EFFECT OF WEAVE ON SOME MECHANICAL PROPERTIES OF HANDLOOM COTTON FABRICS

Dr. Ashis Mitra*

Dr. Prabir Kumar Choudhuri*

Abstract:

Handloom Industry, although having tremendous potentiality in respect of employment generation, foreign money earning and economic upliftment of rural people, is now passing through a precarious situation owing to so many factors in this era of global competitiveness. In order to overcome this stringent situation this moribund sector needs the attention of the technologists to carry on research works in right direction. At present the handloom products are mainly used for the apparels and upholstery or furnishing fabrics. In the present study, an approach has been made to study the effect of different weaves or interlacement patterns on some important physical/mechanical properties of 100% cotton hand-woven fabrics. Five different category of fabric samples woven with five different weaves namely plain, warp rib, weft rib, 1/3 twill and 2/2 twill have been prepared from the same raw material and keeping all other weaving parameters constant to study the effects of weave, i.e., interlacement pattern on some important mechanical behavior of the resultant fabrics. The results obtained have been critically analysed in order to explore the possibilities of application of handloom fabrics in other fields apart from their existing applications.

Keywords: Rib, Bending length, Crease resistance, Tensile properties, Tearing strength.

* Visva-Bharati University, Department of Silpa-Sadana, Textile section, P.O.–Sriniketan, Dist.–Birbhum, W.B.–731236. India

1. Introduction

Handlooms, a traditional means of producing fabric, was initially started to meet the peoples' own requirement. Even today, many people especially in the remote North-eastern region are fully dependent on handloom to meet their own needs. Gradually with the advent of technology, designs from simple to intricate, use of synthetic fibres, indigenousness and product diversification made the handloom sector more attractive and reachable to the different corner of India and abroad. The application of CAD/CAM technology has also widened the product range of the handlooms by producing intricate and varying designs with attractive colour combinations.

In spite of ample favourable conditions, handloom sector has been facing some stringent problems, especially the threat resulting out from the globalization/ liberalization, lifting of reservation policy, abolishing of subsidy schemes etc. As a result, the traditional weavers are on the threshold of life-staking situation. Though there are several reasons behind it as identified by different committees/commissions in post independence period, the textile technologists or researchers can not avoid their responsibilities. Any concrete research work to revive the situation has not been carried out so far, or even if done have not been documented properly in this so-called neglected area in order to boost this sector technologically.

2. Object

The handloom textiles constitute a timeless facet of the rich cultural heritage of India. The handloom forms a precious part of the generational legacy and exemplifies the richness and diversity of our country and the artistry of the weavers. Tradition of weaving by hand is a part of the country's cultural ethos[1]. As an economic activity, handloom is the one of the largest employment providers after agriculture. The sector provides employment to 43.31 lakh persons engaged on about 23.77 lakh handlooms [2].

Handloom sector being the 2nd largest employment generating sector has been playing an important role for the economic development of the rural areas in our country. It is felt necessary to carry out some research work in this domain with a view to revive this moribund industry. At present the handloom products are mainly confined to apparels and upholstery or furnishing fabrics. An attempt has been made in this work to study the effect of different weaves on some

important physical/mechanical properties of 100% cotton hand-woven fabrics. The results obtained will be critically analysed to explore the possibilities of application of handloom fabrics in other areas apart from their existing application.

3. Experimental Design

3.1 Preparation of Fabric Samples[3]

Five different fabric samples using five different weaves like plain, warp rib, weft rib, 1/3 twill and 2/2 twill respectively were manufactured with the help of a semi-automatic handloom. The raw materials and other necessary weaving parameters were as follows for all the weaves:

Type of yarn	: 100% grey cotton (Ring-spun).
Warp count	: 2/17 NF.
Weft count	: 2/17 NF.
Reed count	: 40^s Stockport
Heald count	: 44^s Plain set.
Drafting order	: 1, 3, 2, 4.
Denting order	: 2 ends/dent.

4. Testing Methodology[4]

4.1 Conditions of Testing

All the tests were carried out at the standard testing atmosphere and the samples were conditioned for 24 hrs. before testing.

4.2 Determination of Thread Density

No. of ends/inch and picks/inch for all the fabric samples were measured by the help of Paramount make Pick Glass with Light & Measuring Scale (Model: PG–006). The results are furnished in Table–1.

4.3 Measurement of Fabric Thickness

Fabric thickness was measured by Prolific Fabric Thickness Tester of capacity 0.01–10 mm having standard weight 77 gm. The results are furnished in Table–1.

4.4 Measurement of Crimp[5]

Crimp of both warp and weft for all the fabric samples was measured by using Paramount Crimp Tester. The necessary conditions were as follows:

Yarn tension : 16 gm
Test length : 25 cm.

The results are shown in Table–1.

4.5 Measurement of Crease Recovery Angle[6]

Crease recovery angles were measured by SASMIRA Crease Recovery Tester. Twenty specimens warp way and twenty weft ways for each fabric sample were tested. Each specimen, having a size of 2 in X 1 in has been tested maintaining the following conditions:

Dead weight : 1 Kg.
Time of creasing & recovery : 5 min.

The results are shown in Table–2.

4.6 Measurement of Bending Length

These tests were carried out by EUREKA Stiffness Tester. It is the measure of stiffness that determines draping quality of a fabric. Twenty specimens warp way and twenty specimens weft way were tested. Each specimen, having a size of 6 in X 1 in was tested four times, at each end (front and back) and again with the strip turned over. The results are furnished in Table–2.

4.7 Measurement of Tensile Properties[7]

Three important tensile properties like Breaking load, Breaking extension and Work of rupture both warp and weft ways were determined for each fabric sample with the help of Zwick/Roell Z010 Tensile Strength Tester. The test parameters were as follows:

Specimen length	: 200 mm.
Specimen width	: 50 mm.
Pre-Load	: 5 N.
Pre-Load speed	: 50 mm/min.
Pre-Load holding time mode	: No holding time.
Time upto Pre-Load	: 60 sec.
Traverse speed	: 300 mm/min.
Load cell	: 10 KN.

The results are furnished in Table–2.

4.8 Measurement of Tearing Strength[7]

Both warp way and weft way tearing strength for each fabric sample has been measured by using Zwick/Roell Z010 Tensile Strength Tester maintaining the following testing parameters:

Gauge length	: 25 mm.
Load cell	: 10 KN.
Traverse speed	: 300 mm/min.
Tear path	: 50 mm.

The results are given in Table–2.

5. Results & Discussion

From the test results shown in Table–2, it is found that warp way bending length is maximum for plain weave followed by warp rib, the minimum value is found in case of 1/3 twill. Weft way bending length is also maximum for plain and then followed by weft rib, the least value being for warp rib. The reason of maximum value of bending length in case of plain woven structure is due to maximum no. of intersection points (hence firmness of structure is maximum). Crease resistance in terms of crease recovery angle is maximum for 1/3 twill in both warp and weft way direction and the minimum value is found in case of warp rib. The warp way tearing strength value is found to be maximum in case of warp rib structure followed by 1/3 twill and the least being in case of plain whereas the weft way tearing strength value is found to be highest in case of 1/3 twill followed by weft rib. The cumulative value is maximum for 1/3 twill (137.72 N) and minimum for plain. For weft rib the cumulative value is marginally less than 1/3 twill (130.65 N). This may be due to the fact that in case of 1/3 twill there is groupism/clustering of threads as well as greater scope of lateral movement of the threads during tearing. The higher value of crimp may have some favourable contribution. The marginally lower value of tearing strength for weft rib structure may be due to the restricted movement of the groups of threads in weft ways during the mechanism of tearing. Warp way breaking load is maximum in case of weft rib structure. This may be due to longer float of warp as well as higher value of warp crimp which plays a greater role in crimp interchange [4] during tensile loading. The least value is found in case of plain because of highest no. of intersection points which, in tern, inhibits the mechanism of crimp interchange during tensile loading. In case of weft way breaking load, maximum value is observed for 1/3 twill. This may be due to the fact that more no. of threads resists the external force applied (due to clustering). Higher value of crimp in this direction also favours the action. This reason is also applied for weft rib structure but the marginally lower value may be due to reasonably lower value of weft crimp. Work of rupture in warp way is found to be maximum in case of weft rib structure which may be due to maximum extensibility (14.99%) and breaking load (528.46 N) in that direction, whereas the same for weft way direction is found to be maximum for 1/3 twill. This also may be due to appreciably higher breaking extension (13.97%) and maximum breaking load (589.32 N) in the weft way direction.

6. Conclusion

The following conclusions may be drawn after this study carried out on the 100% cotton hand-woven fabrics having different weave constructions:

- In case of warp way stiffness, the order is found to be: plain>warp rib>weft rib>2/2 twill>1/3 twill.
- In case of weft way stiffness, the order is plain>weft rib>2/2 twill>1/3 twill>warp rib.
- In terms of crease resistance, the order is found to be 1/3 twill>weft rib>2/2 twill>plain>warp rib.
- In terms of resistance to tearing the order is:
  warp rib>1/3 twill>2/2 twill>weft rib>plain [in case of warp way tearing], and
  1/3 twill>weft rib>2/2 twill>warp rib>plain [for weft way tearing].
- In order of warp way tensile strength, the structures may be arranged as weft rib>2/2 twill>1/3 twill>warp rib>plain, whereas in terms of weft way tensile strength the order is 1/3 twill>weft rib>plain>2/2 twill>warp rib.
- In terms of extensibility, the order is:
  Weft rib>2/2 twill>plain>1/3 twill>warp rib [when load is applied warp way] &
  Warp rib>1/3 twill>2/2 twill>plain>weft rib [for weft way tensile loading].
- When cumulative effect of toughness property is compared the order is found to be: weft rib>1/3 twill>2/2 twill>plain>warp rib.
- Since toughness property for weft rib and 1/3 twill structures are higher than other varieties, so it may be said that these two constructions can be used for such purposes where toughness is of prime importance apart from their usual end-uses. But final conclusion in this regard can be drawn after further study.

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Table–1

Name of Weave	Yarn Count (Nf)		E.P.I.	P.P.I.	Fabric Thickness (mm)	Crimp%	
	Warp	Weft				Warp	Weft
Plain	2/17	2/17	43.6	45.6	0.518	8.80	10.00
Warp Rib			44.6	44.4	0.675	6.16	13.84
Weft Rib			42.4	46.2	0.695	10.64	5.12
1/3 Twill			44.0	45.4	0.724	8.04	11.20
2/2 Twill			43.2	44.4	0.650	11.40	10.76

Table–2

Name of Weave	Bending Length (cm)		Crease Recovery Angle (^{0})		Tearing Strength (N)		Breaking Load (N)		Breaking Extension (%)		Work of Rupture (Nmm)	
	Warp way	Weft way	Warp way	Weft way	Warp way	Weft way	Warp way	Weft way	Warp way	Weft way	Warp way	Weft way
Plain	4.68	4.64	128.3	110.3	55.92	42.53	463.34	395.24	11.72	11.69	3490.86	2730.16
Warp Rib	4.56	3.82	111.6	109.6	70.84	51.13	473.42	322.65	7.93	14.80	2849.75	2238.52
Weft Rib	4.41	4.61	128.6	128.9	59.79	70.86	528.46	487.39	14.99	10.46	4752.50	3421.62
1/3 Twill	4.04	3.84	136.8	129.4	65.78	71.94	484.55	589.32	10.05	13.97	3201.23	4701.78
2/2 Twill	4.15	4.27	120.1	123.2	61.62	60.67	525.63	389.79	12.80	11.74	4063.34	2795.57

- All the results are the mean value based on twenty experiments.