaching techniques need to be re-evaluated in the light of the use of modern fabrics.

METHOD OF PROCEDURE

In an effort to create a sampling representative of a type of clothing construction done in the home, broadcloth fabrics were chosen. A Dacron polyester and cotton blend, a "wash and wear" or resin treated cotton, and a cotton fabric without a resin finish were used. In order to obtain fabric from two lots the fabrics were taken from two bolts.

Three samples were cut from each of the two lots of each fabric in an attempt to lessen the possibility of error occuring due to a fabric irregularity that is not plainly visible.

The samples were cut to meet the specifications of American Society for Testing Materials, Committee D-13 (1), for breaking strength, grab method, and to include a five-eigths inch seam allowance. Seams were made on the lengthwise, crosswise and off-

grain of the fabric to simulate the construction seams of garments. The lengthwise and crosswise seam samples were measured and cut with the grain of the fabric. The off-grain seams were cut at a 17 degree angle using a pattern. The degree of angle was determined by measuring the degree of angle of shoulder seams on ten commercial garment patterns and the mean calculated.

A standard 201 Singer sewing machine, the type sold for home use was used for stitching the seams. The number of stitches per inch was determined on the basis of the number of stitches used in a number of ready-made garments that were observed. The better garments, or at least the more expensive ones, had a greater number of stitches per inch than the less expensive ones.

The plain seam and the felled seam were constructed. These seams are widely used on ready-made garments and those commonly constructed at home. Size 50 mercerized cotton thread was selected because of the wide range of color, but since 6-cord cotton, size 50, was limited to black and white, all the thread used was white for the sake of uniformity.

Six spools each of mercerized cotton and 6-cord cotton thread were purchased in six different places to increase the chances of their being from different lots. A bobbin was wound from each spool of thread to be used with it in stitching the seams. A size 14 sewing machine needle, the size recommended by the sewing machine manufacturer as best suited for size 50 thread was used. To insure the greatest degree of possibility for realistic difference, each sample in each series was stitched with its corresponding thread. For example, sample 1 was stitched with

spool 1, sample 2 with spool 2, and so on for the six samples prepared for test.

After the seams were stitched they were pressed with a General Electric steam-dry iron, with the setting at full steam.

The samples were conditioned and broken according to standard test methods. The breaking strengths of seams and fabrics were determined on a pendulum type fabric tester using the grab method.

The thread strengths were determined on a pendulum type fabric strength tester. Ten threads were laid parallel and taped at a distance of five inches. Each of the spools of thread for both the mercerized cotton and the 6-cord cotton were represented within the sample group. The distance between the clamps at the start of the test was five inches. The mean was calculated from twenty samples.

The fabrics were analyzed for the percent of sizing in the non-resin treated cotton fabric and for the percent of resin carried in the resin-treated cotton fabric.

RESULTS AND DISCUSSION

It is assumed that the strength of seams in garments is influenced by many factors. This study was designed to compare the effects of the controlled factors of three kind of fabric, two kinds of thread, two stitch lengths and three grainline directions on the relative strengths of two seams. The fabrics were broadcloth of medium quality, purchased on the open market. Specimens are shown in Plate I.

The physical properties of the fabrics under consideration

EXPLANATION OF PLATE I

Fabrics used in seam construction

Fig. 1 Resin treated cotton fabric

Fig. 2 Non-resin treated cotton fabric

Fig. 3 Dacron polyester cotton blend fabric

PLATE I.

Fig. 1

Fig. 2

Fig. 3

are identified in Table 1. Weight per square yard, thickness, yarn count and breaking strength were characteristics studied.

The weight per square yard of the non-resin treated cotton fabric and the Dacron polyester cotton blend varied only .07 of an ounce per square yard. The resin treated cotton was heaviest, weighing .52 of an ounce per square yard more than the non-resin treated cotton. The Dacron polyester cotton blend was lightest in weight, 3.67 ounces per square yard.

The difference in thickness of the three fabrics was small. The thicker fabric was the resin-treated cotton while the non-resin treated cotton was the thinnest.

The yarn count of the Dacron polyester cotton blend fabric was the most nearly balanced, having 35.3 more warp yarns per inch than filling yarns. The non-resin treated cotton had more than twice as many warp yarns as filling yarns, while the resin-treated cotton had just over twice as many warp yarns as filling yarns.

The warp breaking strength of the non-resin treated cotton was the greatest. The Dacron polyester cotton blend fabric broke at the lowest number of pounds. The spread of mean breaking strengths covered by the three fabrics was 14.2 pounds. The filling breaking strength was much lower than the warp. The resin treated cotton, fillingwise was the strongest whereas the fillingwise of the non-resin treated cotton was the weakest. The spread of breaking strengths, filling wise was 14.4 pounds.

The non-resin treated fabric contained 3.47 percent sizing. The resin-treated cotton contained 3.59 percent resin finish. The Dacron polyester and cotton fabric was sold as 65 percent

Table 1. Properties of three cotton and cotton blended fabrics used for seam tests.

Fabric	Weight Per Square Yard	Thickness	Count		Breaking Strength		Percent of Sizing	Percent of Resin Finish
			Warp	Filling	Mean Warp	Mean Filling		
	oz.	in.	no.	no.	lbs.	lbs.		
Un-Treated Cotton	3.74	.0086	120.8	55.6	62.8	18.4	3.46	
Treated Cotton	4.26	.0113	118	57.6	58.8	32.8		3.59
Dacron/ Cotton	3.67	.009	97.6	62.3	48.6	27		

Dacron polyester and 35 percent cotton.

The thread used was mercerized cotton and 6-cord cotton, both size 50. Mansfield (2), states that since thread holds a garment together it should be inconspicuous as well as strong enough to hold firmly and permanently. It needs to match the fabric as nearly as possible in color, luster, yarn size and elasticity.

The mercerized cotton thread size 50 and 6-cord cotton size 50 were tested for breading strength. The mean of the ten-strand tests revealed a superiority of only .4 pound in favor of the mercerized cotton. The mean of the tests for mercerized cotton was 20.5 pounds, for the 6-cord cotton, 20.1 pounds.

The mean breaking strength of seams will be found in Table 2. The data were analyzed statistically. The analysis of variance for the breaking strengths of the plain seam as it interacted with the variables is shown in Table 3. The analysis of variance for the breaking strengths of the felled seam as it interacted with the variables is shown in Table 4.

Plain Seams. The breaking strength of plain seams in all three fabrics showed a greater mean breaking strength in those stitched with 15 stitches per inch than those with nine. With 9 stitches per inch there was no difference between the mean breaking strength of the resin-treated cotton and the non-resin treated cotton. The Dacron polyester and cotton blend had a higher breaking strength than the other fabrics. When the stich number was increased to 15, there was no difference between the mean breaking strength of the non-resin treated cotton and the Dacron

Table 2. Mean breaking strengths of the plain and felled seams

	Plain Seams		Felled Seams	
	Mercerized	6-cord	Mercerized	6-cord
Resin-treated cotton				
9 stitches				
warp	24.8	25	30.2	31.2
filling	19.2	15.8	36.6	46
off-grain	28.6	25.4	46.6	56.4
15 stitches				
warp	23.4	24.4	30.2	29.6
filling	38.4	40.4	58	56
off-grain	37.0	43.8	56.2	63.8
Non-resin treated cotton				
9 stitches				
warp	17.8	17.6	18	18.8
filling	23.4	21.2	44.4	58
off-grain	26.4	30.2	53.6	54
15 stitches				
warp	17.4	17.4	14.8	19.2
filling	36	40.8	56.6	61.2
off-grain	37	41.4	61	68.4
Dacron polyester and cotton blend				
9 stitches				
warp	26.4	27.4	30.8	30.2
filling	26	33.6	41.2	39.6
off-grain	24.6	31	41.8	40.2
15 stitches				
warp	22	21.8	29.4	27.2
filling	34.2	35.8	43.2	42.8
off-grain	37	38.4	43.8	45.6

Table 3. Analysis of variance for breaking strength of plain seams

Source of Variation	Degree of Freedom	Sum of Squares	Mean Square	F	Significance
Fabric	2	212.05	106.02	6.53	**
Thread	1	140.45	140.45	8.65	**
Stitches	1	2808.45	2808.45	173.04	***
Direction	2	4098.55	2049.28	126.26	***
F x T	2	43.20	21.60	1.33	n.s.
F x S	2	510.53	255.26	15.73	***
F x D	4	582.38	145.60	8.97	***
T x S	1	19.34	19.34	1.19	n.s.
T x D	2	66.03	33.02	2.03	n.s.
S x D	2	2317.50	1158.75	71.40	***
Error	160	2597.05	16.23		
Total	179	13395.53			

* significant at 5 percent level

** significant at 1 percent level

*** significant at 0.1 percent level

Table 4. Analysis of variance for breaking strength of felled seams

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F	Significance
Fabric	2	1785.28	892.64	37.82	***
Thread	1	309.42	309.42	13.11	***
Stitches	1	1258.75	1258.75	53.34	***
Direction	2	25029.74	12514.87	530.29	***
F x T	2	214.81	107.40	4.55	*
F x S	2	361.68	180.84	7.66	***
F x D	4	4791.79	1197.95	50.76	***
T x S	1	39.21	39.21	1.66	n.s.
T x D	2	168.88	84.44	3.58	*
S x D	2	894.49	447.24	18.95	***
Error	160	3775.86	23.60		
Total	179	38629.91			

* significant at 5 percent level

** significant at 1 percent level

*** significant at 0.1 percent level

polyester cotton blend fabric. The resin-treated cotton had a higher mean breaking strength than did the other two fabrics. This interaction of stitches per inch and fabric was significant at the 0.1 per cent level. Plate II illustrates the appearance of plain seams in resin-treated cotton fabric after breaking.

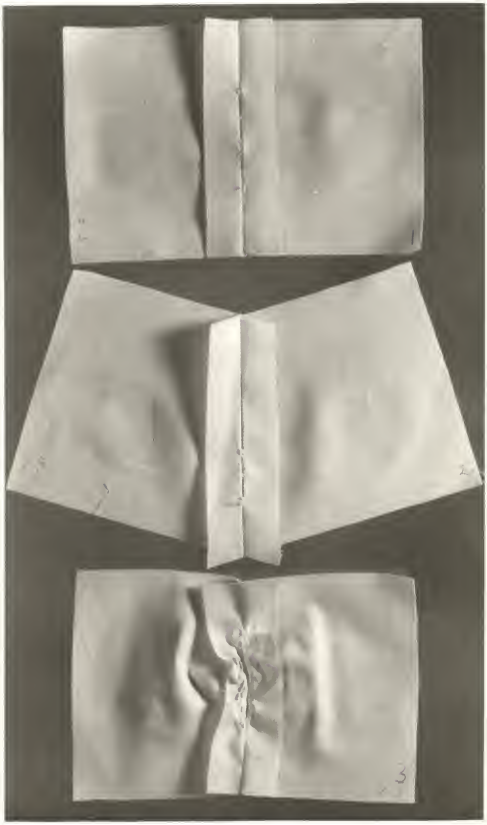
The off-grain seams had a higher mean breaking strength than did the warpwise and fillingwise seams in both the resin-treated and the non-resin treated cotton fabric. However, the fillingwise seams had a higher mean breaking strength than did the warpwise ones. In the Dacron polyester cotton blend there was no difference between the mean breaking strengths of the off-grain and fillingwise seams, whereas the off-grain and fillingwise seams both had higher mean breaking strengths than did the warpwise seams. The warpwise seams showed no difference in the mean breaking strengths on the resin-treated cotton fabric and the Dacron polyester cotton blend fabric. However, the non-resin treated cotton fabric and the Dacron polyester cotton blend fabric had a higher mean breaking strength than did the resin-treated cotton fabric. The Dacron polyester cotton blend had a higher mean breaking strength fillingwise than did the two cotton fabrics. However, the non-resin treated cotton fabric had a higher mean breaking strength than did the resin-treated fabric. The off-grain seams showed no difference in the mean breaking strength among the three fabrics. The interaction of the fabrics in relation to the grainline direction of the seams were significant at the 0.1 per cent level.

The fillingwise and the off-grain seams showed that the mean breaking strength was higher with 15 stitches per inch than

EXPLANATION OF PLATE II

The destruction of the plain seam in resin-treated cotton fabric; fillingwise, off-grain and warpwise grainline direction; 15 stitches per inch and 6-cord cotton thread

PLATE II



with 9. With the warpwise seam, the mean breaking strength was less for the samples with 15 stitches per inch than those with 9 stitches. Nine stitches per inch showed there was no difference between the mean breaking strength of the warpwise and fillingwise seams. The offgrain seams had a higher breaking strength than did the other two seams. When 15 stitches per inch were used, there was no difference between the mean breaking strengths of the offgrain seams and that of the fillingwise seams. The off-grain and the fillingwise seams both had a higher mean breaking strength than did the warpwise seams. Plate III illustrates the appearance of plain seams in Dacron polyester cotton blend fabric after breaking. The number of stitches in relation to the direction of the grainline seam was significant at the 0.1 percent level.

Felled Seams. The mercerized cotton and the 6-cord cotton thread showed no difference between the mean breaking strength of the resin-treated cotton and the non-resin treated cotton fabric. The cotton fabrics both had a higher mean breaking strength than did the Dacron polyester cotton blend. In the resin-treated cotton and the non-resin treated cotton fabric, the 6-cord cotton thread had a higher breaking strength than did the mercerized thread. With the Dacron polyester cotton blend, there was no difference between the mean breaking strength of the two threads. The interaction of thread and fabric was significant at the 5 percent level for felled seams whereas there was no significance for the same interaction on plain seams.

All three fabrics showed a greater mean breaking strength at 15 stitches per inch than at 9. With both 9 and 15 stitches

EXPLANATION OF PLATE III

The destruction of the plain seam in Dacron polyester cotton blend fabric; fillingwise, off-grain and warpwise grainline direction; 9 stitches per inch and mercerized cotton thread

PLATE III

per inch, there was no difference between the mean breaking strength of the resin treated and the non-resin treated cotton fabric. The Dacron polyester and cotton blend had a lower mean breaking strength than did the two cotton fabrics. The relation between stitches per inch and kind of fabric revealed a significance at the 0.1 per cent level.

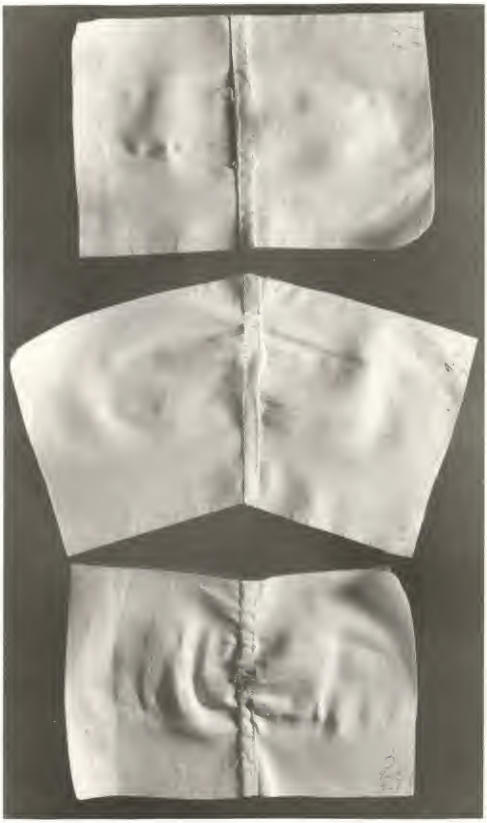
On the resin-treated and the non-resin treated cotton fabric, the off-grain seams had a higher mean breaking strength than did the warpwise seams. In the Dacron polyester and cotton blend, there was no difference between the mean breaking strength of the off-grain seam and the fillingwise seam. The off-grain seam and the fillingwise seam both had a higher mean breaking strength than did the warpwise. The fabric and the grainline direction as interaction variables revealed a significance at the 0.1 percent level.

With both the mercerized cotton and the 6-cord cotton thread, the off-grain seams had a higher mean breaking strength than did the fillingwise and warpwise seams. The fillingwise had a higher mean breaking strength than did the warpwise seams. On the warpwise seams there was no difference between the mean breaking strength of the mercerized cotton and 6-cord cotton thread. However, with the fillingwise and the off-grain seams, 6-cord cotton thread had a higher mean breaking strength than did the mercerized cotton. The thread in relation to the grainline direction showed a significant difference at the 5 percent level. However, in the plain seam there was no significant difference. Plate IV illustrates the appearance of felled seams in non-resin treated cotton fabric after breaking.

EXPLANATION OF PLATE IV

The destruction of the felled seam in non-resin treated cotton fabric; filling-wise, off-grain and warpwise grainline direction; 9 stitches per inch and 6-cord cotton thread

PLATE IV



- In the samples stitched with 15 stitches per inch, the off-grain and the fillingwise seams had a higher mean breaking strength than those stitched with 9 stitches per inch. On the warpwise seam, the mean breaking strength was lower with 15 stitches per inch than with 9 stitches. With 9 stitches there was no difference between the mean breaking strength of the warpwise seams and that of the fillingwise. The off-grain seams had a higher mean breaking point strength than did the warpwise and fillingwise. When 15 stitches were used, there was no difference between the mean breaking strength of the off-grain seams and that of the fillingwise. The off-grain and fillingwise seams both had a higher mean breaking strength than did the warpwise seams. The number of stitches in relation to the seam direction showed a significant difference at the 0.1 percent level. Plate V illustrates the appearance of felled seams in resin-treated cotton fabric after breaking.

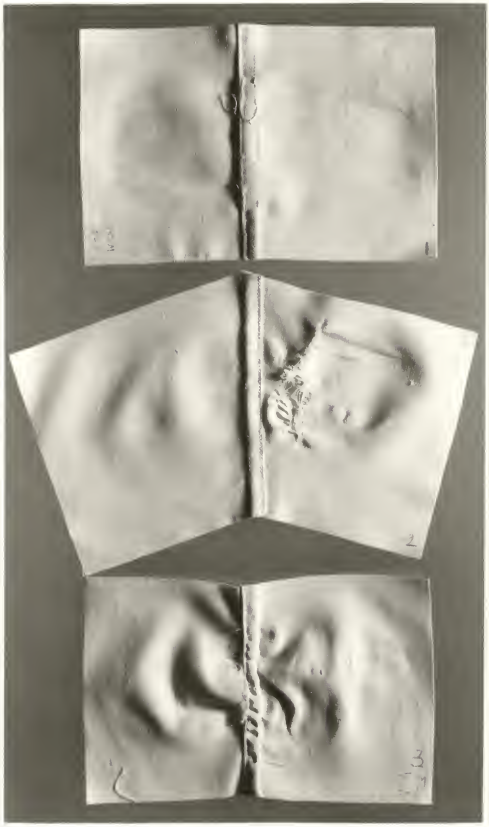
SUMMARY AND CONCLUSIONS.

The purpose of this study was to, (1) ascertain the relative strength of the plain seam and the felled seam in one resin-treated cotton fabric, one non-resin treated cotton fabric and one Dacron polyester cotton blend fabric; (2) to compare the effectiveness of 9 stitches per inch and 15 stitches per inch as used in the plain seam and in the felled seam on the three fabrics; (3) to compare the effectiveness of mercerized cotton thread, size 50, and 6-cord cotton thread, size 50, as used in the two seams on the three fabrics; (4) to compare the strength of the two seams in relstion to the lengthwise, crosswise and off grainline

EXPLANATION OF PLATE V

The destruction of the felled seam in resin-treated cotton fabric; fillingwise, off-grain and warpwise grainline direction; 15 stitches per inch and mercerized cotton thread

PLATE V



in the three fabrics.

The fabrics were different in respect to the kind of finish on the two cotton fabrics and the fiber content of this. The two cotton fabrics were similar in yarn count, both warpwise and fillingwise; the blended fabric differed from the cotton fabrics but was more nearly balanced within itself.

The breaking strength of the mercerized thread was slightly greater than for the 6-cord cotton. However, the difference was not significant, statistically. When the seams stitched with these threads were compared, 9 stitches per inch with 15 stitches per inch, again the interaction was not significant.

The relation of the variables with each other showed that fabric in relation to the thread was significant on the felled seam but showed no significance on the plain seam.

The number of stitches per inch in relation to the fabric showed a significance on both the plain and felled seam; also, the fabric in relation to grainline direction revealed a significance on both seams.

Thread in relation to number of stitches per inch was not significant on the plain seams or the felled seams. However, thread in relation to grainline direction was significant on the felled but showed no significance on the plain seams.

When the interaction of the number of stitches and the grainline direction was analyzed, both the felled seams and the plain seams revealed significance.

In general, the off-grain and fillingwise seams showed the greater strength, perhaps due to the greater strength of the warp

yarns which carried the pull for the fillingwise seams. Both sets of yarns bore the pull for the offgrain seams. The weakness of the warpwise seams may be attributed in some degree to the weaker filling yarns in the fabric.

The plain seam was stronger warpwise with 9 stitches per inch than with 15. However with off-grain and fillingwise seams, 15 stitches per inch were stronger than 9. The kind of thread had no significance, except with the off-grain and fillingwise felled seams.

ACKNOWLEDGMENT

Sincere appreciation is expressed to Professor Alpha Latzke, Head of the Department of Clothing and Textiles for her assistance and guidance in directing this study.

LITERATURE CITED

(1) Committee D-13.
In A.S.T.M. standards on textile materials. Philadelphia American Society for Testing Materials, January 1956.

(2) Mansfield, Evelyn A.
Clothing Construction. Boston: Houghton Mifflin, 1953.

(3) Shelden, Gene.
Workshop Experiments with New Textiles. Journal of Home Economics. 52(2):110. February 1960.

(4) Whitlock, Mary C., Florence E. Petzel, Bess V. Morrison, and Hazel M. Fletcher.
A Laboratory Evaluation of Certain Features of Cotton Housework Dress Construction. United States Department of Agriculture Circular 889. Washington: Government Printing Office, 1952.

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The purpose of this study was to ascertain the relative strength of the plain seam and the felled seam in one resin-treated and one non-resin treated cotton fabric and one Dacron polyester and cotton blend fabric, as related to mercerized cotton thread and 6-cord cotton thread, both size 50 for stitching and to 9 stitches per inch and 15 stitches per inch as used in seams lengthwise, crosswise and in off-grainline direction of the fabrics.

The fabrics were analyzed to determine weight per square yard, yarn count, thickness and breaking strength. All breaking strengths were determined on a pendulum type fabric tester.

The data from the mean breaking strengths of the two seams were analyzed statistically to determine the significance of variance.

The interaction of number of stitches in relation to grainline direction; fabric in relation to grainline direction and fabric in relation to number of stitches was significant in both the seams. The interaction of fabric in relation to thread and of thread in relation to grainline direction was significant only in the felled seams. The interaction of thread and number of stitches was not significant in either seam.