Impact of Thread Count and Stitch Density on Plain Woven Fabric

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Abstract— The seam strength and seam efficiency of the plain-woven fabric have been investigated through this research. Garment samples were stitched with the thread count 20/2, 27, 30, 40, 40/1, 40/2 and 40/3 for superimposed, lapped and bound seam individually. After preparation, each of the samples was 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. It is found that for all the cases, 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.

Index Terms— Woven fabric, Stitch density, thread count, seam, strength, efficiency, properties.

1 Introduction

THE utmost satisfaction of customer depends partially on the quality of the seam strength. The properties of seam strength may be influenced greatly by the types of the sewing thread and its origin, thread count, seam types and fabric nature [1]. Garments durability most of the time depends on on-seam, thread selection and fabric consideration with cost and quality. Seam quality measured by seam strength, seam appearance and seam puckering [2-3]. For the consumer buying behaviour, durability satisfies them first whereas seam defects arise at the early stage where seam performance property has shown the poor quality. The reason behind that faults arose by the wrong selection of the stitch types, seam types, thread count, types of thread, stitch density (SPI), machine load, needle size etc. [3]. In this research, the seam strength of superimposed seam, lapped seam and bound seam were measured at various SPI 8, 10 and 12. 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-

TABLE 1
Sample specification table

Parameters	Specifications
Fabric type	100% cotton plain-woven fabric
GSM	132.3
EPI	110
PPI	65
Warp count	37
Weft count	37
Sample size	10 cm x 10 cm
Seam types	Superimposed 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	190.5 N

2.2. Methods

2.2.1. Sample preparation

At first, five samples from plain woven fabric in the warp direction were cut; the sample size was 10 cm length and 10 cm width. Then the samples were sewn using the mentioned thread count, various SPI and different types of the seam (superimposed, 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.

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

2.3. Accessories

i. Measuring Tape, ii. GSM Cutter

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2.4. Machinery

2.4.1. Lock stitch sewing machine

Juki High Speed Lock Stitch Sewing Machine; Made by china.

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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 discussions

3.1. Impact of thread count (20/2 Tex) on the garment seam strength of plain-woven fabric

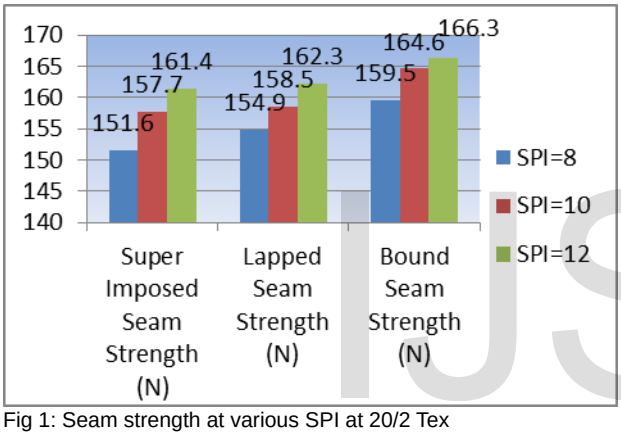

Fig 1: Seam strength at various SPI at 20/2 Tex

From Graph 1, it is clearly visible that the seam strength gradually improved at various DPI and at a constant thread count. Further, the bound seam has more strength than others from the graph and at SPI 12 maximum seam strength has been observed.

3.2. Efficiency analysis at thread count 20/2

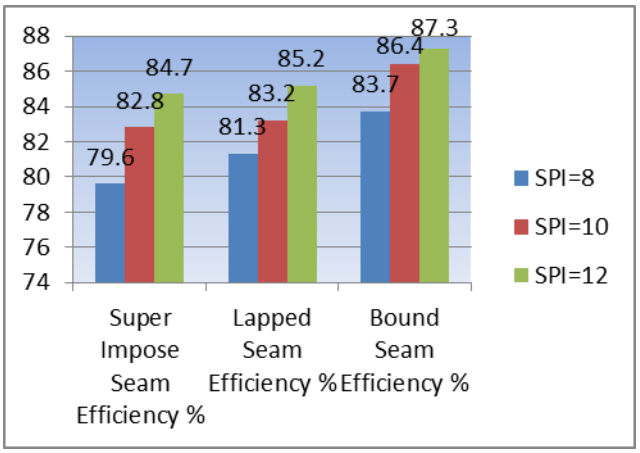

Fig 2: Seam Efficiency of Plain Fabric (Tex 20/2)

Graph 2 shows the efficiency of seam strength at thread count 20/2 where seam efficiency significantly increased with the increase of thread density. It is found that the efficiency found higher in superimposed seam than others. Approximately, 5%, 4% and 4% efficiency observed after SPI 8 to SPI 12 for the superimposed seam, lapped seam and bound seam respectively.

3.3. Impact of thread count (27 Tex) on the garment seam strength of plain-woven fabric

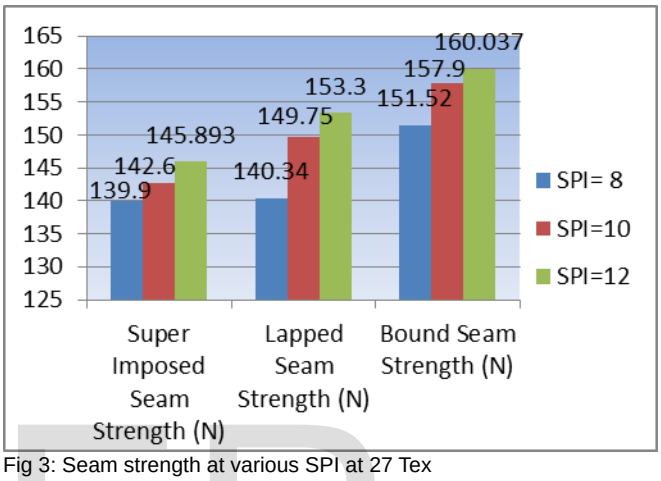

Fig 3: Seam strength at various SPI at 27 Tex

Graph 3 illustrates that the seam strength develops slightly with the increase of SPI at a constant thread count (27 Tex). It is also noted that the strength found higher for bound seam fabric. For all strength recorded higher and gradually improved from SPI 8 to SPI 12.

3.4. Efficiency analysis at thread count 27 Tex

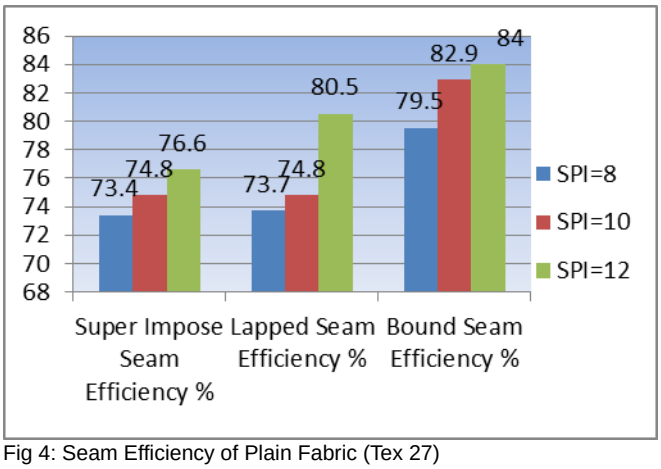

Fig 4: Seam Efficiency of Plain Fabric (Tex 27)

It is noted that seam efficiency found maximum for lapped seam samples where it's efficiency increased up to 7% whereas for superimposed seam and bound seam it has found 3% and 5% respectively.

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. 3.5. Impact of thread count (30 Tex) on the garment seam strength of plain-woven fabric

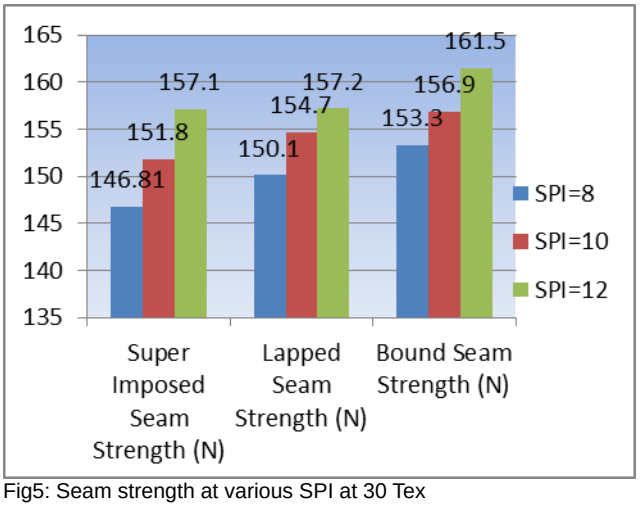

Fig5: Seam strength at various SPI at 30 Tex

Graph 5 demonstrates that the seam strength found higher for superimposed seam sample cases and for other bound seam and lapped seam respectively.

3.6. Efficiency analysis at thread count 30 Tex

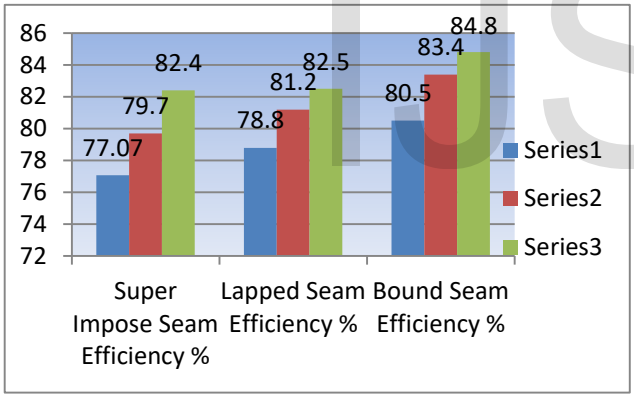

Fig 6: Seam Efficiency of Plain Fabric (Tex 30)

After SPI 12, seam strength found 5%, 4% and 4% higher for the superimposed seam, lapped seam and bound seam samples efficiency cases than SPI 8. So, clearly, it is noted that the efficiency recorded maximum for the samples of superimposed seam.

3.7. Impact of thread count (40 Tex) on the garment seam strength of plain-woven fabric

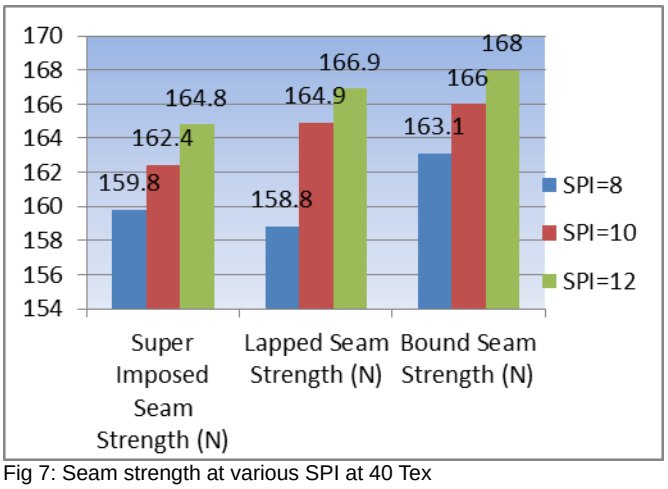

Fig 7: Seam strength at various SPI at 40 Tex

From graph 7, it is recorded that the seam strength found better for lapped seam sample cases than others. However, strength increases with the increase of SPI at a constant thread count 40 Tex.

3.8. Efficiency analysis at thread count 40 Tex

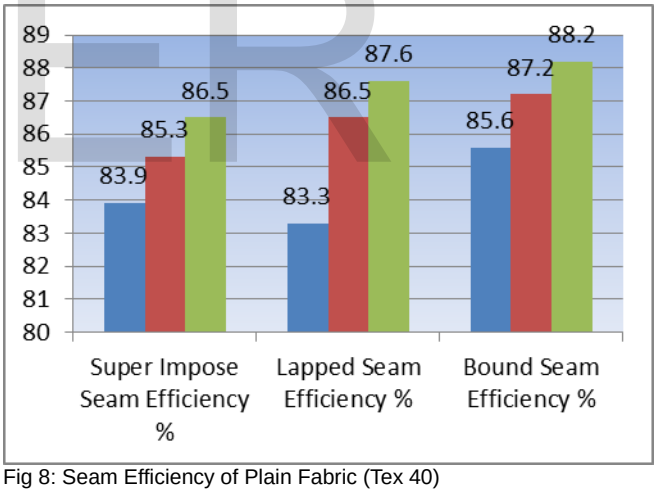

Fig 8: Seam Efficiency of Plain Fabric (Tex 40)

Surprisingly, seam strength found more than 80% for every case. However, lapped seam founds the maximum value than others.

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3.9. **Impact of thread count (40/2 Tex) on the garment seam strength of plain woven fabric**

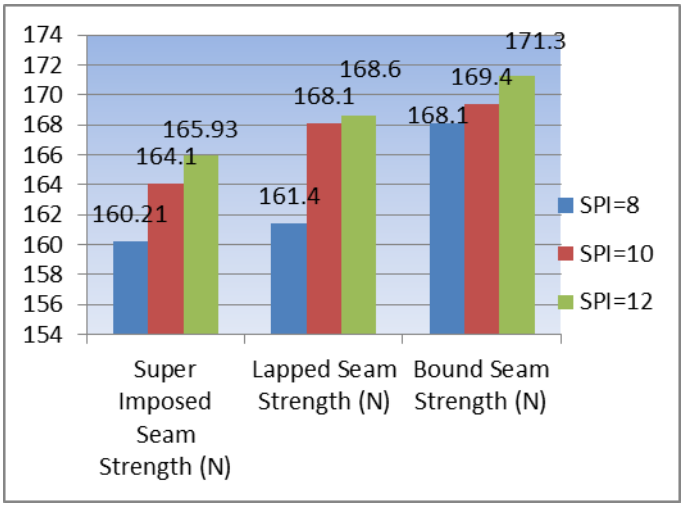

Fig 9: Seam strength at various SPI at 40/2 Tex

Thread count indicates the double-ply which ensures that the strength of thread will be higher than single-ply; i.e. 40 Tex. However, maximum seam strength found for the samples of bound seam fabrics than the other two.

3.10. Efficiency analysis at thread count 40/2 Tex

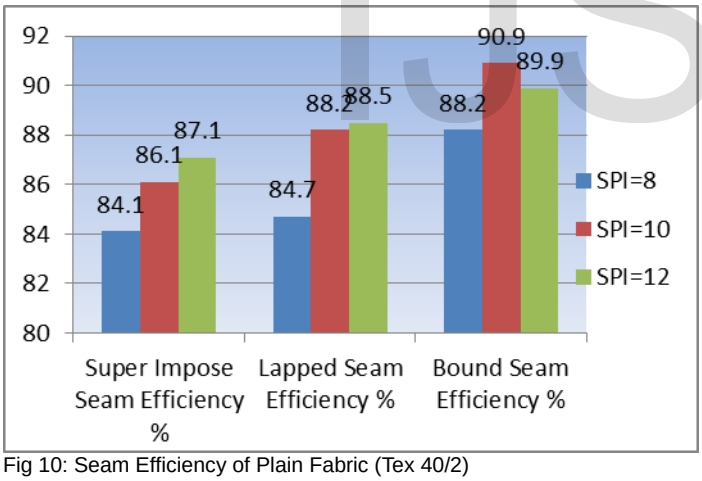

Fig 10: Seam Efficiency of Plain Fabric (Tex 40/2)

From the Graph, we can demonstrate that in terms of the plain fabric of 40/2 Tex; Seam efficiency is increased gradually for a superimposed seam with the increasing number of SPI. For Lapped seam, the graph shows the same result in terms of seam efficiency. For Bound seam, seam efficiency is highest for SPI 10, Less for SPI 12 & the least for SPI 8.

3.11. **Impact of thread count (40/3 Tex) on the garment seam strength of plain-woven fabric**

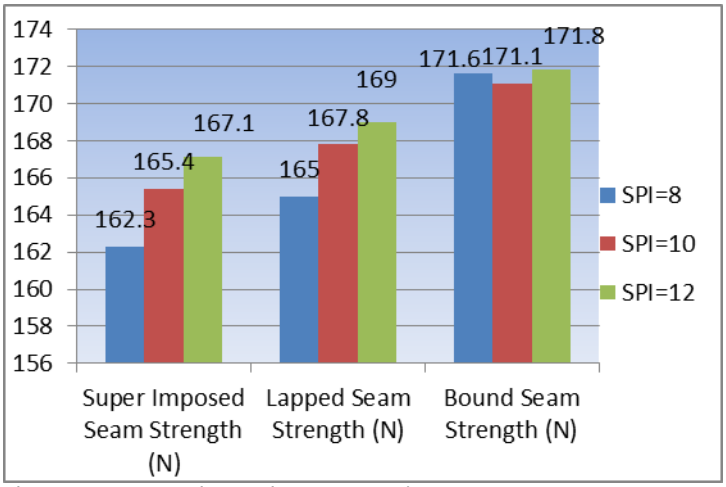

Fig 11: Seam strength at various SPI at 40/3 Tex

From the Graph, we can demonstrate that in terms of the plain fabric of 40/3 Tex; Seam strength is increased gradually for superimposed seam & Lapped seam with the increasing number of SPI. For Bound seam, the graph shows that seam strength is highest for SPI 12, Less for SPI 8 & lowest for SPI 10 in terms of seam strength.

3.12. Efficiency analysis at thread count 40/3 Tex

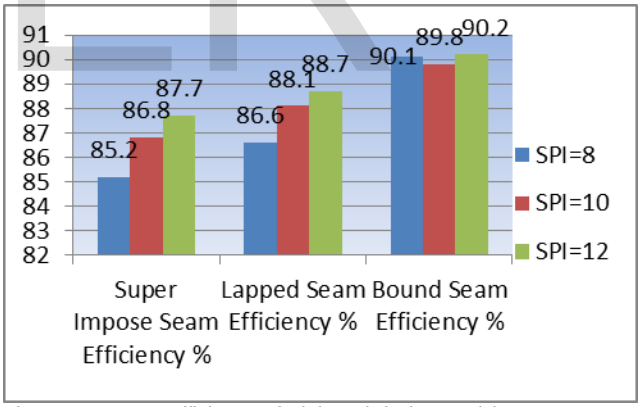

Figure 12: Seam Efficiency of Plain Fabric (Tex 40/3)

From the Graph, we can demonstrate that in terms of the plain fabric of 40/3 Tex; Seam efficiency is increased gradually for superimposed seam & Lapped seam with the increasing number of SPI. For Bound seam, the graph shows that seam efficiency is highest for SPI 12, Less for SPI 8 & lowest for SPI 10 in terms of seam efficiency.

4 Findings

- ✓ Higher the number of thread count higher the seam strength and efficiency
- ✓ Higher the application of stitch density higher the seam strength and efficiency

- ✓ Seam efficiency recorded 2-7% more from SPI 8 to SPI 12 for the samples

5 Recommendation for further research

- ✓ The relation between seam strength and puckering can be a valuable research topic for future
- ✓ Seam strength analysis over knit garment
- ✓ Fault percentage on seam strength on durability can be analyzed

6 Conclusion

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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