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Effect of Thread Count and Stitch Density (SPI) on 2/1 Twill Woven Fabric

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Abstract

The seam strength and seam efficiency of 2/1 twill woven fabric has been investigated all through the research where a variety of 20/2, 27, 30, 40, 40/1, 40/2 and 40/3 thread count were applied individually for superimposed, lapped and bound seam respectively. After preparation, each of the samples, brought into the tensile strength test and the breaking strength and efficiency were measured. For each case, seam strength increased with the increase of SPI at a constant thread count. The lowest seam strength and efficiency were achieved for samples sewed with 27Tex sewing thread, and the maximum value was achieved for samples which were stitched by 40/3 count.

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Keywords: Stitch density, thread count, 2/1 twill fabric, strength and efficiency.

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1.0 Introduction

At every stage of garment attaching, sewing faults arise due to tension of stitch, puckering properties etc. impact much. So, seam strength becomes a part and parcel of the utmost satisfaction on the durability of a garment. The wrong selection of the stitch types, seam types, thread count, types of thread, stitch density (SPI), machine load, needle size etc. is the main reasons of the defects of garment seam (Ali, 2018). That's why without having a proper selection of sewing thread, stitch density and seam types causes the bad appearance of final goods. However, properties of seam strength largely influenced by nature and origin of fabric and sewing thread, thread count, seam types, rpm of the machine and machining condition (Jaber and Islam, 2019). Sometimes lacking proper functioning may hamper the final appearance and measured by seam strength, seam appearance and seam puckering (Naeem *et al.*, 2014; Siddiquee, Hasan and Basir, 2019). From the research of (Rasel *et al.*, 2020), a details study on the plain-woven fabric have been generalized and discussed regards seam strength and seam efficiency. In this research, the seam strength of superimposed seam, lapped seam and bound seam were measured at various SPI 8, 10 and 12 of 2/1 Twill woven fabric. Therefore, thread count considered for the sewing was 20/2, 27, 30, 40, 40/2 and 40/3 Tex respective samples preparation.

2.0. Materials and Methods

2.1. Material

The parameters of the test have been listed as below-

Parameters	Specifications
Fabric type	100% cotton 2/1 twill woven fabric
GSM	145.5
EPI	65
PPI	46
Warp count	10
Weft count	8
Sample size	10 cm x 10 cm
Seam types	Super imposed seam, bound seam and lapped seam
Thread count	40/3Tex, 40/2Tex, 20/2Tex, 27Tex, 30Tex and 40Tex
SPI (Stitch per Inch)	8, 10 and 12
Fabric Tensile strength	178.6 N

2.2. Methods

2.2.1. Sample preparation

At first, 2/1 twill fabric were cut according to 10 cm x 10 cm and sewed using the mentioning thread count and seam types (super imposed, bound and lapped seam).

2.2.2. Determination of seam strength test

According to ASTM D1683 standard seam strength of the samples were measured. The force which has broken the seam of the samples was recorded and considered as the breaking strength of the seam. This method is also known as tensile strength measurement.

2.2.3. Measurement of the efficiency of seam strength

According to ASTM-D1683 Method, seam efficiency was measured. The following formula was used to measure the efficiency of the seam.

$$\text{Seam Efficiency (\%)} = \frac{\textit{Tensile strength of the seam}}{\textit{Fabric tensile strength}} \times 100$$

2.3. Accessories
i. Measuring Tape, ii. GSM Cutter.

2.4. Machinery
2.4.1. Lock stitch sewing machine
Juki high Speed Lock Stitch Sewing Machine; Made by china. Machine speed 2500-3000 r,p,m. Stitch class 300 & two thread are used one is needle thread another bobbin thread.

2.4.2. Overedge/edge neatening chain stitch machine:
Juki Over edge/Edge neatening chain stitch Machine. Made by China. Machine speed 4500-5000 r,p,m. Stitch class 500.

2.4.3. Testing machine specification
Machine Name: Titan Universal Strength Tester
Model No: Titan -4(110)
Manufacturer by: James Heal
Test item: (i) Tensile Strength
(ii) Efficiency

3.0 Results and discussion
3.1. Seam strength analysis at various SPI and thread count of 2/1 twill fabric
3.1.1. Impact of various seam strength at thread count (20/2 Tex)

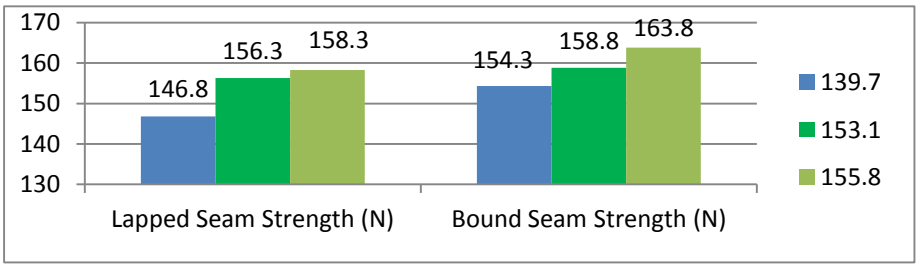

Figure 1: Seam strength at thread count of 20/2 Tex (2/1 twill fabric)

From the given graph, we can assume that, for 2/1 twill fabric of 20/2 Tex thread count, superimposed seam strength is 139.7N for SPI 8, 153.1N for SPI 10 & 155.8N for SPI 12. So we can conclude that superimposed seam strength is gradually increased with the increase of SPI. For lapped seam, strength is 146.8N for SPI 8, 156.3N for SPI 10 & 158.3N for SPI 12. So we can conclude that lapped seam strength is gradually increased with the increase of SPI. In terms of the bound seam, seam strength is 154.3N for SPI 8, 158.8N for SPI 10 & 163.8N for SPI 12. So we can conclude that bound seam strength is gradually increased with the increase of SPI.

3.1.2. Impact of various seam strength at thread count (27 Tex)

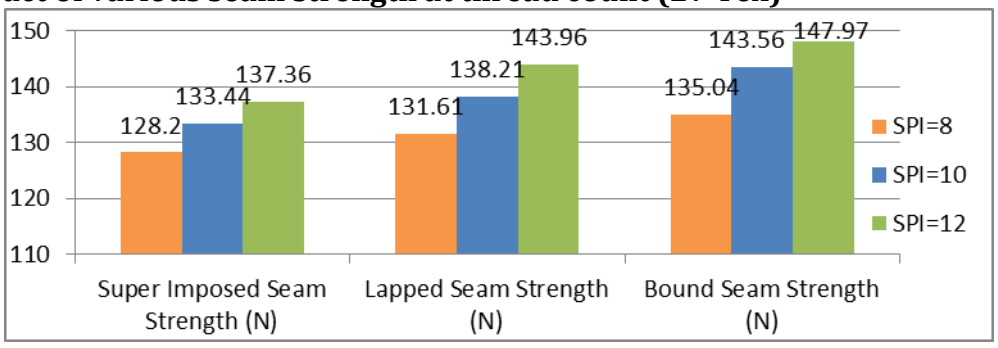

Figure 2: Seam strength at thread count of 27 Tex (2/1 twill fabric)

From the given graph, we can assume that, for 2/1 twill fabric of 27 Tex thread count, superimposed seam strength is 128.2N for SPI 8, 133.44N for SPI 10 & 137.36N for SPI 12. So we can conclude that superimposed seam strength is gradually increased with the increase of SPI. For lapped seam, strength is 131.61N for SPI 8, 138.21N for SPI 10 & 143.96N for SPI 12. So we can conclude that lapped seam strength is gradually increased with the increase of SPI. In terms of the bound seam, seam strength is 135.04N for SPI 8, 143.56N for SPI 10 & 147.97N for SPI 12. So we can conclude that bound seam strength is gradually increased with the increase of SPI.

3.1.3. Impact of various seam strength at thread count (30 Tex)

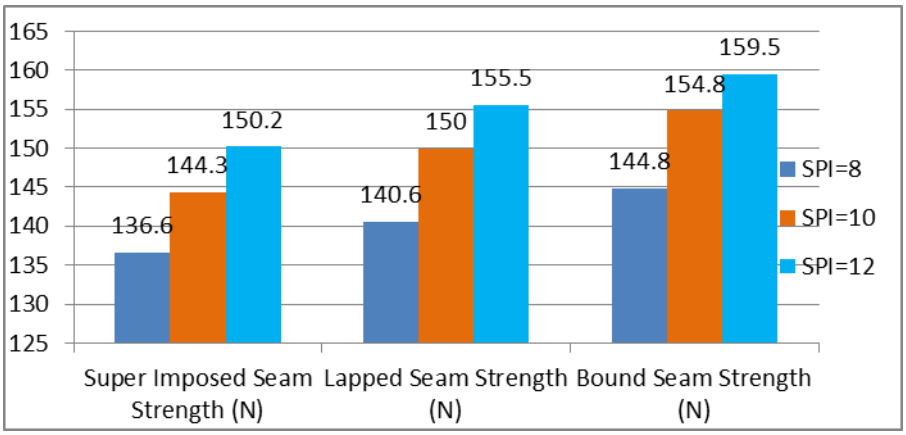

Figure 3: Seam strength at thread count of 30 Tex (2/1 twill fabric)

From the given graph, we can assume that, for 2/1 twill fabric of 30 Tex thread count, superimposed seam strength is 136.6N for SPI 8, 144.3N for SPI 10 & 150.2N for SPI 12. So we can conclude that superimposed seam strength is gradually increased with the increase of SPI. For lapped seam, strength is 140.6N for SPI 8, 150N for SPI 10 & 155.5N for SPI 12. So we can conclude that lapped seam strength is gradually increased with the increase of SPI. In terms of the bound seam, seam strength is 144.8N for SPI 8, 154.8N for SPI 10 & 159.5N for SPI 12. So we can conclude that bound seam strength is gradually increased with the increase of SPI.

3.1.4. Impact of various seam strength at thread count (40 Tex)

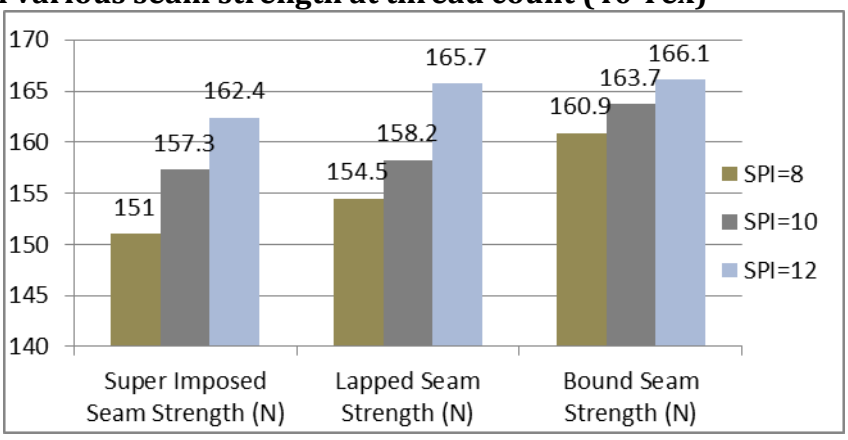

Figure 4: Seam strength at thread count of 40 Tex (2/1 twill fabric)

From the given graph, we can assume that, for 2/1 twill fabric of 40 Tex thread count, superimposed seam strength is 151N for SPI 8, 157.3N for SPI 10 & 162.4N for SPI 12. So we can conclude that superimposed seam strength is gradually increased with the increase of SPI. For lapped seam, strength is 154.5N for SPI 8, 158.2N for SPI 10 & 165.7N for SPI 12. So we can conclude that lapped seam strength is gradually increased with the increase of SPI. In terms of the bound seam, seam strength is 160.9N for SPI 8, 163.7N for SPI 10 & 166.1N for SPI 12. So we can conclude that bound seam strength is gradually increased with the increase of SPI.

3.1.5. Impact of various seam strength at thread count (40/2 Tex)

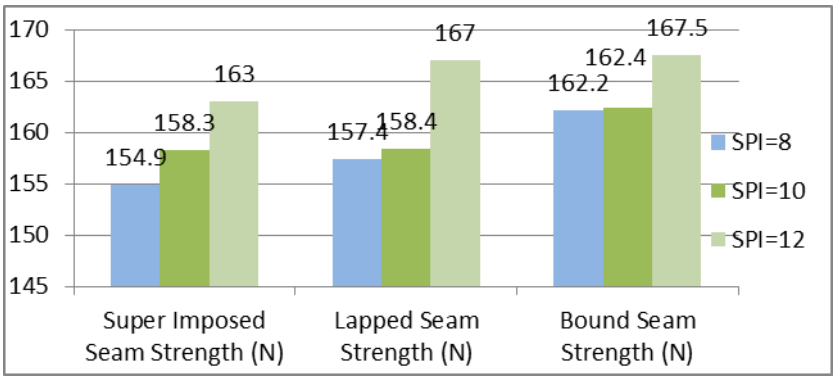

Figure 5: Seam strength at thread count of 40/2 Tex (2/1 twill fabric)

From the given graph, we can assume that, for 2/1 twill fabric of 40/2 Tex thread count, superimposed seam strength is 154.9N for SPI 8, 158.3N for SPI 10 & 163N for SPI 12. So we can conclude that superimposed seam strength is gradually increased with the increase of SPI. For lapped seam, strength is 157.4N for SPI 8, 158.4N for SPI 10 & 167N for SPI 12. So we can conclude that lapped seam strength is gradually increased with the increase of SPI. In terms of the bound seam, seam strength is 162.2N for SPI 8, 162.4N for SPI 10 & 167.5N for SPI 12. So we can conclude that bound seam strength is gradually increased with the increase of SPI.

3.1.6. Impact of various seam strength at thread count (40/3 Tex)

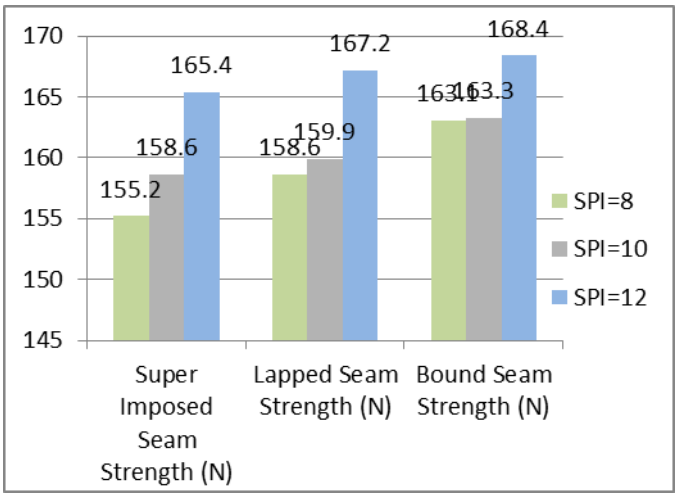

Figure 6: Seam strength at thread count of 40/3 Tex (2/1 twill fabric)

From the given graph, we can assume that, for 2/1 twill fabric of 40/3 Tex thread count, superimposed seam strength is 155.2N for SPI 8, 158.6N for SPI 10 & 165.4N for SPI 12. So we can conclude that superimposed seam strength is gradually increased with the increase of SPI. For lapped seam, strength is 158.6N for SPI 8, 159.9N for SPI 10 & 167.2N for SPI 12. So we can conclude that lapped seam strength is gradually increased with the increase of SPI. In terms of the bound seam, seam strength is 163.1N for SPI 8, 163.3N for SPI 10 & 168.4N for SPI 12. So we can conclude that bound seam strength is gradually increased with the increase of SPI.

3.2. Seam efficiency analysis at various SPI and thread count of 2/1 twill fabric

3.2.1. Impact of seam efficiency at thread count (20/2 Tex)

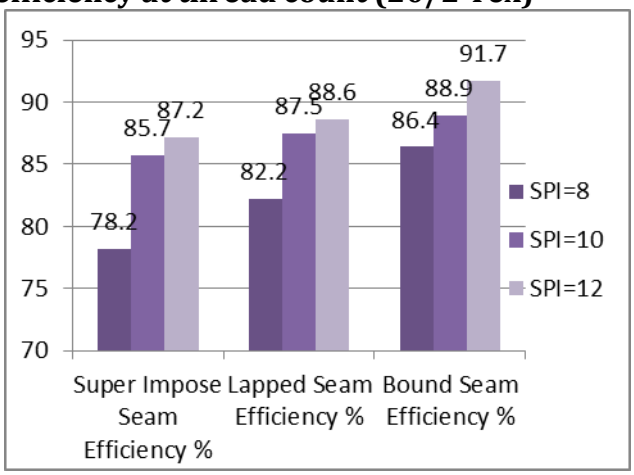

Figure 7: Seam efficiency at thread count of 20/2 Tex (2/1 twill fabric)

From the graph, we can assume that, for 2/1 twill fabric of 20/2 Tex thread count, superimposed seam efficiency is 78.2% for SPI 8, 85.7% for SPI 10 & 87.2% for SPI 12. So we can conclude that superimposed seam efficiency is gradually increased with the increase of SPI. For lapped seam efficiency is 82.2% for SPI 8, 87.5% for SPI 10 & 88.6% for SPI 12. So we can conclude that lapped seam efficiency is gradually increased with the increase of SPI. In terms of the bound seam, seam efficiency is 86.4% for SPI 8, 88.9% for SPI 10 & 91.7% for SPI 12. So we can conclude that bound seam strength is gradually increased with the increase of SPI.

3.2.2. Impact of seam efficiency at thread count (27 Tex)

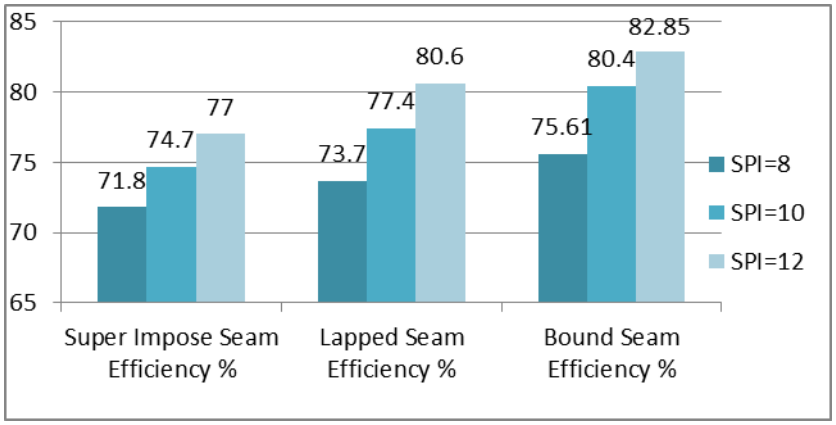

Figure 8: Seam efficiency at thread count of 27 Tex (2/1 twill fabric)

From the given graph, we can assume that, for 2/1 twill fabric of 27 Tex thread count, superimposed seam efficiency is 71.8% for SPI 8, 74.7% for SPI 10 & 77% for SPI 12. So we can conclude that superimposed seam efficiency is gradually increased with the increase of SPI. For lapped seam efficiency is 73.7% for SPI 8, 77.4% for SPI 10 & 80.6% for SPI 12. So we can conclude that lapped seam efficiency is gradually increased with the increase of SPI. In terms of the bound seam, seam efficiency is 75.61% for SPI 8, 80.4% for SPI 10 & 82.85% for SPI 12. So we can conclude that bound seam strength is gradually increased with the increase of SPI.

3.2.3. Impact of seam efficiency at thread count (30 Tex)

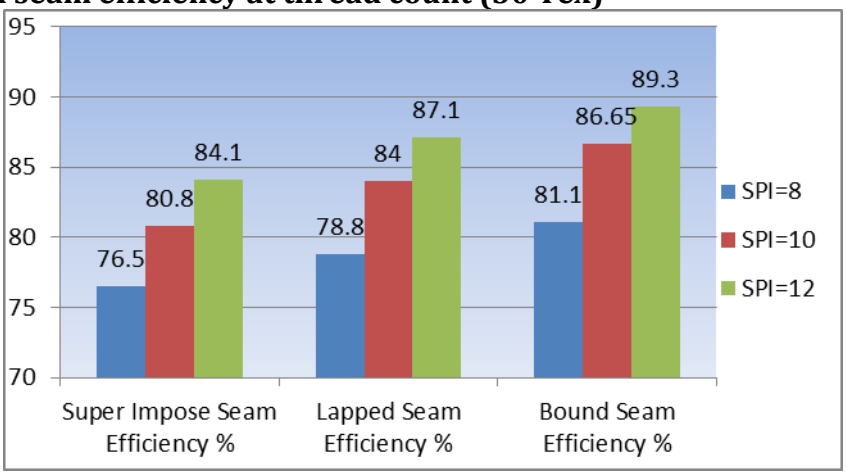

Figure 9: Seam efficiency at thread count of 30 Tex (2/1 twill fabric)

From the given graph, we can assume that, for 2/1 twill fabric of 30 Tex thread count, superimposed seam efficiency is 76.5% for SPI 8, 80.8% for SPI 10 & 84.1% for SPI 12. So we can conclude that superimposed seam efficiency is gradually increased with the increase of SPI. For lapped seam efficiency is 78.8% for SPI 8, 84% for SPI 10 & 87.1% for SPI 12. So we can conclude that lapped seam efficiency is gradually increased with the increase of SPI. In terms of the bound seam, seam efficiency is 81.1% for SPI 8, 86.65% for SPI 10 & 89.3% for SPI 12. So we can conclude that bound seam strength is gradually increased with the increase of SPI.

3.2.4. Impact of seam efficiency at thread count (40 Tex)

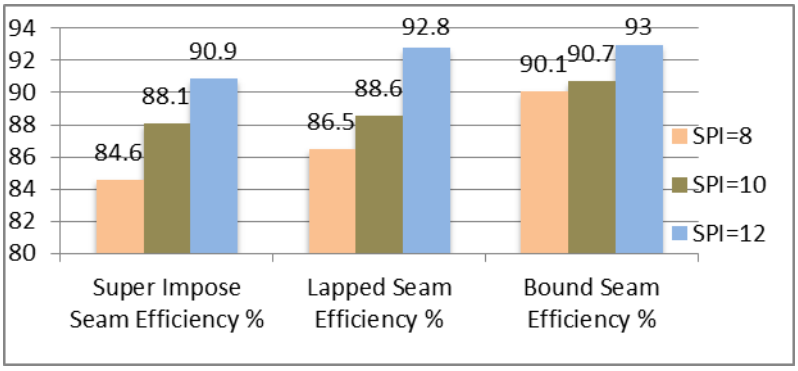

Figure 10: Seam efficiency at thread count of 40 Tex (2/1 twill fabric)

From the given graph, we can assume that, for 2/1 twill fabric of 40 Tex thread count, superimposed seam efficiency is 84.6% for SPI 8, 88.1% for SPI 10 & 90.9% for SPI 12. So we can conclude that superimposed seam efficiency is gradually increased with the increase of SPI. For lapped seam efficiency is 86.5% for SPI 8, 88.6% for SPI 10 & 92.8% for SPI 12. So we can conclude that lapped seam efficiency is gradually increased with the increase of SPI. In terms of the bound seam, seam efficiency is 90.1% for SPI 8, 90.7% for SPI 10 & 93% for SPI 12. So we can conclude that bound seam strength is gradually increased with the increase of SPI.

3.2.5. Impact of seam efficiency at thread count (40/2 Tex)

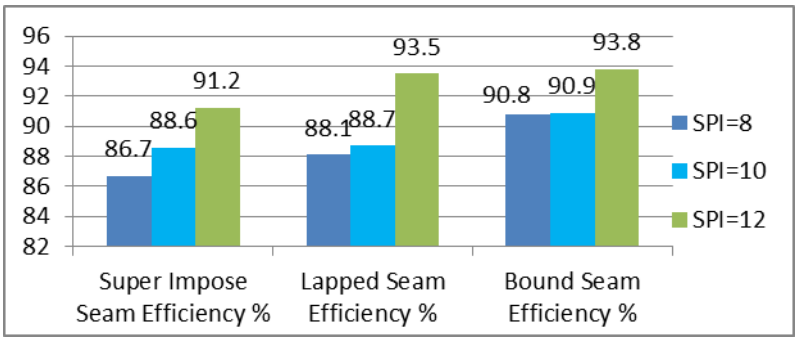

Figure 11: Seam efficiency at thread count of 40/2 Tex (2/1 twill fabric)

From the given graph, we can assume that, for 2/1 twill fabric of 40/2 Tex thread count, superimposed seam efficiency is 86.7% for SPI 8, 88.6% for SPI 10 & 91.2% for SPI 12. So we can conclude that superimposed seam efficiency is gradually increased with the increase of SPI. For lapped seam efficiency is 88.1% for SPI 8, 88.7% for SPI 10 & 93.5% for SPI 12. So we can conclude that lapped seam efficiency is gradually increased with the increase of SPI. In terms of the bound seam, seam efficiency is 90.8% for SPI 8, 90.9% for SPI 10 & 93.8% for SPI 12. So we can conclude that bound seam strength is gradually increased with the increase of SPI.

3.2.6. Impact of seam efficiency at thread count (40/3 Tex)

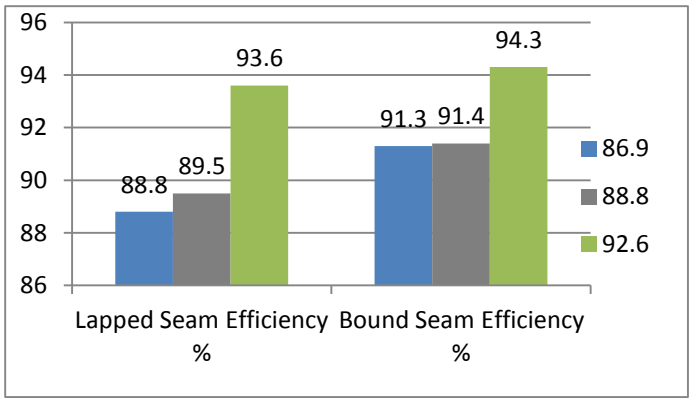

Figure 12: Seam efficiency at thread count of 40/3 Tex (2/1 twill fabric)

From the given graph, we can assume that, for 2/1 twill fabric of 40/3 Tex thread count, superimposed seam efficiency is 86.9% for SPI 8, 88.8% for SPI 10 & 92.6% for SPI 12. So we can conclude that superimposed seam efficiency is gradually increased with the increase of

SPI. For lapped seam efficiency is 88.8% for SPI 8, 89.5% for SPI 10 & 93.6% for SPI 12. So we can conclude that lapped seam efficiency is gradually increased with the increase of SPI. In terms of the bound seam, seam efficiency is 91.3% for SPI 8, 91.4% for SPI 10 & 94.3% for SPI 12. So we can conclude that bound seam strength is gradually increased with the increase of SPI.

4 Findings

For most of the cases, seam strength and efficiency of bound seam found higher than others whereas coarser thread count increases the seam strength and efficiency as well. Therefore, approximately 2-7% higher seam efficiency found from SPI 8 to SPI 12 that means the higher stitch density enhance the seam performance especially for seam strength and efficiency.

5 Recommendation for further research

The overall performance and satisfaction of customers regards any garment ends products depends largely on types of seam, its performance especially on seam strength and efficiency. That's why it a burning issue for any time. In this research only the impact of SPI and thread count over 2/1 twill woven fabric has been analyzed, however, garment items are not limited on a single type whereas a varieties of woven, knit and non-woven garments are available. For each case, customer's satisfaction is mandatory. Therefore, I would like to suggest to research with different types of woven fabric i.e. 2/2 twill, poplin, gabardine, oxford etc. for future.

6 Conclusions

The durability of the garment/ end product is largely subjected to different types of seam and stitch types where sewing thread plays a significant role. Perfect selection of each of that ensures the final satisfaction of the customers. Therefore, seam strength and durability relies on the sewing, fabric, thread, yarn, fibre parameters etc. Besides, numerous parameters like material types, thread type and count, type of seam, type of stitch and stitch density etc. also responsible for the seam quality whereas seam quality is subjected to seam strength, strength efficiency, puckering and appearance. From this research, it is observed that with the increase of thread count and SPI, seam strength and efficiency increased significantly i.e. overall seam performance improved.

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