International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8 Issue-5, January 2020

# Seam Strength of the Plain and Medium Weight Selected Apparel Wear Fabrics Stitched with Lockstitch-301 Seam

**Md. Vaseem Chavhan, B. Venkatesh, Govardhanrao Ch.**

***Abstract:*** ***A study on lockstitch - 301 seam mechanics by stitching on medium weight selected apparel wear fabrics have been carried out. The effect of fabric types and numbers of fabric layers, on to on to the seam strength, seam efficiency and seam elongation is studied. It has been found that the seam strength is depends on to the stitch density for both warp and weft direction while seam efficiency is only depends on the fabric type irrespective of the seam direction. The seam elongation is only affected by the number of layers in war direction.***

***Index Terms: seam efficiency, seam elongation, seam strength, woven fabric***

## II. INTRODUCTION

The apparels which are formed by the joining the pieces of fabric, there are various seams are used to join the fabric based on the position of seam at apparel and its requirement for a particular type of fabric. The sewing thread made from different fibres of different polymer[1][2], the strength prediction [3][4] is important base on the type of fibre. The particular seam is selected basically based on its strength, elongation and some time ability to hold the ends yarn at its place. The lock stitch seam 301 which is known for its firmness and stability, generally used to join a layers of fabrics. In lock stitch seam the needle thread passes through the bobbin thread by interloping and form the interlacing point, this interloping provides the stability to the seam. During the physical activities various stresses are developed on to clothing and at seam linings, by considering this it is required to have a minimum seam strength. In one of the study the 80% of the seam efficiency is recommended very specifically for the combat clothing.

From mechanical performance and durability point of weave the seam mechanical parameters; seam strength, seam elongation and the seam efficiency are the parameters tat have to be considered. At joining of materials it is required to study the mechanical performance[5]. There are different parameters that decided the seam mechanical parameters like the types of sewing thread, the type of fabrics and the sewing parameters like stitch density.

The fabric type and its construction affect the sewing performance with respect to seam strength, various studied are available where the seam performance for the specific type of seam is addressed. Different type of fabric from light weight to heavy weight having different interaction with the sewing thread and results in to the different stitch performance. The fabric of different characteristic results in to different results, the fabric made from the compressible material like wool having different performance that the made from the high weigh compact stiff fabric.

In another study [6] the while stitching on to different types of the wool/polyester fabrics with different sewing parameters and different sewing thread types, it was found that other that stitch density the fabric types also significantly decided the seam strength and the seam efficiency while the sewing thread not having significant influence. Similarly with respect to the fabric type, the investigation of the seam performance of the polyester woven fabrics has been carried out. The seam performance in terms of seam strength and seam efficiency for the nylon woven canopy fabric also have been studied.

In present study the apparel fabric used in normal wear made with pain cotton/polyester have been considered to study the seam strength and seam efficiency stitched with different sewing parameters and at different numbers on layers. The number of layers are considered as in apparel at various places it required to join the numbers of layers of the fabrics.

## III. MATERIAL AND METHOD

The three different fabric of light to medium fabric weight were stitched at different sewing parameters. The spun polyester sewing threads with breaking strength 14.62 RKM and 47.9 % breaking elongation is used for stitching purpose. The fabrics were used are the 100% cotton bleached fabric, polyester/cotton blend shirting and suiting fabric with different constructional parameters as shown in Table1. .Table 1. Physical characteristic of different fabrics The thread density is measure using the counting glass, thread count using Beesley balance (ASTM D2260, ASTM-D105911.), fabric weight using the the GSM cutter.

Manuscript published on January 30, 2020.
* Correspondence Author
**Md. Vaseem Chavhan***, Department of Textile Technology, under the School of Chemical Engineering, VFSTR (Deemed to be University), Guntur, Vadlamudi, India.
**B. Venkatesh**, Department of Textile Technology, under the School of Chemical Engineering, VFSTR (Deemed to be University), Guntur, Vadlamudi, India.
**Goverdhanrao Ch.**, Department of Textile Technology, under the School of Chemical Engineering, VFSTR (Deemed to be University), Guntur, Vadlamudi, India.

The fabric strength is measure using the fabric tensile strength tester Unistretch 250 at a speed of 300 mm/min at 200mm gauge length also same is used for the measurement of the seam strength measurement (ASTM D5034, ASTM-D1683 ).

**Table1.Physical characteristic of different fabrics**

| S.N. | Property | Cotton fabric (Cf) | | Shirting fabric (Sh) | | Suiting fabrics (Su) | |
|---|---|---|---|---|---|---|---|
| | | warp | weft | warp | weft | warp | weft |
| 1 | Thread density($cm^{-1}$) | 39 | 31 | 49 | 29 | 25 | 22 |
| 2 | Thread count (Ne) | 18 | 17 | 13 | 17 | 37 | 45 |
| 3 | Fabric strength (Kgf) | 24.3 | 124.5 | | 35.67 | 102.95 | 74.95 |
| 4 | Fabric weight ($g/m^2$) | 112 | | 104 | | 220 | |

A full factorial design have been used for the experiment by considering the three factors at different levels as shown in the table 2

**Table 2. Experiment design with different factors and the levels**

| Factors | Fabric type | Stitch density ($cm^{-1}$) | Number of plies |
|---|---|---|---|
| Levels | Cf, Sh, SU | 3, 4, 5 | 2, 4 |

The response variable Seam strength and the seam efficiency are measured in both the warp and weft directions. Seam strength, seam efficiency and seam elongation measurements are measured as per ASTM D1683. Seam strength expresses the maximum force (in Newton) to cause a seam specimen to rupture.

$$\text{Seam Efficiency \%} = \frac{\text{Fabric Strength with Seam of seam assembly}}{\text{Fabric Strength without Seam}} \text{x100}$$

$$\text{Seam Elongation\%} = \frac{\text{Extended length at break of seam assembly}}{\text{Initial length of fabric assembly}} \text{x100}$$

## IV. RESULT AND DISCUSSION

The three different types of fabric of different construction as given in table 2 parameters have bee stitched at different stitch densities and at different numbers of layers.

For each combination the seam strength, seam elongation and the seam efficiency have been calculated in both warp and weft directions as shown in Table 3.

Table.3 Results of seam strength, seam elongation and seam efficiency of the different types of fabric at different sewing parameters.

| Sr. no | Fabric type | Spc | layers | Seam strength (Kgf) | | Seam elongation (%) | | Seam efficiency (%) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Warp | weft | Warp | Weft | Warp | Weft |
| 1 | Shirting | 3 | 2 | 12 | 25.4 | 7.65 | 3.3 | 13.0 | 71.2 |
| 2 | Shirting | 4 | 2 | 23.5 | 17.5 | 3.85 | 3.3 | 25.5 | 49.1 |
| 3 | Shirting | 5 | 2 | 5.3 | 29.9 | 2 | 3.5 | 5.7 | 83.8 |
| 4 | Shirting | 3 | 4 | 5.6 | 9.2 | 3.8 | 2.75 | 6.1 | 25.8 |
| 5 | Shirting | 4 | 4 | 18.7 | 20.5 | 2.9 | 3 | 20.3 | 57.5 |
| 6 | Shirting | 5 | 4 | 26 | 21 | 3.35 | 3.3 | 28.2 | 58.9 |
| 7 | Cotton | 3 | 2 | 12 | 14.6 | 7.65 | 5.95 | 49.4 | 117.3 |
| 8 | Cotton | 4 | 2 | 17.8 | 16.6 | 6.55 | 2.75 | 73.3 | 133.3 |
| 9 | Cotton | 5 | 2 | 19 | 31.8 | 6.7 | 2.7 | 78.2 | 255.4 |
| 10 | Cotton | 3 | 4 | 16.1 | 21.7 | 2.55 | 5.55 | 66.3 | 174.3 |
| 11 | Cotton | 4 | 4 | 24.6 | 13.2 | 2.65 | 4.15 | 101.2 | 106.0 |
| 12 | Cotton | 5 | 4 | 26.9 | 21.7 | 2.55 | 6.15 | 110.7 | 174.3 |
| 13 | Suiting | 3 | 2 | 13 | 22.1 | 3.2 | 4.2 | 12.6 | 29.5 |
| 14 | Suiting | 4 | 2 | 13.3 | 16.5 | 3.15 | 3.35 | 12.9 | 22.0 |
| 15 | Suiting | 5 | 2 | 27.3 | 35.1 | 3.65 | 3.9 | 26.5 | 46.8 |
| 16 | Suiting | 3 | 4 | 15.4 | 14.6 | 3.5 | 2.9 | 15.0 | 19.5 |
| 17 | Suiting | 4 | 4 | 15.9 | 19.9 | 3.4 | 3.45 | 15.4 | 26.6 |
| 18 | Suiting | 5 | 4 | 30 | 27.5 | 3.3 | 3.85 | 29.1 | 36.7 |

The full factorial design is used with all possible combinations of the same for the given levels of the factors considered for the study. The design was analyzed and the surface plot for the each response of that seam strength, seam elongation and the seam efficiency with respect to the input parameters; stitch density and the number of layers, were plotted. Also the analysis of variance (ANOVA) is carried out to see the significance of the each factor on to the response.

### A.Seam Strength

The interaction effect of the number of plies and the stitch density on to the seam strength in the warp direction can be seen from the fig. 1a. It can be seen from the fig. that the seam strength is increasing at all the number of plies with increase in the number of stitches per linear meter of the seam line along the warp direction. As the numbers of stitches are increasing the numbers of interlacement pointes are increasing for the given length of the seam. The interlacement point at the lock stitch seam formed by the interloping of the needle and bobbin thread acting as the binding points contributes to the seam strength. Also from the table 4, it can be seen that the stitch density has a significant effect on to the seam strength along the warp direction. For high stitch densities the seam strength along the warp direction is increasing with increase in the number of layers but for the lower stitch density there not much change is observed.

As the number of layered are increasing the thickness of the seam assembly is also increasing, with increase in the thickness the thread interlacement is also increasing at the interlacement point which may results in to the increase in the seam strength. Further at higher seam density where the length of stitch is less and more number of stitches are there for the given length the integrated effect with linearly increase trend of the seam strength with respect to the stitch density can be observed in fig. 1a. Surprisingly the effect of the fabric type on to the seam strength along the warp direction is not significant, as the medial weight of fabric with less variation in the fabric weight and the of the same weave construction have been considered for the study.

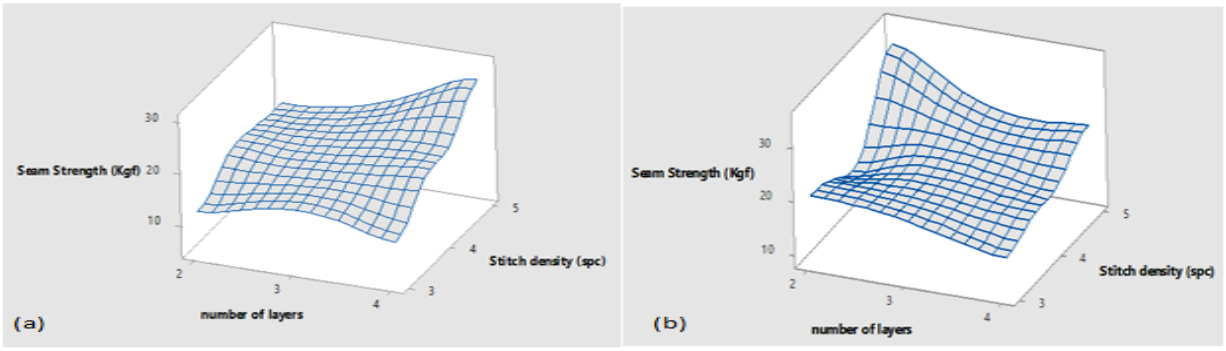


Fig. 1 Effect of change in stitch density and the number of layers on seam strength (a) warp direction (b) weft direction

**Table 4. Significant test result using analysis of variance for the response seam strength**

| Factors | DF | P-Value | Significance |
|---|---|---|---|
| Seam Strength: Warp direction | | | |
| **Stitch density (spc)** | **1** | **0.041** | **Significance** |
| Number of layers | 1 | 0.109 | No Significance |
| Fabric type | 2 | 0.130 | No Significance |
| Seam Strength :Weft direction | | | |
| **Stitch density (spc)** | **1** | **0.003** | **Significance** |
| Number of layers | 1 | 0.067 | No Significance |
| Fabric type | 2 | 0.6 | No Significance |

Similar to the effect of the number of layers and the fabric type on to the seam strength in warp direction, in weft direction also there is a no significant difference have been obtained for the stitch density the fabric type and significant different for the stitch density is obtained.

### B. Seam elongation

The interaction effect of the number of plies and the stitch density on to the seam elongation in the warp direction can be seen from the fig. 2a. It can be seen from the fig. that the seam elongation is not changing at all the number of plies with increase in the number of stitches per linear meter of the seam line along the warp direction, except for the double layer stitched fabric at less stitch density of 3 spc. This may be because of the less tension development at the interlacement point with less firmness for less number of stitches for the lower thickness of the seam assembly. Also from the table 4, it can be seen that the stitch density has a no significant effect on to the seam elongation along the warp direction. The number of layered have significant difference on to the seam elongation along the warp direction as shown in table 5. The seam elongation is decreasing with increase in the number of plies stitched together, the higher value of the seam elongation can be seen for the lower number of the stitches per linear unit length. As the number of layers are increasing the for the seam thread tension for the higher thickness of seam assembly there will be more firmness results in to the low elongation at break, specially for the 2 numbers of layers stitched at the 3 spc that can be seen from the fig. 2b.

Surprisingly the effect of the fabric type on to the seam elongation along the warp direction is not significant, as the medial weight of fabric with less variation in the fabric weight and the of the same weave construction have been considered for the study.

**Table 5. Significant test result using analysis of variance for the response seam elongation**

| Factors | DF | P-Value | Significance |
|---|---|---|---|
| Seam Elongation: Warp direction | | | |
| Stitch density (spc) | 1 | 0.422 | No Significance |
| **Number of layers** | **1** | **0.029** | **Significance** |
| Fabric type | 2 | 0.324 | No Significance |
| Seam Elongation :Weft direction | | | |
| Stitch density (spc) | 1 | 0.397 | No Significance |
| Number of layers | 1 | 0.616 | No Significance |
| Fabric type | 2 | 0.090 | No Significance |

Similar to the effect of the stitch density and the fabric type on to the seam elongation in warp direction, in weft direction also there is a no significant difference have been obtained for the stitch density the fabric type. Only the effect of the direction can be seen for the seam elongation with respect to the number of layers, for the weft direction there is no significant effect of number of layers have been observed. The fig. 2 b shows the interaction stitch density and the number of plies for the seam elongation in weft direction. With change in the number of layers at different stitch densities there in no specific trend for the seam elongation along weft direction.

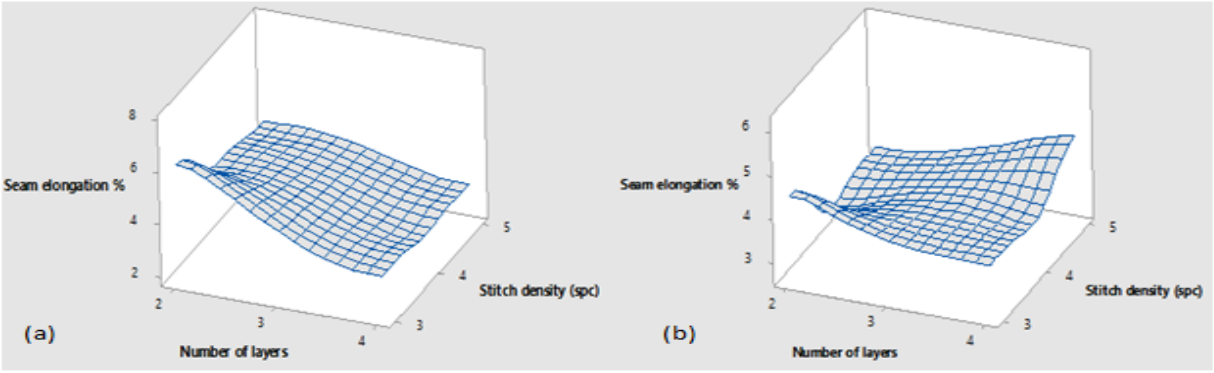


Fig. 2 Effect of change in stitch density and the number of layers on seam elongation (a) warp direction (b) weft direction

### C.Seam efficiency

For seam efficiency there is no difference along warp and weft direction for number of layers and the stitch density have been seen as shown in fig. 3. While seam efficiency is significantly affect by the given range of the fabric type as a shown in table 6 in both warp and weft direction, as the seam efficiency is calculated by considering the original fabric strength to the seam strength. Compare to seam strength where the stitch density have significantly affects the result while in case of seam efficiency the relative effect have not been seen.

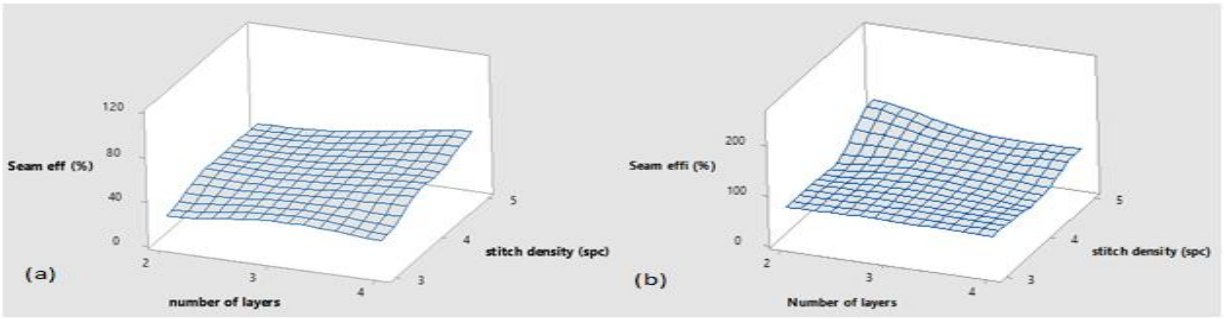


Fig. 3 Effect of change in stitch density and the number of layers on seam efficiency (a) warp direction (b) weft direction

The seam efficiency can be predicted from the given type of fabric using the stitch density and the number of layers by using the equations obtained from the linear regression mode for both warp and weft direction as below:

**Table 6. Significant test result using analysis of variance for the response seam efficiency**

| Factors | DF | P-Value | Significance |
|---|---|---|---|
| Seam efficiency: Warp direction | | | |
| Stitch density (spc) | 1 | 0.033 | No Significance |
| Number of layers | 1 | 0.075 | No Significance |
| **Fabric type** | **2** | **0.00** | **Significance** |
| Seam efficiency: Weft direction | | | |
| Stitch density (spc) | 1 | 0.048 | No Significance |
| Number of layers | 1 | 0.312 | No Significance |
| **Fabric type** | **2** | **0.000** | **Significance** |

$$\text{Seam eff. Warp} = 38.30 + 41.54\,\text{Fabrictype}_{\text{cotton}} - 21.85\,\text{Fabric type}_{\text{Shirting}} - 19.69\,\text{Fabric type}_{\text{Suting}} - 11.25\,\text{spc}_3 + 3.13\,\text{spc}_4 + 8.11\,\text{spc}_5 - 5.29\,\text{layeres}_2 + 5.29\,\text{layeres}_4$$

$$\text{Seam eff. Weft} = 82.66 + 77.44\,\text{Fabrictype}_{\text{cotton}} - 24.96\,\text{Fabric type}_{\text{Shirting}} - 52.49\,\text{Fabric type}_{\text{Suting}} - 9.74\,\text{spc}_3 + 16.92\,\text{spc}_4 + 26.66\,\text{spc}_5 - 7.17\,\text{layeres}_2 + 7.17\,\text{layeres}_4$$

From the equations it can be seen that the for seam efficiency in vertical direction contributed by majorly by the type of the fabric followed by the stitch density and the number of plies in the assembly also in the horizontal direction perpendicular to the selvedge. Also the above equations it have the good correlation in perdition of the values of the seam efficiency. The equation for seam efficiency in warp direction is having a strong coefficient of determination ($R^2$= 91.59%) as well as the weft direction ($R^2$=86.48%). The given equations which are proposed are based on the given medium weight fabric according to the given types of fabrics that are 100% cotton bleached and the polyester and cotton blend fabrics used for shirting and the suiting, the seam performance can be predicted.

## IV. CONCLUSION

For the given range of the fabric types which are of medium weight and weaved with a plain weave, the seam strength is significantly affected by the stitch density in both warp and weft directionally stitched lock stitch seam. Out of given sewing parameters; stitch density, number of layers and the fabric types, the seam elongation is only affected by the number of layers for the seam stitched in warp direction. The seam efficiency is only affected by the fabric type irrespective of the stitch density and numbers on plies.

## REFERENCES

1. V. P. K. Madhuri K.V., "Applications, Microbial exopolysaccharides: Biosynthesis and potential," *Orient. J. Chem.*, vol. 30, no. 3, p. 1401, 2014.
2. Abraham K.P., Srieenivas J., Venkateswarulu T.C., Indira M., Babu D.J., Diwakar T., "Investigation of the potential anti biofilm activities of plant extracts," *Int. J. Pharm. Pharm. Sci.*, vol. 4, no. 4, pp. 282–285, 2012.
3. M. R. N. Venkata Rao K., Murthy B.S.N., "boring of AISI 316 steel with artificial neural network," *Meas. J. Int. Meas. Confed.*, vol. 51, no. 1, pp. 63–70, 2014.
4. T. B. Kumar K.P., Rao K.V.N.S., Krishna K.R., "Neural network based vibration analysis with novelty in data detection for a large," *Shock Vib.*, vol. 19, no. 1, pp. 25–35, 2012.
5. S. V. Surendar A., Kishore K.H., Kavitha M., Ibatova A.Z., "Effects of Thermo-Mechanical Fatigue and Low Cycle Fatigue Interaction on Performance of Solder Joints," *IEEE Trans. Device Mater. Reliab.*, vol. 18, no. 4, p. 606, 2018.
6. F. Iwona, "Analysis of lockstitch seam strength and its efficiency," *Int. J. Cloth. Sci. Technol.*, vol. 28, no. 4, pp. 480–491, Jan. 2016.

## AUTHORS PROFILE

**Md. Vaseem Chavhan** , M.Tech from NIT Jalandhar have many publication in SCI and SCOPUS indexed journals, his area of interest is seam & stitches, nonwoven and filtration.Presently working as a Assistant professor for the program of the textile technology at VFSTR vadlamudi.

**Goverdhanrao Ch** M.Tech from DKTE Ichalkaranji have many publication in indexed journals, his area of interest is fabric manufacturing and novel fibres. Presently working as a Assistant professor for the program of the textile technology at VFSTR vadlamudi.

**B. Venkatesh** M.Tech from Anna University have many publication in indexed journals, his area of interest is chemical processing for textiles. Presently working as a Assistant professor for the program of the textile technology at VFSTR vadlamudi.