International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 5 May 2022, pp: 2209-2212 www.ijaem.net ISSN: 2395-5252

Seam superiority; A study on the analysis of various mechanical properties

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Submitted: 20-05-2022 Revised: 28-05-2022 Accepted: 30-05-2022

ABSTRACT
Seam superiority is pretentious by several properties of fabric like mechanical, chemical etc. with a combination of their sewing parameters. The purpose of this present research was to investigate the act of seam quality in terms of seam exterior and strength constructed with different sewing factors. The investigation was done for different fabric categories, namely light, light to medium, medium, medium to heavy and heavy weight. The total fabrics with different weave densities, fibre types and structures were used. Seams were produced using various sewing parameters such as threads with different fibre types and structures, needle sizes and stitch densities. From the experimental work, it was concluded that the usage of thicker threads did not always give better strength and the seam appearance was also poor. A combination of finer thread with moderate strength and a medium level of stitch density according to fabric weight category provided an effective result for both seam appearance and strength. From the modelling work, it was found that the extensibility, bending and shearing properties, together with thread properties including extensibility, tensile strength and size, were among the properties included in the predictive equations. The validation results showed that the standard deviation between fabric properties used to develop the equations and new fabric properties used for validation plays an important role.

KEYWORDS: Seam exterior, Seam strength, Seam superiority, Fabric, Sewing thread, Seam puckering.

I. INTRODUCTION

Stitches and seams plays vital role for constructing a garments. Stitches are used to join the materials like piece of fabric and hold the apparel together, and seams give the shapes and element of the apparel. These two elements together with the material properties contribute to the quality of the clothing.

Since fabric materials have non-linear mechanical properties, one set of sewing parameters cannot be used for all types of fabric. This means that one particular type of fabric cannot necessarily be handled the same way as another type of fabric. Any changes in the process parameters, especially during the sewing process, will affect the overall quality of apparel produced. For this research, selected fabrics are being sewn with different sewing parameters which include types and sizes of sewing thread, needle size and stitch densities in order to have variations of seam performance in terms of appearance and strength that are used for developing the equations for prediction. Different stitch densities are selected based on fabric weight category. Fabrics are sewn with different types of sewing thread in terms of thread size, structure and fibre content. Needle size is selected according to the size of the sewing thread. After sewing, sewn fabrics are evaluated for appearance and strength in order to investigate the changes in terms of overall quality after alterations in the sewing parameters. Beside sewing parameters, the performance of the fabric has a direct correlation with apparel quality: high quality fabrics will be likely to give high quality apparel.

II. LITERATURE SURVEY

2.1 Seamappearance or puckering

Puckering is an intolerable waviness in appearance along the seam length that occurs immediately after seam construction or that may develop after several washing and drying processes (Ukponmwan, Mukhopadhyay et al. 2000). The Oxford English Dictionary defines seam puckering as ‘a ridge, wrinkle or corrugation of the material or a number of small wrinkles running across and into one another, which appear in sewing together two pieces of cloth.

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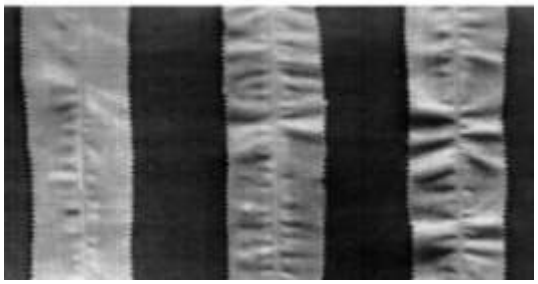

Figure 1: Seam puckering

2.1.1 Types of seampuckering

There are several types of seam puckering which can be divided into three categories:

i. displacementpuckering,
ii. tension puckering,and
iii. feedpuckering.

Displacementpuckering

Displacement puckering is more likely to occur when sewing with higher count fabrics, finer fabrics and also thicker sewing thread. Stitch size also plays an important role in the occurrence of structural jamming. Stitch size is usually described by the number of stitches cm^{-1} (spcm). Lower numbers of spcm can be considered lower quality because the stitch tends to snag and be exposed to higher abrasion. A higher number of spcm gives better strength to the sewn fabric but in cases of structural jamming of the fabric with the sewing thread, puckering occurrences can clearly be seen. The use of fabric with lower fabric density in warp and weft directions can reduce the likelihood of puckering due to structural jamming.

Tensionpuckering

If there is too much tension given to the thread, there will not be enough thread to form the stitch and the thread will be overstretched. During the relaxation process after sewing, the thread will return to its original length and compress the fabric and this can produce seam puckering known as tension puckering and also create an unbalanced stitch (Mori and Niwa 1994; Dobilaite and Juciene 2006). If the tension is too low, the seam cannot hold together firmly, especially under stress, and can be easily pulled apart.

Feedpuckering

When there is high friction, the fabric, either its top or bottom layers, tend to move at different rates and this can cause puckering. Differential fabric stretch can also cause puckering on one side of the seam and this usually happens when piecing together two different types of fabric. Slowing down the sewing process and reducing the pressure help reduce the occurrence of seam puckering. Alternatively, most garment manufactures adopt machine feed systems such as differential bottom feed and adjustable top feed systems that can be adjusted for smooth sewing for any type of material or seam (Carr and Latham 2000).

2.2Seamstrength

The seam strength can be affected by the changes of seam and stitch type because it affects the interlacing of sewing thread with yarns in the fabric (Gribaa, Amar et al. 2006). Elongation in the seam can be defined as the amount that a seam can be stretched without breaking and a suitable stitch type, seam type, thread tension, stitch density, sewing thread and fabric properties are needed so that the seam can elongate the same amount as the fabric (Glock and Kunz 1995). A failed seam makes the apparel unwearable even though the fabric is still in good condition, which is why it is very important to relate sewing parameters to fabricproperties.

2.3 Fabric mechanical properties with relation to seamquality

During the production of fabric into a garment, the fabric is exposed to different kinds of strain such as tensile, pressure, shear and bending. Since textile material has non- linear mechanical properties, different materials react differently to strain and that is why it is important to look into the relationship between fabric mechanical properties and their behaviour (Pavlinic and Gersak 2003).

2.3.1 Extensibility

Extensibility determines the capability of the fabric to be stretched during the making up process of the garments (Ly, Tester et al. 1991). This is because during the sewing process, fabric needs to be stretched in order to match up with the garment shape. The value of extensibility determines the sewability of the fabric. Some examples of recommended fabric extensibility are: i) FAST control chart for wool fabrics: minimum limit of 2 per cent for the warp and weft directions and a maximum limit for the warp direction of 4 per cent and 6 per cent for the weft direction (Cheng, How et al. 1996)

2.3.2 Bending

The bending rigidity is closely related to the stiffness during fabric handling. Bending rigidity measures the resistance of the fabric to beingbent. Lightweight fabrics usually have low bending rigidity and this makes it difficult to handle during cutting because of its flexibility and can cause seam puckering. It is recommended that lightweight fabrics should have a minimum value of 5 μN.m for warp

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and weft directions (Cheng, How et al. 1996). High bending rigidity fabric is more manageable and can produce a flat seam compared to lightweight fabric (Minazio 1995; Saville 1999).

III. EXPERIMENTAL RESULTS &ANALYSIS

Threads and fabrics were tested for their physical and mechanical properties. Five different threads were tested for linear density, tensile strength, extensibility together with twist and number of plies. 45 fabrics were tested for mechanical properties using the KES-F, FAST and Instron tensile tester. All fabrics were prepared and sewn for seam appearance and strength evaluation. In this chapter, results on thread and fabric properties together with seam evaluations were presented andanalyzed.

3.1 Medium to heavy weightfabrics

Under this section, tensile strength, seam appearance and seam strength for medium to heavy weight fabrics are presented and analyzed. Seamstrength Figure 2 shows a relationship between fabric tensile strength in weft and seam strength for medium to heavy weight fabrics. In comparison with other fabric weight categories, the R value is low for medium to heavy weight fabrics even though weft still gives a higher reading. Medium to heavy weight fabrics have a higher tensile strength either in weft or warp directions as shown in Figure 3. When the seam strength was tested, thread in the seam was stretched and broke. The value of seam strength due to the breakage of thread is low when compared with the fabric strength itself. This gives a low correlation between tensile strength and seam strength.

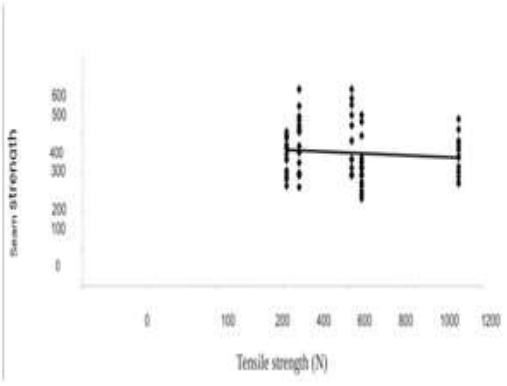

Figure 2: Relationship between tensile strength (weft direction) and seam strength for medium to heavy weight fabrics.

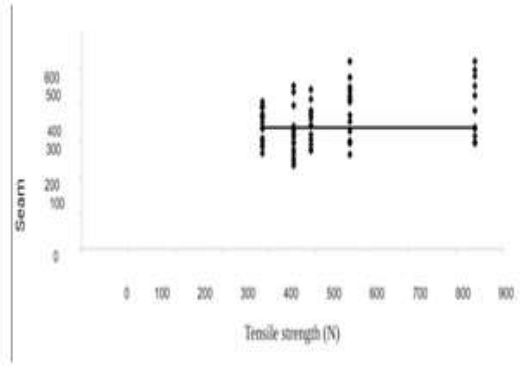

Figure 3: Relationship between tensile strength (weft direction) and seam strength for medium to heavy weight fabrics

Figure 4shows seam efficiency between 55-69% of seam efficiency for 6.0 spcm. Stitch density of 5 gives the seam efficiency between 70-84%. An excellent seam efficiency percentage is also achieved using 6.0spcm.

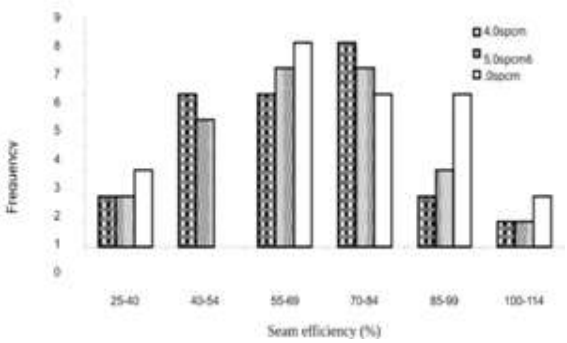

Figure 4: The effect of stitch density to seam efficiency for medium to heavy weight fabric

IV. CONCLUSION

The usage of medium stitch density did not always give the best seam appearance but it is the safest choice for minimizing occurrence of seam puckering. Medium stitch density needed less tension and thread when compared with the high stitch density. The effect of structural jamming, where the thread is compacted inside the fabric during sewing, can be reduced. Tension puckering due to thread elongation during sewing and the subsequent recovery after sewing can also be reduced by using medium stitch density. Lower stitch density means more thread on the surface of the sewn fabrics. The thread is exposed to abrasion during wear and care and can break easily.

Thread size andstructure

Thread with a finer size gave a better result of seam, especially for light, light to medium and medium weight fabrics. Most of the fabrics in these categories have a finer warp and weft yarn. Thicker

thread makes structural jamming more obvious and gave a poor seam appearance. Thread with higher extensibility gave a poor seam appearance for all fabric categories. Thread with high extensibility should be avoided for normal garment and apparel applications. It should only be used with special apparel that needs to haveelasticity.Thicker threads also have a relatively high tensile strength. On average, thicker threads gave higher seam strength. A combination of medium stitch density and a finer thread gave a good seam appearance and seam strength performance.

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