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Effect of a New Attachment in Rapier Loom on Properties of Textiles

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Design and development of an innovative automated device focus on eliminating the auxiliary selvedge in shuttleless rapier looms. This auxiliary selvedge continuously contributes to increased material waste, additional labor and time for removal. So, the proposed device integrates cutting-edge automation technologies with existing loom mechanisms to address these challenges. The auxiliary selvedge is by grasping the protruding weft ends after each pick insertion in the weaving process, with consequent cutting and suctioning the projecting ends and so the device presents a sustainable solution for the textile industry by optimizing material utilization and by reducing the production costs. The scaling down in material remnants was quantified, and the quality of fabric is analyzed by testing the yarn density, areal density, tensile strength, tearing strength, bursting strength, air permeability, dimensional stability and crimp percentage for the fabric produced before and after installation of the attachment. A new attachment to the loom significantly reduces yarn wastage and cost, achieving a 62.5% reduction in both, without altering the loom's constructional parameters in the process of weaving and the produced fabric quality. The statistical significance of the fabric properties produced with and without the attachment was evaluated using a t-test. No significant differences were found in yarn density, areal density, tearing strength, and dimensional stability of the fabrics produced with and without the attachment. However, there were slight but statistically significant differences observed in crimp percentage, tensile strength, bursting strength, and air permeability of the fabrics produced with and without the attachment.

Keywords: Automation, Cost reduction, Material optimization, Mechanical innovation, Sustainability

Introduction

Textile fabrics are manufactured through different processes like weaving, braiding, knitting, tufting, and nonwoven processing. The choice of a fabric is determined by its look, functionality, and price. Fabrics are used extensively in apparel, home furnishings, and industries. Weaving weaves warp and weft yarns perpendicularly,[1] braiding binds yarns diagonally to create fabric,[2] and knitting loops yarn into courses and wales.[3] Tufting places yarn loops into a backing fabric, primarily for carpets[4] whereas nonwoven fabrics are produced through the bonding of fibers, filaments, or polymers to form a porous network.[5]

Weaving continues to be the predominant textile production method with more than 70% of world fabric production, with shuttle less looms having a central role in increasing efficiency and quality of fabric.[6] Of these, rapier looms are also extremely versatile, being able to produce a vast variety of fabric types and weights, and are utilized in both household and industrial textile use everywhere.[7,8] India's power loom sector, a key contributor to fabric production, has seen significant expansion, with shuttleless technologies increasingly replacing traditional shuttle looms.[6,9] The year-wise contribution of the power loom industry to the total cloth production of India is presented in the Table 1.

David Rigby Associates (DRA), UK, states that 73% of technical textiles are woven fabrics.[10] Nonetheless, there exists one long-standing and economically relevant problem in shuttle less weaving particularly rapier looms the creation of auxiliary selvedges, which are transient yarns brought in to allow cutting of the weft yarns during the beat-up stage.[11] Although the yarns create smooth formation of fabric and avoid yarn entanglement, they are completely wasted after weaving, leading to substantial material waste, labor input, and increased costs in production. Research shows that selvedge waste contributes 4–8% of the total yarn used, which is a huge hindrance to profitability and sustainability for rapier-based weavers.[12,13]

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Table 1 — Year-wise contribution of power loom sector to the total cloth production of India

S. No	Year	Total production (kg)	Production on power loom	% of power loom over total cloth production
1.	2008–2009	54,966	33,648	61.22%
2.	2009–2010	60,333	36,997	61.29%
3.	2010–2011	62,559	38,015	60.77%
4.	2011–2012	60,453	37,445	61.94%
5.	2012–2013	62,792	38,038	60,57%
6.	2013–2014	63,500	36,790	57.93%
7.	2014–2015	65,276	37,749	57.83%
8.	2015–2016	65,505	36,984	56.78%
9.	2016–2017	64,421	35,672	55.37%
10.	2017–2018 (upto Aug)	27,789	16,119	—

(Source: Ministry of Textiles, Govt. of India - Annual Report 2017-18, texmin.nic.in)

Optimization efforts in weaving technologies have historically concentrated on making them energy-efficient, noise-reducing, and productive.[14–16] However, relatively less attention has been given to avoiding auxiliary selvedge waste, given its evident economic and environmental impacts.[17] Experimental mechanisms for briefly grasping and reusing weft yarns exist, but they are complex or non-commercial in nature.[18–20]

Over the past few years, a number of innovations have been focused on improving automation and ease of use in textile manufacturing processes. For instance, assistive technologies have been created to make differently-abled people's functioning easy for industrial sewing machines.[21] With these advancements in mind, the current research proposes a new loom attachment to minimize auxiliary selvedge waste while maintaining fabric quality.

To directly fill this need, this current research presents a new, automated rapier loom attachment that obviates auxiliary selvedge formation with no sacrifice of fabric quality or loom efficiency. The mechanism incorporates synchronized weft grip, cut, and suction activities into the parent loom cycle to allow reuse of projecting weft ends without the use of extra selvedge yarns. This remedy not only enhances material utilization but also meets industry needs for cost-effectiveness and sustainability.

The success of the attachment was quantitatively proven by comparing fabrics spun with and without the device, evaluating important parameters including crimp percentage, tensile strength, air permeability, and dimensional stability. Statistical tests also verified that the device facilitates a 62.5% reduction in yarn waste and cost, with little or no loss of fabric properties.

The research is novel in creating a commercially feasible auxiliary selvedge removal mechanism that interfaces with loom timing. Its usability value is in achieving weaving sustainability without sacrificing fabric quality or machine efficiency. Focusing on the usually neglected problem of auxiliary selvedge waste, this research also provides a practical, affordable, and scalable solution for the weaving community, pushing the discipline towards more sustainable manufacturing processes.

Materials and Method

Materials

After careful examination of the loom's structure, operation, and the kind of function that must be carried out, the component sizes and designs were determined. The loom specification details and Specification of fabric produced has listed in Table 2.

Method of Setting the Attachment

Setting up and Commissioning the Loom

A domestic rapier looms with the specification mentioned in Table 2 is produced by Salem, Tamil Nadu - based m/s Hi-Fi Tech Engineering Works was chosen for installation. After the mechanism was set in place and the loom was given a trial run, fabric without any auxiliary selvedge development was produced. During the trial run, about 15 meters of cloth were developed. The fabric and loom specifications were maintained exactly with those used to produce the same fabric with an auxiliary selvedge as indicated in Fig. 1.

Table 2 — Loom specification and produced fabric details

	Particulars	Specification
LOOM SPECIFICATION	Loom make	Hi-Fi Tech Engineering, Salem
	Rapiers type	Double rapiers - flexible
	Weft insertion type	Rapier
	Type of weft transfer	Loop system - Gabler
	Shedding Type	Cam shedding
	Type of beat-up	Link beat-up mechanism
	Loom width	142 cm
	Speed of the loom	230 rpm
	Picking type (rapier drive)	Eccentric drive with segment gear
	Weft accumulator type	Drum type
	Let-off type	Negative
	Weft stop type	Piezzo-electric
	Warp stop type	Electrical warp stop - open drop pins
	Take-up type	7 – wheel take-up
	Weave	Plain
	EPC	26
	PPC	24
	True selvedge type	Leno selvedge
	Temples type	Ring temples
	Yarn count/type (Warp)	20.6 Tex/cotton
	Yarn count/type (Weft)	22.8 Tex/ cotton
	Number of ends in auxiliary selvedge	Either sides 14
	Auxiliary selvedge ends package for supply	Auxiliary selvedge bobbin
PRODUCED FABRIC	Yarn used	Cotton
	EPI	25
	PPI	25
	Weave type	Plain

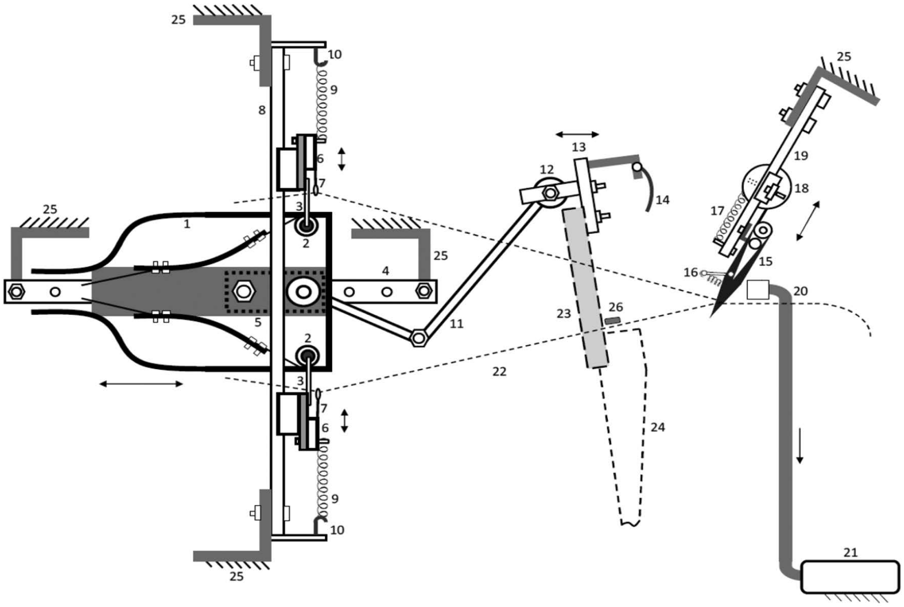

Fig. 1 — Schematic Diagram of an auxiliary selvedge eliminating mechanism: 1. Linear cam; 2. Cam followers; 3. Follower; connectors; 4. Linear guide rail; 5. Mono-block for cam; 6. Shedding mono-blocks; 7. Shedding needles; 8. Linear guide rail; 9. Return springs; 10. Spring hooks; 11. Link; 12. Roller bearings; 13. Connectors; 14. Curved cutter lifter; 15. Cutter with roller; 16. Cutter blade spring; 17. Cutter return spring; 18. Cutter mono-block; 19. Linear guide rail; 20. Suction hose; 21. Suction pump; 22. Gripper ends; 23. Reed; 24. Sley sword; 25. Loom connections; 26. Rapier

Sequence of Operations Based on Loom Timing

The mechanism's operation was coordinated with the primary motion time of the loom. While determining the mechanism timing pertaining to the primary motions, the loom crankshaft's degrees of rotation and the crank's position at different degrees were used as references. The consecutive operation of the mechanism and Face to face with the loom timing is given in Table 3.

Results and Discussion

On the rapier loom, the mechanism was effectively mounted and set up for use, and fabric is produced without an auxiliary selvedge. The installed mechanism in the loom and the fabric produced with an auxiliary selvedge before the installation of the mechanism and the fabric without the auxiliary selvedge produced after the attachment mounted on the rapier loom with the same rapier loom and fabric specification are depicted in the Fig. 2.

Paired t-test was used in the study since every property of the fabric was tested on two sets of samples drawn from the same loom under the same conditions, one having the developed mechanism and the other with no mechanism. Since, these are naturally paired and dependent measurements, paired t-test will be suitable in determining the mean difference while adjusting for variation between matching samples.

Crimp Percentage

The crimp percentage of yarn in weaving refers to the amount of waviness or the degree to which the yarn is bent or curved within the woven fabric. In Fig. 3 the crimp percentage of the yarn is presented. There is a small increase in crimp percentage of the yarn in the fabric produced with attachment. This is due to the decrease in weaving tension. The results obtained in this study are consistent with the findings of previous research conducted by earlier work by Qureshi *et al*., 2021.(13)

While checking for the Statistical significance between crimp percentages of the fabric produced with and without mechanism in warp ways and weft ways in Table 4 using two tailed t-test, the p-value (0.0024 & 0.0004) is less than the significance level 0.05. So, it is statistically proven that there is a significant difference between fabric produced with and without attachment. This very little change may be due to the reduction in weaving tension and this will not make any variation on the quality of the fabric produced with an attachment since the difference is very negligible.

Table 3 — Consecutive operation of the mechanism and face to face with the timing of the loom

Degrees of crankshaft rotation	Normal loom function	Sequence of operations of the mechanism
90° of the Loom at front center	The sley is positioned at the front center, the beat-up process has been completed, the warp shed has been crossed, and the rapiers are at rest.	The linear cam is in its most forward position close to the reed, holding the extending weft ends, which are grabbed by the closed shed presented by the gripper ends. The cutter is still open at its most rear position.
90° to 180° of the loom	The sley begins to move backward, rapiers remain at rest, and warp yarns shift to create the next shed.	As the cam retracts, cam followers and shedding mono-blocks move to set up the subsequent shed, as the grippers still retain the weft.
180° of the loom at bottom center	The sley is positioned between the front and back centers. As the shed opens for the next pick, the rapiers begin their initial movement from rest.	The cutter approaches and cuts the weft 10 mm from the fabric edge. The cut ends are released by the grippers, and they are taken away by a suction system. A new shed is established at the same time.
180° to 270° of the loom	Sley moves close to the back center, the shed is opened, and the rapiers are moved into the shed.	The cam goes as far as it can, leaving the gripper shed open to permit the rapiers to enter for weft insertion.
270° of the loom at back center	The shed is fully opened, and the sley is positioned at the back center. The weft is passed from the giver rapier to the taker rapier.	The open griper shed allows the giver rapier to transfer the weft to the taker rapier.
270° to 360° of the loom	The sley is positioned between the back and front centers. As the warp shed begins to close, the rapiers continue to retreat from the warp shed	As the cam comes back forward, the gripper shed starts closing in sync with rapier withdrawal.
360° (0°) Loom top center	Sley in between the back and the front centers, warp shed process is still closing, rapiers continues to retreat from warp shed	The cam goes still farther forward, and the gripper shed continues to close as rapiers move out of the warp shed.
0° to 90°	Sley is moving towards the front center, the warp shed closes and begins crossing, and the rapiers fully exit the shed after releasing the weft.	Close to its frontmost position once more, the grippers grasp the new weft, shortly before it is released by the rapier preparing for the next cycle.

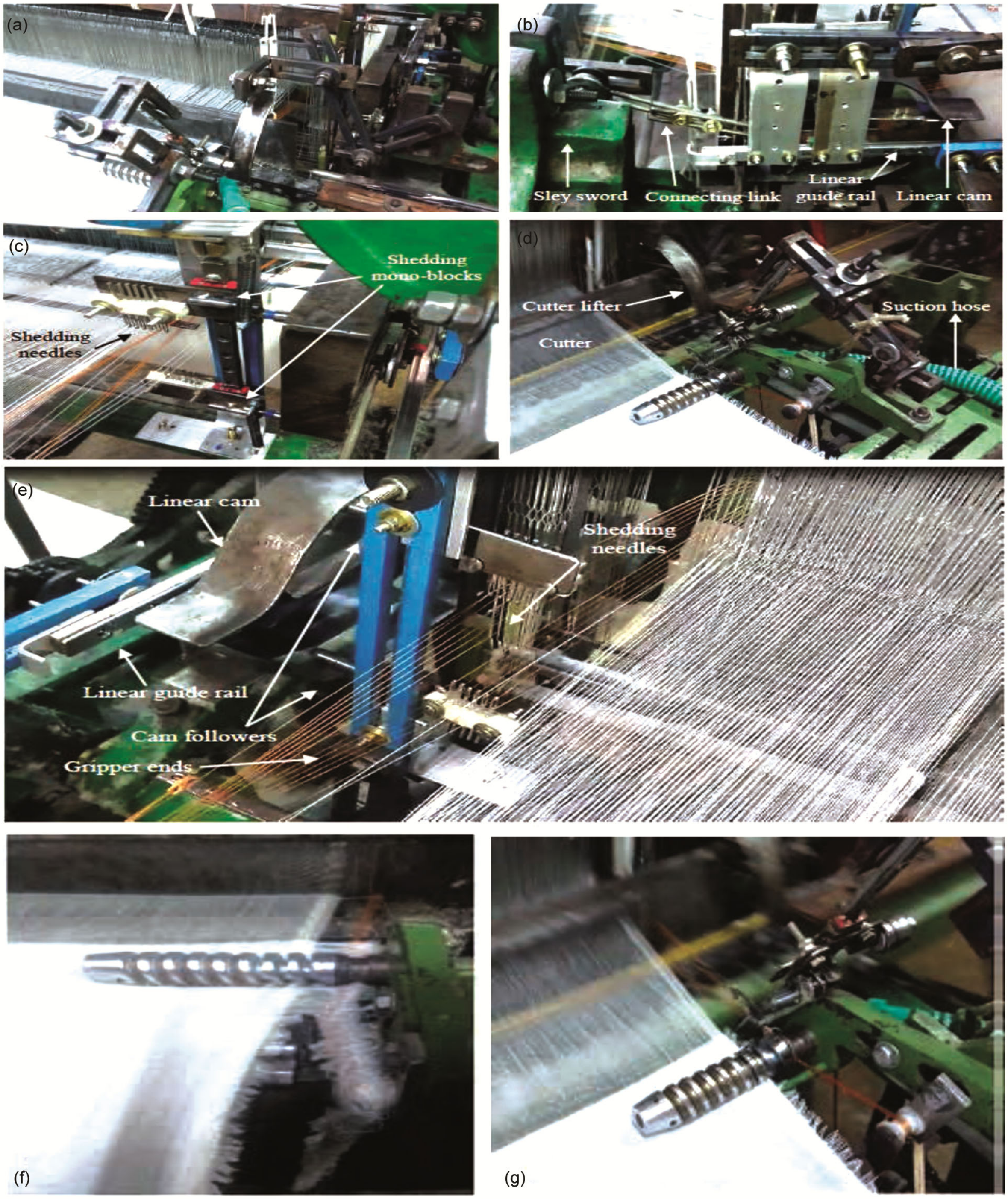

Fig. 2 — Installed mechanism on the loom and fabric produced with and without the mechanism: (a) mechanism as installed on loom, (b) the linear cam assembly, (c) the shedding assembly, (d) the cutter assembly with suction hose, (e) shedding needles with gripper ends, (f) fabric formed with auxiliary selvedge and without mechanism, (g) fabric formed without auxiliary selvedge and with mechanism

Ends per cm and Picks per cm

The yarn density of a fabric produced with and without an attachment is presented in Fig. 4. The fabric produced with an attachment shows slight less yarn density than the fabric produced without an attachment. This result is because the waviness of the yarn which took more space.

The fabric produced with an attachment shows slight less yarn density than the fabric produced without an attachment. When checking for the

Statistical significance between yarn densities of the fabric produced with and without mechanism in ends and picks direction in Table 5 using two tailed t- test, the p-values (0.189 & 0.8899) are greater than the significance level 0.05. So, it is statistically proven that there is no significant difference between fabric produced with and without attachment.

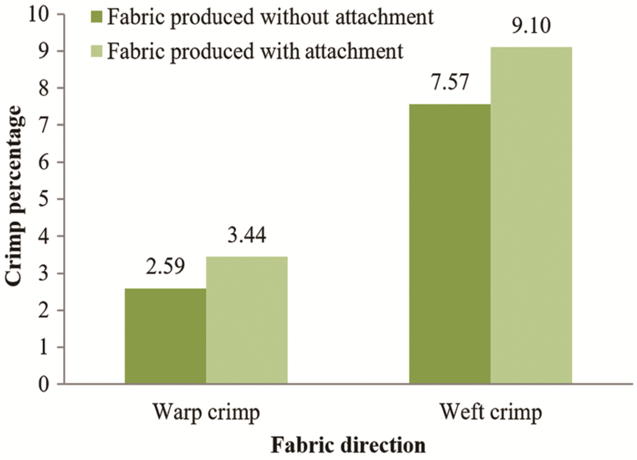

Fig. 3 — Graphical representation of the crimp percentage (with and without attachment)

Areal Density

The areal density of a fabric refers to the mass of the fabric per unit area. Areal density quantifies how much mass (weight) is contained within a given area of fabric. It provides information about the thickness and density of the fabric material itself. It could be seen from Fig. 5 that the Fabric produced with an attachment has a slight high areal density than the fabric produced without an attachment. This is

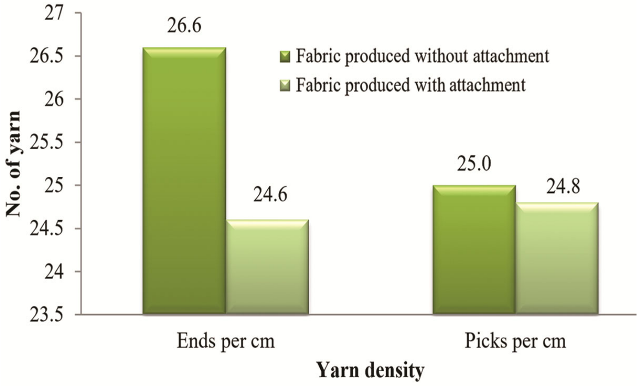

Fig. 4 — Graphical representation of the yarn density (with and without attachment)

Table 4 —Statistical significance (t-test: paired two sample for means) between crimp percentages of the fabric produced with and without mechanism in warp and weft way

Parameters	Warp way		Weft way	
	Variable 1	Variable 2	Variable 1	Variable 2
Mean	2.588	3.442	7.568	9.104
Variance	0.0068	0.0438	0.0069	0.0994
Observations	5	5	5	5
Pearson correlation	−0.781	—	0.1486	—
Hypothesized mean difference	0	—	0	—
df	4	—	4	—
t Stat	−6.854	—	−10.94	—
P (T<=t) two-tail	0.0024	—	0.0004	—
t Critical two-tail	2.7764	—	2.7764	—

Table 5 — Statistical significance (t-test: paired two sample for means) between yarn densities of the fabric produced with and without mechanism in ends direction

Parameters	Ends direction		Picks direction	
	Variable 1	Variable 2	Variable 1	Variable 2
Mean	26.6	24.6	25	24.8
Variance	0.8	7.8	4	2.2
Observations	5	5	5	5
Pearson correlation	0.1201	—	−0.506	—
Hypothesized mean difference	0	—	0	—
df	4	—	4	—
t Stat	1.5811	—	0.1474	—
P(T<=t) two-tail	0.189	—	0.8899	—
t Critical two-tail	2.7764	—	2.7764	—

because the crimp percentage is higher; yarns are more tightly packed into the fabric structure.

The fabric produced with an attachment has a slight high areal density than the fabric produced without an attachment. But when testing for the Statistical significance between areal densities of the fabric produced with and without mechanism using two tailed t- test (Table 6), the p-value (0.1942) is greater than the significance level 0.05. Hence, it is evident that there is no statistical significance between fabric produced with and without attachment.

Tensile Strength

A fabric's tensile strength is its capacity to bear strains caused by pulling or stretching without breaking. It is a crucial mechanical characteristic that establishes the fabric's flexibility and durability in various uses and it was tested according to ISO 13934-1: 2013. Also, the results in Fig. 6 show that there is a little increase in tensile strength as the crimp of the warp and weft yarn increases in the fabric produced with an attachment. Similar result was also found and reported in one of the earlier publications by Qureshi *et al*., 2021.(13)

Statistical significance between tensile strength of the fabric produced with and without mechanism using two tailed t-test for warp and weft is shown in Table 7, respectively.

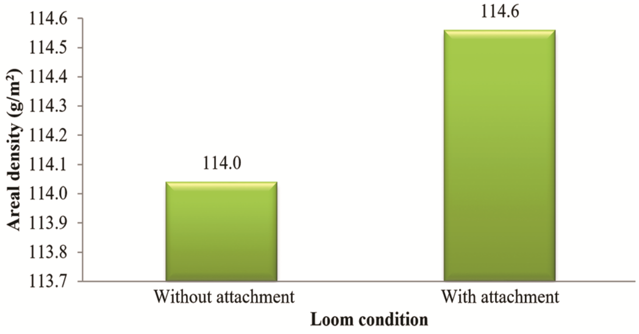

Fig. 5 — Graphical representation of the areal density (with and without attachment)

Table 6 — Statistical significance (t-Test: Paired Two Sample for Means) of areal density between the fabrics produced

Parameters	Variable 1	Variable 2
Mean	114.04	114.56
Variance	0.848	0.628
Observations	5	5
Pearson correlation	0.6297	—
Hypothesized mean difference	0	—
df	4	—
t Stat	−1.558	—
P(T<=t) two-tail	0.1942	—
t Critical two-tail	2.7764	—

Statistical significance test between tensile strength of the fabric produced with and without mechanism using two tailed t-test for warp and weft reveals that, the p-values (0.0212 & 0.0147) are lesser than the significance level 0.05. It is evident that the value is statistically significant between fabric produced with and without attachment and the significant we got is very minimal which corroborates that there are no major changes in the quality of the fabric produced with an attachment. Also, the result obtained is in line with the previous work done by earlier author Qureshi *et al*., 2021.(13)

Tearing Strength

Tearing strength is the force required to tear the fabric apart once a small initial cut has been made. It measures the fabric's resistance to tearing under a controlled condition. Here, The tearing strength was tested in accordance with ISO 13937-I:2001 by the Elmendorf method. The results given in Fig. 7 illustrated the tearing strength of both fabrics. It shows that the fabric produced with an attachment show less tearing strength which supports the earlier study published elsewhere in the literature.[13] This is

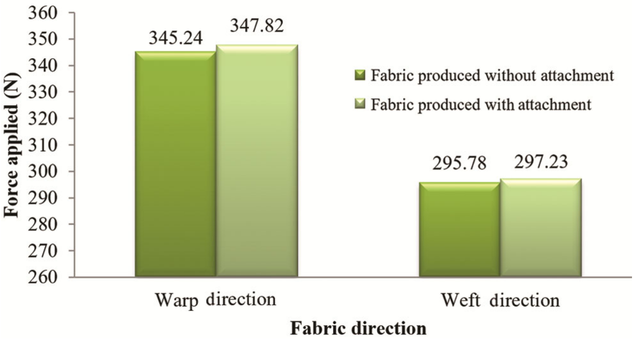

Fig. 6 — Graphical representation of tensile strength (with and without attachment)

Table 7 — Statistical significance (t-test: paired two sample for means) of tensile strength of the fabric produced with and without an attachment in warp way

t-Test: Paired Two Sample for Means	Warp way		Weft way	
	Variable 1	Variable 2	Variable 1	Variable 2
Mean	345.27	347.82	295.79	297.23
Variance	1.8153	0.3234	0.3292	0.9222
Observations	5	5	5	5
Pearson correlation	−0.169	—	0.5771	—
Hypothesized mean difference	0	—	0	—
df	4	—	4	—
t Stat	−3.683	—	−4.116	—
P(T<=t) two-tail	0.0212	—	0.0147	—
t Critical two-tail	2.7764	—	2.7764	—

due to the increased crimp generally leads to a reduction in the direct load-bearing capacity of the individual yarns because they are not aligned straightly along the direction of the force.

Statistical significance of tearing strength test between the fabric produced with and without mechanism using two tailed t-test for warp and weft is shown in Table 8. The p-values of warp (0.2193) and weft (0.6655) are greater than the significance level 0.05. Hence, it is evident that there is no statistical significant between fabric produced with and without attachment.

Bursting Strength

Bursting strength is defined as the maximum hydrostatic pressure required bursting the fabric. It measures the fabric's ability to resist rupture when subjected to pressure from an internal force. It could be observed from Fig. 8 that the bursting strength of the fabric produced with an attachment shows little increase. Since, the crimp of the warp and weft yarn increases. The findings of this study align with the results of research[13] found elsewhere in the published literature.

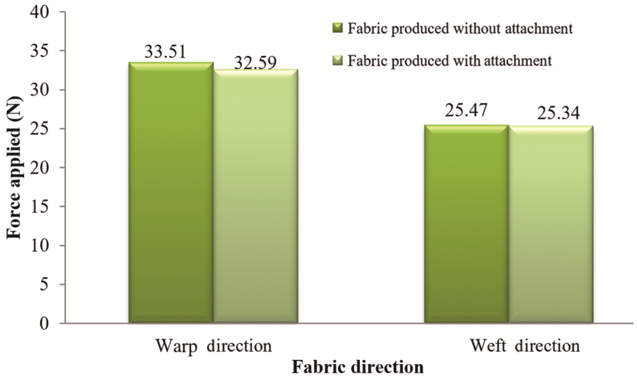

Fig. 7 — Graphical representation of tearing strength (with and without attachment)

Table 8 — Statistical significance of tearing strength of the fabric produced before and after attachment in warp way

Parameters	Variable 1	Variable 2	Variable 1	Variable 2
	Warp way		Weft way	
Mean	32.694	32.576	25.472	25.386
Variance	0.0117	0.0236	0.0183	0.2615
Observations	5	5	5	5
Pearson correlation	0.0748	—	0.7908	—
Hypothesized mean difference	0	—	0	—
Df	4	—	4	—
t Stat	1.4553	—	0.4659	—
P(T<=t) two-tail	0.2193	—	0.6655	—
t Critical two-tail	2.7764	—	2.7764	—

It could be seen from Table 9 that the p-value for bursting strength (0.0104) is significant statistically because it is less than the 0.05 threshold. Yet, as the value is quite near the significance level and the actual bursting strength difference is small, its practical effect on overall fabric quality is not appreciable. This difference could be due to the minor increase in crimp percentage, but it does not lead to any significant variation in the functional behavior of the fabric. The findings of this study align with the results of previous research conducted by Qureshi *et al.*, 2021.(13)

Air Permeability

Air permeability is a measure of the ease with which air can pass through a fabric. The air permeability was tested with a pressure of 125 Pa and for a test area of 38 cm^2 according to ASTM D-737-2004 (CFM). The air permeability of the fabrics produced is shown in Fig. 9. The fabric produced without an attachment shows little less air permeability this is due to the denser fabric with fewer and smaller inter-yarn spaces.

The air permeability p-value (0.0372), presented in Table 10, is statistically significant as it is less than 0.05. Still, since it is close to the significance level and because the change is very small, its practical

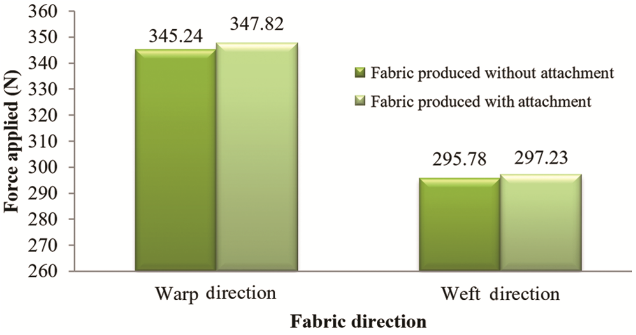

Fig. 8 — Graphical representation of bursting strength (with and without attachment)

Table 9 — Statistical significance test of the bursting strength of the fabric

Parameters	**Variable 1**	**Variable 2**
Mean	781.14	782.04
Variance	117.01	123.46
Observations	5	5
Pearson correlation	0.9995	—
Hypothesized mean difference	0	—
df	4	—
t Stat	−4.557	—
P(T<=t) two-tail	0.0104	—
t Critical two-tail	2.7764	—

effect on fabric quality is nominal. The difference observed will most probably stem from the higher crimp percentage, causing the fabric to be denser with fewer and smaller inter-yarn spaces. However, this means that the installed attachment produces very little interference in fabric formation and does not harm overall fabric quality. The findings of this study support the results of earlier research conducted by Qureshi *et al*., 2021.(13)

Dimensional Stability

Dimensional stability of a fabric refers to its ability to maintain its original dimensions and shape under various conditions, especially during use and care processes such as washing, stretching, ironing, or exposure to environmental factors. The dimensional stability of the fabrics produced is shown in Fig. 10. The fabric produced with an attachment shows slight less dimensional stability because the wavy yarns can straighten out under tension that causes a stretch. This has been validated through an earlier study by Qureshi *et al*., 2021(13) where in similar type of result was obtained.

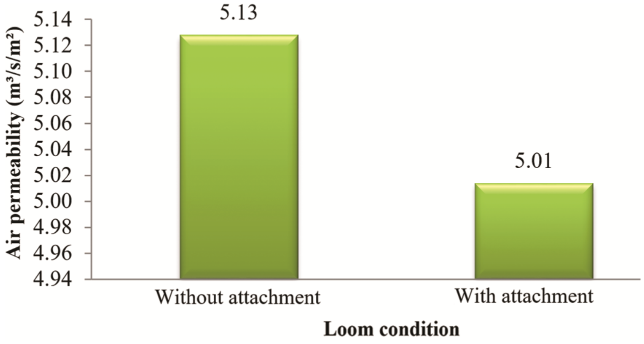

Fig. 9 — Graphical representation of air permeability (with and without attachment)

Table 10 — Statistical significance of air permeability of the fabrics

Parameters	Variable 1	Variable 2
Mean	5.148	5.424
Variance	0.0073	0.0689
Observations	5	5
Pearson correlation	0.8001	—
Hypothesized mean difference	0	—
df	4	—
t Stat	−3.071	—
P(T<=t) two-tail	0.0372	—
t Critical two-tail	2.7764	—

The statistical difference in dimensional stability of the fabrics in both warp and weft direction is presented in Table 11. Test for the statistical significance shows, the p – value (0.5286) in Warp and (0.6667) in weft in Table 11 is greater than the significance level 0.05. So, there is no significance difference between them.

Waste percentage calculation

Cost comparison of yarn wastage before and after installation of an attachment is shown in Table 12.

A wastage calculation analysis was performed for yarn usage in looms before and after adding an attachment. Here's a summary of the data:

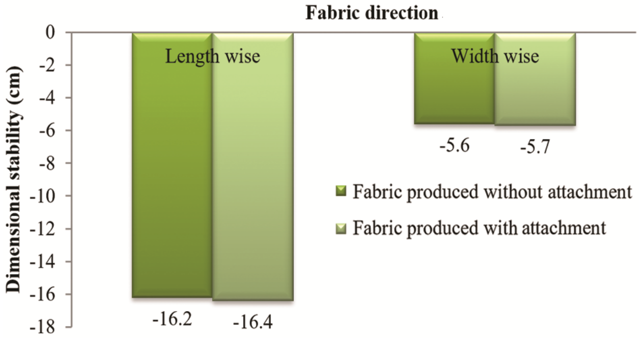

Fig. 10 — Graphical representation of dimensional stability (with and without attachment)

Table 11 — Statistical difference of dimensional stability of the fabrics produced on warp direction and weft direction

Parameters	Warp way		Weft way	
	Variable 1	Variable 2	Variable 1	Variable 2
Mean	−16.2	−16.27	−5.567	−5.533
Variance	0.12	0.0433	0.0233	0.0633
Observations	3	3	3	3
Pearson correlation	0.9707	—	0.9538	—
Hypothesized mean difference	0	—	0	—
df	2	—	2	—
t Stat	0.7559	—	−0.5	—
P(T<=t) two-tail	0.5286	—	0.6667	—
t Critical two-tail	4.3027	—	4.3027	—

Table 12 — Cost comparison of yarn wastage before and after installation of an attachment

Wastage Calculation	Wastage before an attachment per shift	Wastage after an attachment per shift	Saved yarn and cost per shift after an attachment	Percentage of saved yarn and cost (%)
For a loom (Kg)	0.8	0.3	0.5	62.5
Cost of yarn for a loom (Rs)	320	120	200	62.5
For 25 looms (Kg)	20	7.5	12.5	62.5
Cost of yarn for 25 looms (Rs)	8000	3000	5000	62.5

Wastage before an attachment per shift: For a single loom: 0.8 kg, costing Rs 320; For 25 looms: 20 kg, costing Rs 8000.

Wastage after an attachment per shift: For a single loom: 0.3 kg, costing Rs 120; For 25 looms: 7.5 kg, costing Rs 3000.

Saved yarn and cost per shift after an attachment: For a single loom: 0.5 kg of yarn saved, costing Rs 200 saved; For 25 looms: 12.5 kg of yarn saved, costing Rs 5000 saved.

Percentage of saved yarn and cost: The percentage of yarn and cost saved after using the attachment is 62.5%.

This analysis shows that adding an attachment to the loom significantly reduces yarn wastage and cost, achieving a 62.5% reduction in both.

Conclusions

The study verifies that elimination of an auxiliary selvedge in rapier weaving has little influence on most fabric properties like tensile strength, percentage crimp, and air permeability. The fabrics weaved without an auxiliary selvedge actually performed slightly better in tensile and bursting strength because of greater crimp in warp and weft yarns from lower tension of weft because of the installed mechanism. These results confirm the practical usability of the developed mechanism that provides cost savings and material efficiency without weakening fabric quality. A significant restriction is that the study used a certain type of fabric and weaving configuration; expanded testing on various materials and loom configurations is required. Future studies must investigate the optimization of the mechanism for different weaving conditions and fabric structures. Industrial-wise, the attachment offers a cost-effective and environmentally friendly means of reducing auxiliary selvedge waste, with significant potential for universal application in textile production.

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