Study of Seam Performance of Jute Bag in Plain and Twill Fabric

Rezaul Karim[1*], K. A. Islam[1], Azad[1], Imran[1], S. Leon[1], and Nupur[1]

[1]Department of Textile Engineering, Sonargaon University, Dhaka-1212, Bangladesh

*email: rezatex99@gmail.com

Abstract

Stitches and seams are two important elements of jute bag construction. Stitches are used to join the materials and hold the product together, and seams give the shape/contour and detail of the product. These two elements together with the material properties contribute to the quality of the product. Seam quality, in our research, is affected by various fabric mechanical properties under a combination of their sewing parameters. Previously a lot of research has been done on identifying the parameters that influencing seam quality by looking into correlation between fabric properties and sewing parameters. The purpose of the current study is to investigate the performance of seam quality in terms of seam appearance and strength constructed with different sewing parameters on jute fabric. In this work, it has concluded that the usage of thicker threads has not always given better strength and the seam appearance as also poor. It was found that 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. The principal was that the prediction equations developed conclusion possible to be used and gave a strong validation between experimental and predicted results when the new fabric properties were within one standard deviation.

Keywords: *Jute fibre, Sewing parameters, Mechanical properties, Fabric properties, Stitches*

1.0 INTRODUCTION

Stitches and seams are two important elements of jute bag construction. Stitches are used to join the materials and hold the product together, and seams give the shape/contour and detail of the product. These two elements together with the material properties contribute to the quality of the product.

The quality of product depends on two factors: physical and performance features [1]**.** Physical features depend on the materials and methods used to assemble the product. Types of fiber (natural or synthetic), properties of the fabric, stitch and seam types are some factors that should be considered when dealing with physical features of the product. Performance features define the visual and functional requirements of the product. Visual requirements are based on colors, patterns, design, trends and accessories, and functional requirements are more related to the stability of the product during use and care. The product manufacturers have a set of standards as a guideline for product development and these standards are based on customers' preferences [2]. Consumers can easily judge the visual or aesthetic performance where this refers to the attractiveness of the product, but they can only identify product that meet or fail the functional performance standards after wear and care. Consumers may change their preferences if they find that the product is low in quality or varies in quality from time to time [3]. The product manufacturers must consider both physical and performance features to keep up the quality of the product. Because physical and performance features are important, it is essential to determine the relationship between these two features. For this research, physical features which include the fabric's mechanical properties and sewing parameters are investigated and their relation to performance features, which include seam appearance and strength are studied.

The use of jute product mostly still now in bags and sacks for packing almost all kinds of agricultural products, minerals, cement etc. packs for packing wool and cotton, wrapping materials fabrics, carrier and backing fabric for carpet and linoleum, cordage and twines, webbing to cover inner springs in auto seats and upholster furniture, cargo separator in ship, cloth for mine ventilation and partition, filling material in cable, roofing and floor covering apparel, footwear lining, wall covering and furnishing fabric, fashion accessories, soil erosion control fabric and many more [4]. A seam is a joint between two pieces of fabric and is defined as „the application of a series of stitches or stitch types to one or several thicknesses of material [5]. Since seam puckering is a major problem in the textile and apparel industries, different approaches to evaluate seam puckering objectively have been done in order to accurately rate the level of puckering in the sewn fabric [6]. 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 [7]. 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 [8]. It is very important to have a correct selection of needle (size and shape) and sewing thread according to the fabric characteristics so that a balanced stitch can be formed

reducing stitch damage, puckering and improving seam strength [9]. Fabric objectivity measurement technology is defined as the evaluation of fabric handle, quality and related fabric performance attributes, in terms of objectively measurable properties. It is recommended that lightweight fabrics should have a minimum value of 5 μN.m for warp and weft directions [10].

High blending rigidly fabric is more manageable and can produce a flat seam compared to lightweight fabric [11]. if the fabric has high shear rigidity, it will be difficult to shape and mould during the sewing process [12]. Jute has some drawbacks too, like relative coarseness, brittleness, harshness in feel, wide variation in fibre length and fineness with, branching nature, poor washability, and proneness to yellowing under exposure to sunlight. Low extensibility of jute is sometimes advantageous and sometimes disadvantageous too. Chemically the major constituents of jute are cellulose (54-60%), hemi-cellulose (20-24%) and lignin (12-14%). Jute is mainly used as sackings (for packing) and hessian (for coarser wrapping/cover fabrics) and different types of bag, besides its uses are for making decorative, furnishing, pandals, floormats, geotextiles, soft luggage's, fancy bags and other diversified uses.

Therefore, to increase the market acceptability of decorative and furnishing fabrics made from jute fibers, it is highly essential to reduce or eliminate some of the drawbacks in property parameters through appropriate chemical processing at low cost. Whole work is organized as; section 1 contains introduction, background of the study, and a brief literature review, section 2 describes materials, section 3 explains methods of this work, then results and discussion has given in section 4, and finally conclusion of the research has given in section 5.

1.1 Stitch

Seam and stitch are related to each other. Stitch cannot be made without seam. Seam is the join between two or more plies of pieces of material. Seams are usually formed by sewing. Sewing is done by joining one or more threads with interlooping, intralooping or interlacing. Stitch is the unit of this sewing. We used two type of stitch this experiment jute bag decorative designing are use hand stitch type 200 and bag made and seam strength test used single thread lock stitch type 301 for our project work.

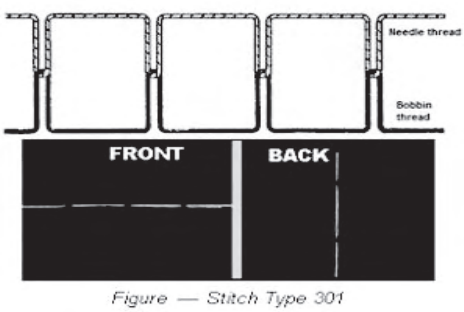

Figure — Stitch Type 301

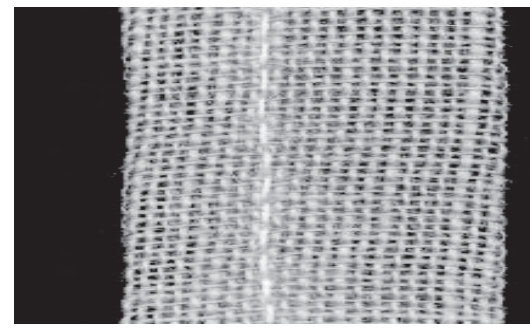

Fig. 1: Single thread lock stitch type 301

2.0 MATERIALS

Stitch type number as per ISO: 4915-1981 was used for study. Conventional sewing machine stitch and conventional hemming sewing machine producing single thread locked stitch (type 301) and hand stitch (type 200) using needle number 22 (singer numbering) instead of 28 for smooth passage of sewing thread through the needle eye were used.

Jute twine was used as sewing thread for all the samples in both the stitch type. In spite of the poor sewability of jute yarn, no other sewing thread was used since only mixed cotton is used for the purpose. Superimposed seam were fabricated for both the stitch type 301 with a constant bight of 10 mm. A strong twill weave jute sacking fabric called twill (4 × 4 inch 16.20 Oz) was initially considered with the intention that the seam would break before the fabric breaks which was required to assess the effect of stitch type on seam strength. Another quality of strong plain weave jute fabric (4 × 4 inch 14.56 Oz) was also used the experiment. Stitch density was varied from 10-12 stitch per dm (SPI) while preparing the samples.

3.0 METHODS

Based on the concept of stitchology, i.e. formation, application and properties of single thread locked stitches (type 301), experiments were conducted at jute mills to prepare sample bags for comparative study of their

performances. In mill, 5 number of bags with stitch densities10-12 stitches/dm) were pre pared, keeping the seam bight constant at 10 mm all along. The sample bags were so prepared that while one side of a bag was stitched with stitch type 301 to avoid, as far as possible, the variation of warp-way and weft-way tensile property of the fabric stitch. The 22 number needles and 10 Ib x 2 ply jute sewing thread were used for stitch types. The tests for seam strength of the bags were performed both at the respective mill SQC laboratories and at karim jute mills physical testing laboratory. Weft-way and warp-way tensile strength of the fabrics was measured at karim jute laboratory to calculate the seam efficiency for the stitch types.

The study was further extended to standard plain and Twill 4 x 4 inch bags in 5 jute samples where the stitch density and the depth of stitch were maintained at 10-12stitches/dm and to mm respectively. One side of each bag was stitched with stitch type 301 using 10 Ib x 2 ply jute twine as sewing thread. The bags were tested at karim jute mills to examine the effect of stitch type on seam strength for plain and Twill bags. Warp-way and Weft-way tensile strength of stitch was also tested to find out the seam efficiency.

Drop test for both plain fabric and Twill fabric (without safety stitch) bags pre pared by incorporating this types of stitch were conducted at karim jute mill to assess the end use performance of the bags. Experiment was carried out with single thread locked stitch (type 301) for joining the tail ends of cuts during their feeding in the cloth cutting machine. Seam specifications for this study were the same as those for seaming of plain and Twill bags.

4.0 RESULTS AND DISCUSSION

The effects of stitch type and stitch density on seam strength of plain bags are shown in Tables 1 and twill bags are shown in table2. When the results of seam strength of the bags of a given mill are considered, the effect of stitch type on the seam strength is not very clear and that of the stitch density indicates that the seam strength increases with the increase in stitch density.

However, when the results of the five sample are averaged, as shown in Table-1, it is clearly observed that the stitch type 301 gives lower seam strength then the twill fabric on plain weave warp and weft way for all the stitch densities except 10-12 SPI stitches/ dm and the seam strength of the bags increases with the increase in stitch density. The same trend is observed in case of seam efficiency also (Table 1).

Table 1:Seam strength of plain weave

Sample	Warp way (Kg)	Weft way (Kg)	Seam strength (Kg)
01	169.78	172.36	72.58
02	183.00	167.89	68.03
03	174.28	181.43	54.43
04	181.30	165.56	63.50
05	165.00	167.73	60.78
Average	174.67 kg	170.98 kg	63.86 kg

The stitch density was varied from 10-12 stitches/dm as in the earlier studies. Because when the results of seam strength of the bags of a given mill are considered, the effect of stitch type on the seam strength is not very clear and that of the stitch density indicates that the seam strength increases with the increase in stitch density. However, when the results of the five sample are averaged, as shown in Table-2, it is clearly observed that the stitch type 301 gives higher seam strength then the plain fabric on twill warp and weft way the stitch densities of less than 8

Table 2 - seam strength of twill fabric

Sample	Warp way (kg)	Weft way (kg)	Seam Strength (kg)
01	192.27	189.47	74.34
02	183.53	172.05	65.43
03	170.92	180.67	63.92
04	165.74	170.52	57.12
05	191.32	184.09	64.08
Average	180.75 kg	179.36 kg	65.12 kg

stitches/dm and more than 12 stitches/dm show deteriorating effects on the seam strength. Also, the stitch density of more than 10-12 stitches/dm decreases the manufacturing cost. The results of the similar experiments carried out on Twill bags (Table 2).

Show that in each of the 5 sample, stitch type 301 contributes higher seam strength. The average seam strength for the plain bag off 5 samples is 63.86 kg and average seam strength for twill bag of 5 samples is 65.12 kg. The seam efficiency is also higher (75.9%) in case of stitch type 301. It is observed that not a single bag prepared with either type of stitch has been damaged. The performance of bags has therefore been found to be excellent. The above results clearly indicate the suitability of single thread locked stitches for seaming jute bags.

4.1 Advantage of Stitch Type 301

- Lower thread consumption than double chain stitch.
- Same seam strength on the upper and lower side.
- Good seam strength owing to interlocking in the middle of the material (but not as strong with the chain stitch).
- Easy trying of the seam end by reverse sewing.
- No seam impression on thin woven fabric.

4.2 Thread Consumption

The length of sewing thread required to stitch a unit length (1 cm) of fabric has been calculated for types of stitch and the results. It is observed that stitch type 301 requires 5.5 cm of sewing thread to stitch lcm of fabric whereas the stitch type 301 needs as much as 8 cm for sewing the same length of fabric.

4.3 Production of Bag

The average actual working speed of the sewing machine producing stitch type 301 is around 1800 stitches/min. The average production of bags (plain) in the mills using stitch type 301 is around 55 bundles /shift/machine (1375 bags). Therefore, it can be expected that the sewing machine with higher speed of 1800 stitches /min for stitch type 301 would produce around 63 bundles /shift /machine (1571 bags) with the consequence that the productivity will increase by about 14.5 %.

5.0 CONCLUSIONS

The research used a variety of fabric samples which were grouped according to the fabric weight categories. The fabrics were sewn with different sewing parameters which included the types of thread, needle size and stitch densities. Needle size was selected according to the thread size and stitch densities according to the fabric weight categories. Seam appearance and strength were tested.

- Single thread locked stitch (stitch type 301) gives higher seam strength than the conventional stitch density of 12 (SPI) stitches /dm.
- Seam strength increases with the increase in stitch density up to a certain limit.
- Both the will and plain bags stitched with stitch type 301 show excellent performances in drop test.
- No operational problem is encountered with 22 number needle used for producing stitch type 301 with 10 Ib x 2 ply sewing thread.
- In the prediction, thread tensile strength, extensibility and size were selected in most of the equations. Thread properties play an important role in determining the quality of seam. The equations have not been tested with other types of sewing threads since threads used for this study are commonly used in the apparel industry.

ACKNOWLEDGEMENT

This research has been supported by Sonargaon University, Dhaka, Bangladesh and Karim Jute Mills Ltd. Demra, Dhaka, Bangladesh. We would like to thank our colleagues from Sonargaon University who provided insight and expertise that greatly assisted this research work. We would like to show our love to the students and stuff of Sonargaon University and Karim Jute Mills Ltd.

REFERENCES

[1] Brown and Rice, 2001, Ready-to-Wear Apparel Analysis, 4th Edition.
[2] Glock and Kunz, 2005, Apparel Manufacturing: Sewn Product Analysis, 4th Edition.
[3] R M Laing and J Webster, 1998, Stitches and seams, Manchester, UK, Textile Institute press.

[4] Mullick, Mollah and Khan, National Jute Board 2010; Bangladesh Jute Mills Corporation 2011; 2000, 171 and 2010.
[5] Ukponmwan, Mukhopadhyay et al, 2000, Journal of the Textile Institute 91(4), pp. 509-522.
[6] Inui and Shibuya, 1992, International Journal of Clothing Science and Technology, 4(5), pp. 24-33.
[7] Gribaa, Amar et al., 2006, International Journal of Clothing Science and Technology 18(4).
[8] Glock and Kunz, 1995, Apparel Manufacturing: Sewn Product Analysis, 2nd Edition.
[9] Gribaa S., Amar, S.B., et al. 2006. Influence of sewing parameters upon the tensile behavior of textile assembly. International Journal of Clothing Science and Technology, 18(4): pp.235-246.
[10] Cheng, How and Yick, 1996, the application of fabric objective measurement in shirt manufacture, International Journal of Clothing Science and Technology 8(4):44-64, April 1996.
[11] Minazio 1995; Saville 1999, High bending rigidity fabric is more manageable and can produce a flat seam compared to lightweight fabric, [accessed 13.07.2018], https://www.escholar.manchester.ac.uk › api › datastream.
[12] Hui, Chan et al., seam performance [accessed 13.07.2018], https://www.escholar.manchester.ac.uk › api › datastream.