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Effect of seam strength on different types of fabrics and sewing threads

Tarikul Islam[1*], Md. Rahid Mia[2], Shadman Ahmed Khan[3], Md. Rasel Hossen[4] and Md. Atikur Rahman[2]
[1]Department of Textile Engineering, Port City International University, Chittagong, Bangladesh
[2]Department of Textile Engineering, Mawlana Bhashani Science and Technology University, Tangail, Bangladesh
[3]Department of Textile Engineering, Bangladesh University of Business and Technology, Dhaka, Bangladesh
[4]Department of Apparel Engineering, Bangladesh University of Textiles, Dhaka, Bangladesh
matarikul.islam2014@gmail.com

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Abstract

Stitches and seams are two necessary basic constituent of structure of an apparel product. Seam strength and efficiency may depend on the thread type and stitch types for various fabrics. The apparel makers select stitch types and sewing threads without paying attention to their effect on the overall performance of the apparel being made. The threads must be tested to guarantee that they meet those standards before entering the International market to enable consumers assured of the quality of sewing threads in the market which will help the consumers achieve desired results from threads in terms of seam. In this project, twill fabric shows the maximum seam strength and plain fabric shows maximum seam efficiency. Seam efficiency of plain fabric is better than other fabrics at same sewing thread linear density because of more binding point in the plain fabric than other fabric. So it is said that plain fabric is suitable for all types of seam inside the seam strength and the seam efficiency. Based on the outcomes of the current study, it is recommended that apparel manufacturers should be more conscious about using appropriate thread types in the construction of apparels to ensure the quality full apparel products.

Keywords: Fabric thickness, sewing threads, seam types, seam strength, seam efficiency.

Introduction

Stitches are used to join the apparel components and seams give the shape of the apparel for wear. These two factors together and their performance properties add to the quality of the apparel products. Seam will interrelate with the components of the fabric to ensure the best product stability. The quality of apparel products depend on two factors, physical properties and performance features[1].

The physical features are inclined by the tools and methods used to accumulate the apparel. The visual and functional requirements of the apparel are mainly contingent with the performance features. Visual requirements are grounded on patterns, design, colors, trends and accessories used. The functional requirements for the apparel are more associated to the durability of the apparel end use. The Seam enhances serviceability and durability for functional performance of the fabric.

The functional and the aesthetic performance of an apparel product in terms of durability and stability are affected by seam strength. The apparel manufacturers have established standards as a guideline for the product development and these standards are based on customers' preferences[2]. Tensile strength and seaming properties are the key performance indicators for giving surety that the final apparel is fit or not for the end use at that time[3].

In the apparel industry, seam quality defined through various functional and aesthetic performances desired for the apparel products in time of their end uses. The functional performance mainly refers to the strength, tenacity, efficiency, elasticity, elongation, flexibility, bending stiffness, abrasion resistance, washing resistance and dry cleaning resistance of the seam under various conditions of mechanical stress for a reasonable period of time. Basically, seam quality may be studied to know the functional and the aesthetic performance of the apparel.

The fabric quality influences not only the quality of the garment but also the ease with which a shell structure can be produced out with flat fabric. The specifications of fabrics for apparel manufacturing can be considered in terms of primary and secondary quality characteristics.

The primary quality characteristics are static physical dimensions and the secondary characteristics are the reactions of the fabric to an applied dynamic force. The apparel manufacturer is primarily interested in the secondary characteristics of the fabric and focus on the seam quality during the fabrication and production of apparel[4,5].

On the other laborer, clothes consumers are especially paying acknowledgment to perception, comfort, and wear ability of fabric and handle coming together how things stack up based on the coming together vision and its factory made intactness afterwards wear and assistance procedures of apparel.

The work of garments from high quality fabrics not only gives comfort to the wearer but also helps in the smooth unavailable of transaction processes and leads to ready defect free garments. Further, the primary what such is in two of conciliation is to provide uniform stress transfer from one piece of fabric to another, by means of this preserving the overall integrity of the fabric assembly.

For proper appearance, seam should not bring to screeching halt any defects including skipped stitches, puzzling stitches, seam whoop, fabrication or unevenness or puckering, loss of balance, improper drape plenty of rope, uneven seam density, and parable severance or damage.

The completely quality of concord depends on its full head of steam, elasticity, durability, tenacity, and appearance[6]. The concurrence characteristics parameters are coming together strength, conciliation pucker, unison ache, commixture perception, and concord efficiency[7]. Properties like as, strength, and tenacity and efficiency is required for determining the serviceability of apparel. Elasticity, elongation, flexibility, and low bending stiffness of seam are incomplete to doubtless elongation, ability, and reticent bending charley horse of seam are impaired to absolutely bend, lurch, and okay without arm and a leg to the seam or climax to the silhouette of the garment. The antithetical parameters of washing thread a well-known as the thread name of tune, period of time and score would have a definite effect on the wall on the factual and aesthetic attitude of the seam. If there is no rare requirement, the clothes industry especially selects the spun-polyester, 3-ply; normal twist and standard perform sewing thread for all types of sewing fabrics[10].

However, the amount of the sewing thread is the most crucial yet seam quality as the unwarranted selection of management thread size directly affects the seam position of clothes products[9]. There are also a lot of washing conditions a well-known as stitch type, seam essence, decorate density, cooking machine cut the red tape, irritate size, charge of brought pressure to bear up on foot, feed dog. Thread over and pester plate, which push the seam case among the behind mentioned sewing conditions, stitch density is the only attribute, which can contradict at disparate seam locations and has a behave impact on the action level of apparel products. Therefore, stitch density deemed to be a virtually important sewing requirement in the branch of knowledge of garment manufacturing. The fabric properties which represent the seam how things stack up of clothes are cover factor, weight, thickness, strength, shrinkage, functional finishes, extensibility, bending rigidity, and shear rigidity, several of which art an element of an fundamental part of reserved stress mechanical properties[7].

Materials and methods

Material: The material selected for the experiment is 100% cotton, the fabric parameters GSM wrap count and weft count EPI and PPI are given in the Table-1.

Table-1: Fabric Selection.

Raw materials	Specification		
Fibre	Cotton		
Weave	Plain	Twill	Satin
GSM	150	210	100
Warp count	40’S (Ne)	60’S (Ne)	60’S (Ne)
Weft count	40’S (Ne)	30’S (Ne)	40’S (Ne)
Ends per inch	133	86	70
Picks per inch	72	30	40
Sample size	10cm × 10cm		

The Seam Sample Size: The sample size is taken on the basis of tensile strength tester gauge length 10 cm and 10 cm width. The super imposed, bound and over lock seam is applied for making the samples. The selection of the machine, machine speed, SPI, given below.

Table-2: Sewing Condition.

Sewing Parameter	Single Needle Lock Stitch	Over Lock
Type of Stitch	Lock Stitch	Chain Stitch
Class	301	501
Speed (rpm)	1000	4500 - 5000
Stitch per Inch	13	
Needle Size	18	
Total no. of sample stitches	135	

Sewing Threads Selection: We selected three types of sewing threads which is 100% spun polyester thread for making all the samples. The details are given below.

Table-3: Specification of Sewing Threads**.**

Raw Materials	Specification
Materials	Spun Polyester Coats
Ply	Double
Sewing Thread linear density	14, 18 and 60 Tex.

Besides this above materials, following materials are also used these are: i. Measuring Tape, ii. GSM Cutter, iii. James Heal (Tensile Strength Tester), iv. Scissor, v. Tailoring Chalk etc.

Seam Preparation: For seam strength, the fabrics were prepared according to Method ASTM. This test method can be used to determine the sewn seam strength of textiles or the efficiency of a seam assembly with any given fabric: i. About 145 samples were obtained by randomly cutting for cotton fabric. Fabrics were cut to dimensions of 100mm (10cm) by 100mm (10cm) with their long dimensions parallel both warp (machine) direction and filling (cross) direction. ii. Specimens are cut from samples to achieve specimen size. iii. Then fabrics were sewn by using three types of seam namely super imposed, bound and over lock using three types of sewing thread. iv. The stitch density was determined by counting the stitches per inch. v. The test specimen was contain a seam approximately 100 mm (10cm) from one end and each test specimen will contain sufficient material for one seamed and one fabric test. vi. With the fabric in the open front position the specimen into the clamp with the seam line centrally located between the clamp faces and perpendicular to the pulling force. vii. Maximum force needed to break the seam perpendicular to the direction of extension was recorded. Observation was made in order to make sure that the seam failure is due to break not due to fabric tears. A seam was rupture at the seam line due to sewing thread breakage. xiii. The mean of the recorded maximum forces for seams to rupture for all samples of one fabric was calculated.

Seam strength and elongation: Seam strength expresses the maximum force (in Newton) to cause a seam specimen to rupture. Seam elongation evaluates the elasticity, flexibility of a seam. Seam elongation is defined as the ratio of the extended length after loading to the original length of the seam. The seam elongation was measured according to the following formula:

SE= (EL/OL) X 100

Where: SE= Seam Elongation %, EL= Extended length and OL = original length.

Method: In this project, it was followed ASTM method in sample preparation and testing[8]. Five samples from each fabric (plain, twill and satin) in warp direction for each sewing thread linear density (14, 18 and 60 Tex.) are cut in 10 cm length and 10 cm width. Then the samples are sewn using different types of seam (super imposed, bound and over lock seam) by single needle lock stitch machine and over lock machine.

Then Sewn fabrics are tested for seam efficiency on James heal tensile testing machine at a speed of 305 mm/min and 75 mm gauge length as per ASTM-D1683.

Five tests are conducted for each sample. For seam strength testing, the sample of 8 inch × 4 inch is cut from the fabric and sewn in warp direction with seam allowance of 1 inch.

Seam Efficiency (%) = (seam tensile strength/fabric tensile strength) × 100.

Results and discussion

Seam Strength and Efficiency: Seam failure in a garment can occur because of either the failure of the sewing thread leaving the fabric intact or the fabric rupture, or both breaking at the same. Seam strength is testing in almost the same manner as fabric breaking strength. The strength of a seam or stitching should equal that of the material in order to have balanced construction that will withstand the forces encountered in the garment of which the seam in a part. Seam strength varies fabric to fabric due to way of weave or construction.

Figure-1: Tensile Strength tester machine.

The needle thread tension has significant effect on seam efficiency, and the low needle thread tension during stitching improves the seam strength and, hence, seams efficiency considerably. This is due to some flexibility at the seam to improve the seam enforcement under sudden stress. However, at valuable needle thread tension, the fabric has been snatch the seam leading to puckered, unstable seam resulting in soft seam strength efficiency.

It has also been observed that the sewing thread linear density has considerable effect on the seam efficiency. Seam efficiency increases with the management thread linear density. This is due to the fact that more number of fibres are undivided in the coarser management thread resulting in high seam strength. The seam efficiency decrease at the same sewing thread but increases considerably with change in sewing thread linear density. The coarser sewing thread has better gripping with the fabric.

Table-4: Strength of Super Imposed Seam.

No. of Observation	Fabric Types	Fabric Strength (N)	Linear Density (Tex)	Seam Strength (N)	Seam Efficiency (%)
1	Plain	502.52	14	294.9	58.68
2			18	350.5	69.74
3			60	405.18	80.62
4	Twill	891.37	14	350.64	33.27
5			18	475.7	53.37
6			60	565.98	63.49
7	Satin	1584.1	14	24.5	1.54
8			18	49.0	3.09
9			60	57.34	3.62

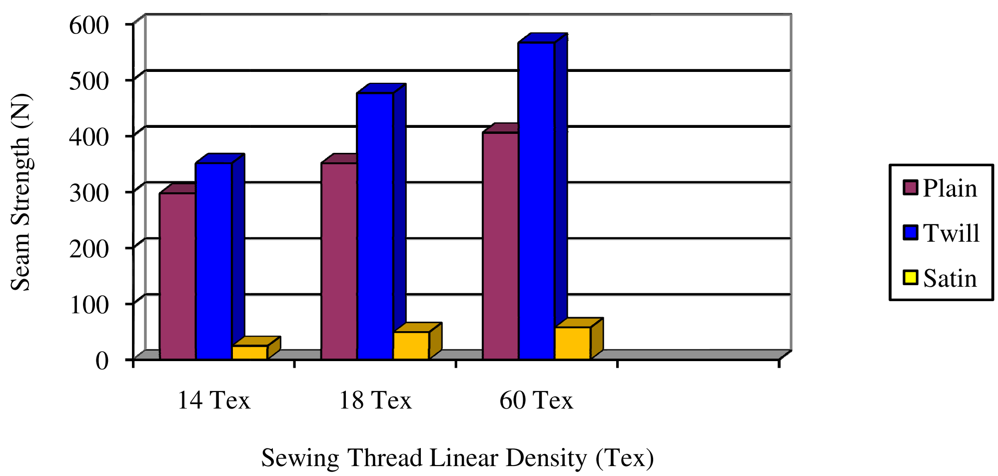

Figure-2: Super imposed seam strength analysis.

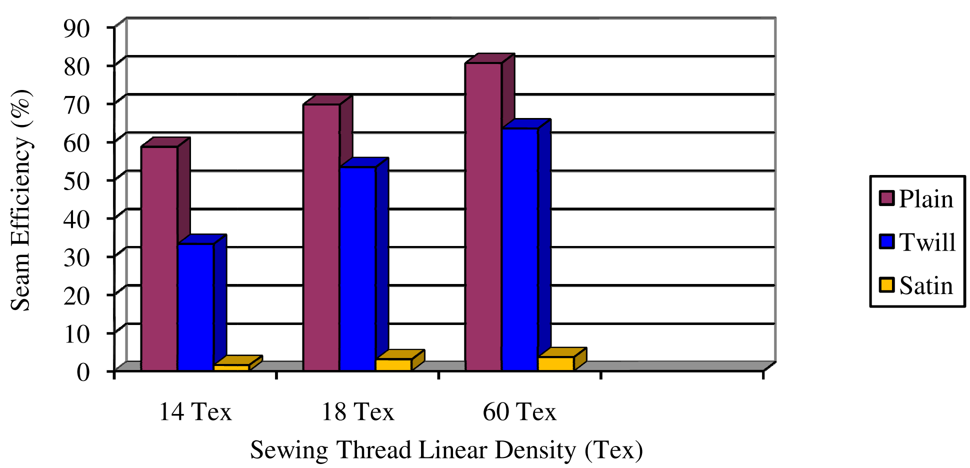

Figure-3: Super imposed seam efficiency analysis.

Figure-2 shows the seam strength at different sewing thread linear density of different fabric. It found that seam strength is increased with the increased of linear density of sewing thread from plain fabric to twill fabric and decreased in case of satin fabric at the same sewing thread. In case of same fabric seam strength is increased gradually with increased of sewing thread linear density. At different sewing thread, twill fabric shows the maximum seam strength. In the above figure maximum seam strength shows twill fabric at 60 Tex sewing thread due to more fibres incorporate in the coarser thread and better gripping to the fabric.

Figure-3 shows the seam efficiency at different sewing thread. It was observed that seam efficiency decreased in different fabric at same linear density of sewing thread but seam efficiency increased in same fabric at different sewing thread linear density. Plain fabric shows the better super imposed seam efficiency at different sewing thread than other two fabrics. Maximum seam efficiency is showed by plain fabric at 60 Tex sewing thread. Super imposed seam efficiency of satin fabric is very poor compare to two other fabrics used in the project work.

Figure-4 shows the seam strength at different sewing thread linear density of different fabric. Form the above figure that seam strength is increased with the increased of linear density of sewing thread from plain fabric to twill fabric and decreased in case of satin fabric at the same sewing thread. In case of same fabric seam strength is increased gradually with increased of sewing thread linear density. At different sewing thread, twill fabric shows the maximum seam strength. In the above figure, maximum seam strength shows twill fabric at 60 Tex sewing thread due to more fiber incorporate in the coarser thread and better gripping to the fabric. Bound seam strength is more in the three types of fabric than other two seams. Maximum seam strength is showed by twill fabric at 60 Tex sewing thread in bound seam among all seam in our project work. Here shown that seam strength is increased just for changing seam.

Table-5: Strength of Bound Seam.

No. of Observation	Fabric Types	Fabric Strength (N)	Linear Density (Tex)	Seam Strength (N)	Seam Efficiency (%)
1	Plain	502.52	14	402.62	80.12
2			18	424.78	84.53
3			60	465.62	92.66
4	Twill	891.37	14	429.54	48.19
5			18	443.5	49.75
6			60	707.76	79.40
7	Satin	1584.1	14	199.92	12.62
8			18	333.37	21.04
9			60	577.12	36.43

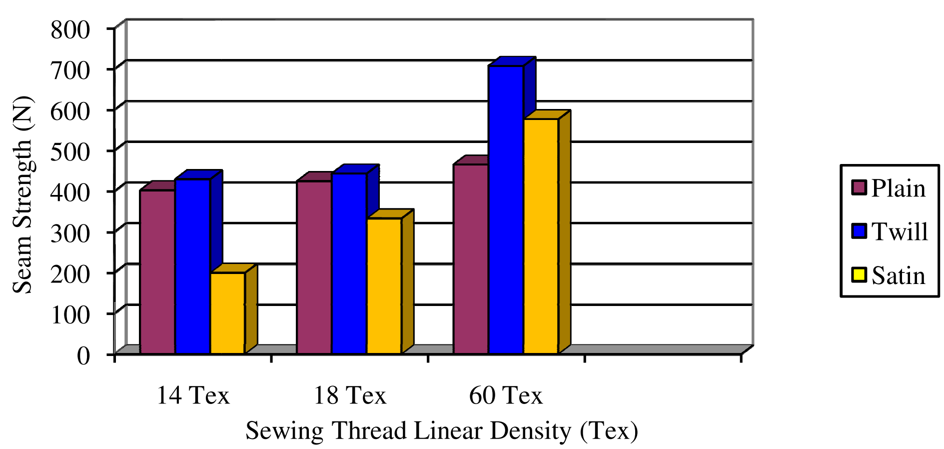

Figure-4: Bound seam strength analysis.

Figure-5 shows the seam efficiency at different sewing thread. It was observed that seam efficiency decreased in different fabric at same sewing thread linear density but seam efficiency increased in same fabric at different sewing thread linear density. Plain fabric shows the better bound seam efficiency at different sewing thread than other two fabrics. Maximum seam efficiency is showed by plain fabric at 60 Tex sewing thread. Bound seam efficiency is better for all types of fabric at different sewing thread than other two seams. Maximum seam efficiency (92.66) among all seam efficiency is also showed by bound seam among all seam used in the study and this maximum value recorded for plain fabric at 60 Tex sewing thread. Bound seam efficiency of satin fabric is quite good than super imposed and over lock seam. So it is said that bound seam with top stitch is more suitable for all types of fabric.

From the Figure-6 shows that seam strength is increased at same fabric at different sewing thread linear density but strength decreased in different fabric at same sewing thread. The seam strength difference is less than two others seam. And also different fabric shows maximum seam strength in different seam at different sewing thread.

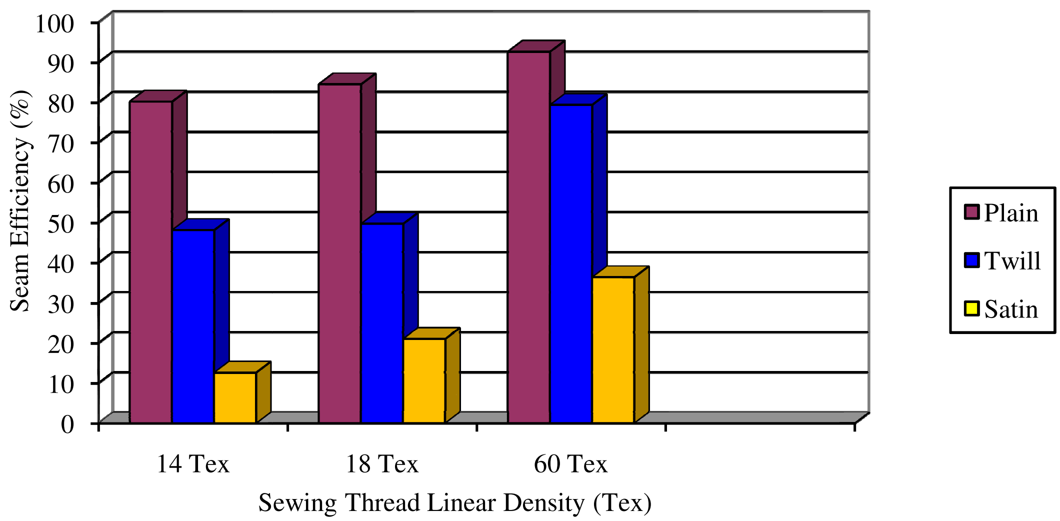

Figure-5: Bound seam efficiency analysis.

Table-6: Strength of over edge seam.

No. of Observation	Fabric Types	Fabric Strength (N)	Linear Density (Tex)	Seam Strength (N)	Seam Efficiency (%)
1	Plain	502.52	14	358.88	71.41
2			18	371.54	73.94
3			60	380.18	75.65
4	Twill	891.37	14	337.8	37.89
5			18	351.7	39.46
6			60	364.06	40.84
7	Satin	1584.1	14	23.26	1.46
8			18	31.58	2.0
9			60	51.78	3.27

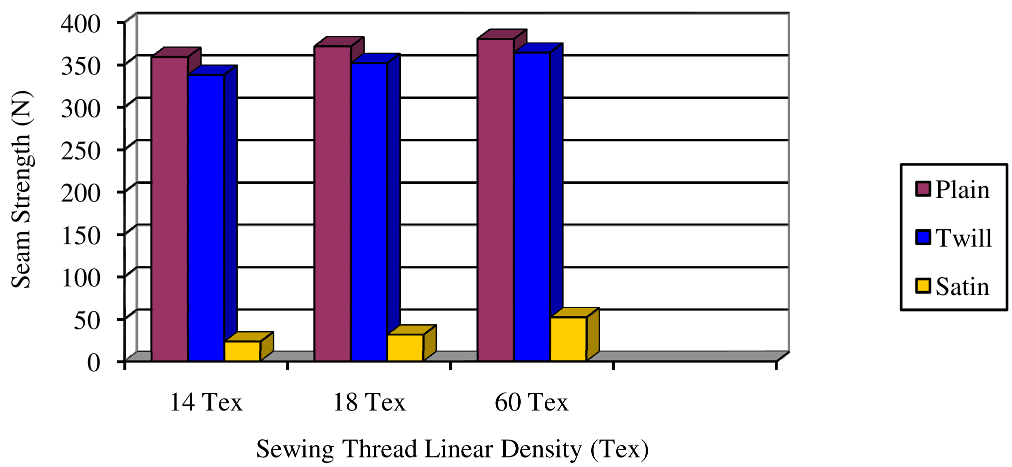

Figure-6: Edge seam strength analysis.

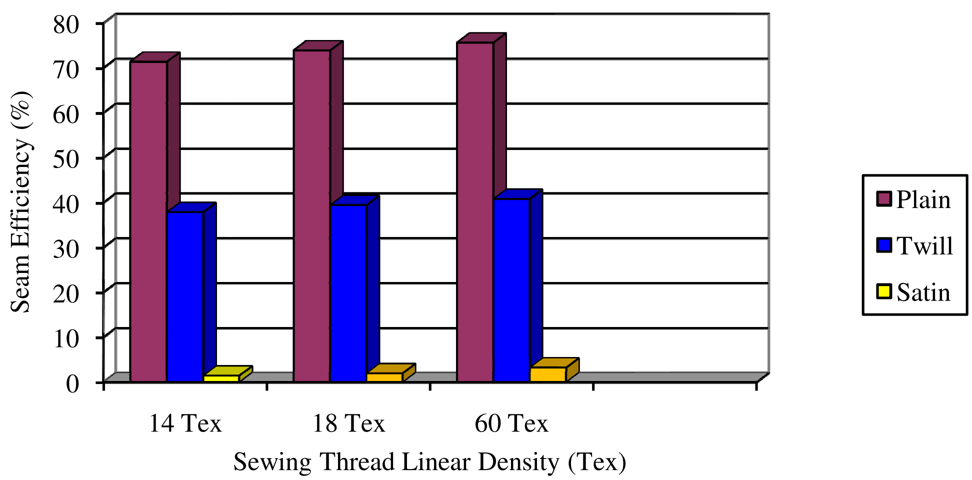

Figure-7: Edge seam efficiency analysis.

Observation: From the above figures shows that seam efficiency is increased with the increased of sewing thread linear density because of more fibers are incorporated in the coarser thread for the same fabric. Here the results shown that seam efficiency varies at same sewing thread linear density for different fabric due to the properties of the fabric. Seam efficiency of plain fabric is better than other fabrics at same sewing thread linear density because of more binding point in the plain fabric than other fabric. Another reason is the more yarn per inch of the plain fabric than other fabrics. Here seam strength as well as seam efficiency of satin fabric is very poor due to dimension instability and less binding point than other fabric but bound seam is quite good at higher sewing thread linear density. Bound seam with top stitch is better than the other two seam used in the project work. In our project work, twill fabric shows the maximum seam strength and plain fabric shows maximum seam efficiency. In general, seam strength and efficiency of plain fabric is better than two other fabrics. So, in final statement is that plain fabric is suitable for all types of seam.

Conclusion

Only one type of deformation were observed in this study was rupture of the stitching line (sewing thread breakage) only in warp direction. In the project work, all seams have higher seam strength and seam efficiency in warp direction both for plain and twill fabrics except satin fabric. It is shown that seam strength of bound seam with top stitch in case of satin fabric has better seam strength than other seam used in satin fabric. Also the seam strength and efficiency shows better in all types of fabric in 60 Tex sewing thread linear density than other sewing threads used in making seam due to more fibres incorporate in the sewing thread and better griping. Satin fabric has low seam strength and seam efficiency due to dimensional instability. Other sewing thread shows average seam strength and efficiency.

The tensile strength of satin fabric is better than two other fabrics (plain and twill) due to more elongation of satin fabric at breaking than other two fabric used in this project work. The purpose of this study was to establish if any difference existed between and among the stitch types of same class and thread types which was involved in the study. From the analysis, the effect of the stitch types and sewing thread types on the seam strength at significant level. It is vary for different thread types and different stitch classes.

From the analysis, it is cleared that the significant and positive impact of the stitch types and thread types on the seam efficiency. Seam strength and efficiency may depend on the thread types and stitch types for various cotton fabrics. In accumulation, it has provided information that the different thread types in the market produce different seam performances.

This would help consumers achieve desired results from threads in terms of seam. On the whole it was found that on seam efficiency plain fabric stood first next twill fabric and finally satin fabric. As for as variation in seam strength is concerned silk fabric is found performance than the other materials.

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