Study On Selvedge wastage In Rapier Loom

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………Dedicated To My Parents

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Finally, we would like to acknowledge that we remain responsible for the inadequacies & error, which doubtless remain in the following report

DECLARATION

I do, hereby declare that the work presented in this project is done by me under the supervision of **Dr. Md. Mahbubul Haque,** Professor & Head Department of Textile Engineering, Daffodil International University. I also declare that neither this report, nor any part of its being concurrently elsewhere for the award of any kind of degree, deploma or publication.

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ABSTRUCT

This paper present the analysis of waste% of selvedge in rapier loom used in Bangladesh. Woven fabric is produced by interlacement of warp and weft yarns.

Construction of fabric is very important for woven fabric because amount of weft yarn and warp yarn depends on EPI and PPI of the fabric. The density of fabric depends on EPI and PPI. Count of yarn also important for woven fabric.

Selvedge is the waste of total fabric production but it is very important to maintain the width of the fabric. It is also very to maintain construction of the fabric during weaving.

For this study we collected the samples from weaving industry.

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1.INTRODUCTION

1.1 General Introduction

Weaving is a method of fabric production in which two distinct sets of yarns or threads are interlaced at right angles to form a fabric or cloth. The longitudinal threads are called the warp and the lateral threads are the weft or filling. Cloth is usually woven on a loom, a device that holds the warp threads in place while filling threads are woven through them. A fabric band which meets this definition of cloth (warp threads with a weft thread winding between) can also be made using other methods, including tablet weaving, back-strap, or other techniques without looms. The way the warp and filling threads interlace with each other is called the weave. The majority of woven products are created with one of three basic weaves: plain weave, satin weave, or twill. Woven cloth can be plain, or can be woven in decorative or artistic designs.

1.2 Object of the Study

This paper defines wastage in weaving machine of filling yarn and key issues of filling yarn wastage. In addition, example of wastage in rapier loom in industry are presented.

The following are the main objective of this study:-

- ✓ To know the wastage in rapier loom.
- ✓ To know the wastage of weft yarn in rapier loom.
- ✓ To know the percentage of wastage in rapier loom.
- ✓ To calculate the wastage of weft yarn.
- ✓ To give clear idea about percentage of filling yarn.
- ✓ Know the wastage percentage of fabric as selvedge.

2.Liturature Survey

A stationary package of yarn is used to supply the weft yarns in the rapier machine. One end of a rapier, a rod or steel tape, carries the weft yarn. The other end of the rapier is connected to the control system. The rapier moves across the width of the fabric, carrying the weft yarn across through the shed to the opposite side. The rapier is then retracted, leaving the new pick in place. In some versions of the loom, two rapiers are used, each half the width of the fabric in size. One rapier carries the yarn to the centre of the shed, where the opposing rapier picks up the yarn and carries it the remainder of the way across the shed. The double rapier is used more frequently than the single rapier due to its increases picks insertion speed and ability to weave wider widths of fabric. The housing for the rapiers must take up as much space as the width of the machine. To overcome this problem, looms with flexible rapiers have been devised. The flexible rapier can be coiled as it is withdrawn, therefore requiring less storage space. If, however, the rapier is too stiff then it will not coil. If it is too flexible, it will buckle. Rigid and flexible rapier machines operate at speeds operating at speeds ranging from about 200 to 260 ppm, using up to 1300 meters of weft yarn every minute. They have a noise level similar to that of modern projectile looms. They can produce a wide variety of fabrics ranging from muslin to drapery and upholstery materials. Newer rapier machines are built with two distinct weaving areas for two separate fabrics. On such machines, one rapier picks up the yarn from the center, between the two fabrics, and carries it across one weaving area; as it finishes laying that pick, the opposite end of the rapier picks up another yarn from the center, and the rapier moves in the other direction to lay a pick for the second weaving area, on the other half of the machine. The above figure shows the action on a single width of fabric for a single rigid rapier system, a double rigid rapier system, and a double flexible rapier system.

2.1 Weaving

The process of producing a fabric by interlacing warp and weft threads is known as weaving. The machine used for weaving is known as weaving machine or loom. Weaving is a skill that has been practiced for thousands of years. The initial application of weaving dates back to the Egyptian civilization. Over the years, both the process as well as the machine has undergone phenomenal changes.

2.2 Rapier Loom

Rapier loom is a shuttle less weaving loom in which the filling yarn is carried through the shed of warp yarns to the other side of the loom by finger like carriers called rapiers. As in the projectile loom, a stationary package of yarn is used to supply the weft yarns in the rapier machine. One end of a rapier, a rod or steel tape, carries the weft yarn. The other end of the rapier is connected to the control system .The rapier moves across the width of the fabric, carrying the weft yarn across through the shed to the opposite side. The rapier is then retracted, leaving the new filling in place.

Fig: Rapier Loom

In some versions of the machine, two rapiers are used, each half the width of the fabric in size. One rapier carries the yarn to the center of the shed, where the opposing rapier picks up the yarn and carries it the remainder of the way across the shed. A disadvantage of both these techniques is the space required for the machine if a rigid rapier is used. The housing for the rapiers must take up as much space as the width of the machine. To overcome this problem, looms with flexible rapiers have been devised. The flexible rapier can be coiled as it is withdrawn and will therefore require less space. However, if the rapier is too stiff, it will not coil; if it is too flexible, it will buckle. The double rapier is used more frequently than the single rapier. Rigid and flexible rapier machines operate at speeds of up to 1,300 meters of weft per minute. These rapier looms are efficient. They operate at speeds ranging from about 200 to 260 ppm at about the noise level of projectile looms. They can produce a wide variety of fabrics ranging from muslin to drapery and upholstery materials.

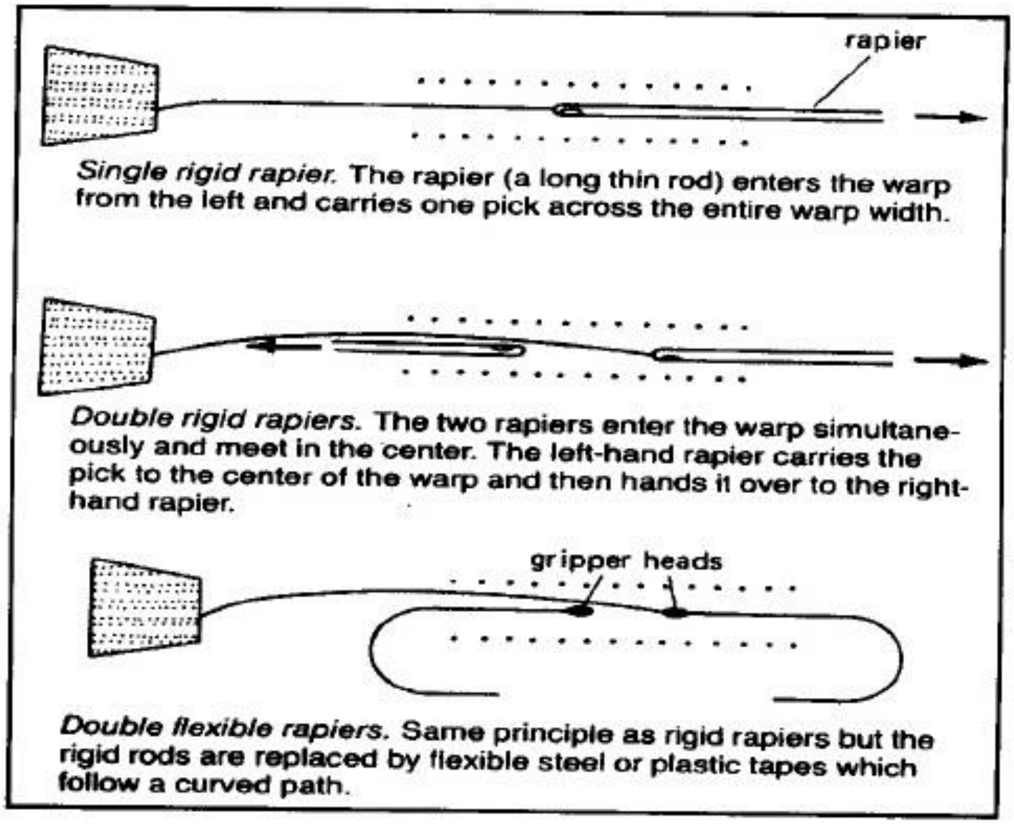


Fig: The operation principle of three rapier system

Newer rapier machines are built with two distinct weaving areas for two separate fabrics. On such machines, one rapier picks up the yarn from the center, between the two fabrics, and carries it across one weaving area; as it finishes laying that pick, the opposite end of the rapier picks up another yarn from the center, and the rapier moves in the other direction to lay a pick for the second weaving area, on the other half of the machine. Rapier machines weave more rapidly than most shuttle machines but more slowly than most projectile machines.

2.3 Features of Rapier Loom

An useful feature of rigid rapiers is that they can be simultaneously inserted in two sheds one above the other, for producing double plush and certain carpets.

Rapier loom may have various types according to the weft insertion mechanism & number of pick such as insertion of double pick, insertion of single pick, two phase rapier etc.

In all rapier looms to-and-fro-movement of the rapiers is derived initially either from a linkage mechanism or from a cam. The use of linkage mechanism has the advantages of simplicity reliability & is cheap, quite and consumers less energy than a cam mechanism but it does not provide any dwell to the rapiers.

The only two phase rapier in commercial operation is the saurer of width 2 x 185 cm or 2 x 220 cm having weft insertion rate is about 1200 mpm.

The rigid rapier is driven from the centre and has a rapier head at each end.In one cycle of 360 degree the rapier inserts one pick alternately in the right hand and the left hand fabrics, the picks being inserted and beaten up in opposite phase .

In gabler system of weft insertion the rapier system is combined with air jet picking system.

Gabler system rapier may be single sided or double sided. The machine include on gabler system Draper DSL,Gusken etc. Those operating on dewas system include dornier, picanol, Novo pignon SACM, Gunne, Smit, Sommet, Sulzer-Ruti etc.

2.4 Advanage Of Rapier Loom

The rapier loom doesn’t require dynamic forces or anything like the magnitude as those involved in the conventional loom.

The weft insertion rate in a rapier loom is very much influenced by the method of weft control. Weft insertion rate is very high rather than any conventional loom

It can occur double pick at a time by double picking insertion system. Here is no need to cut the weft selvedges and no weft wastage.

Weft insertion rate is very high rather than any conventional loom Rigid rapiers has a useful features that they can be simultaneously inserted in two sheds one above the other ,for producing double plush and certain carpets.

Looms that use rigid rapiers eliminate entirely the need to assist the rapier head through the warp shed, this is a undoubted advantages.

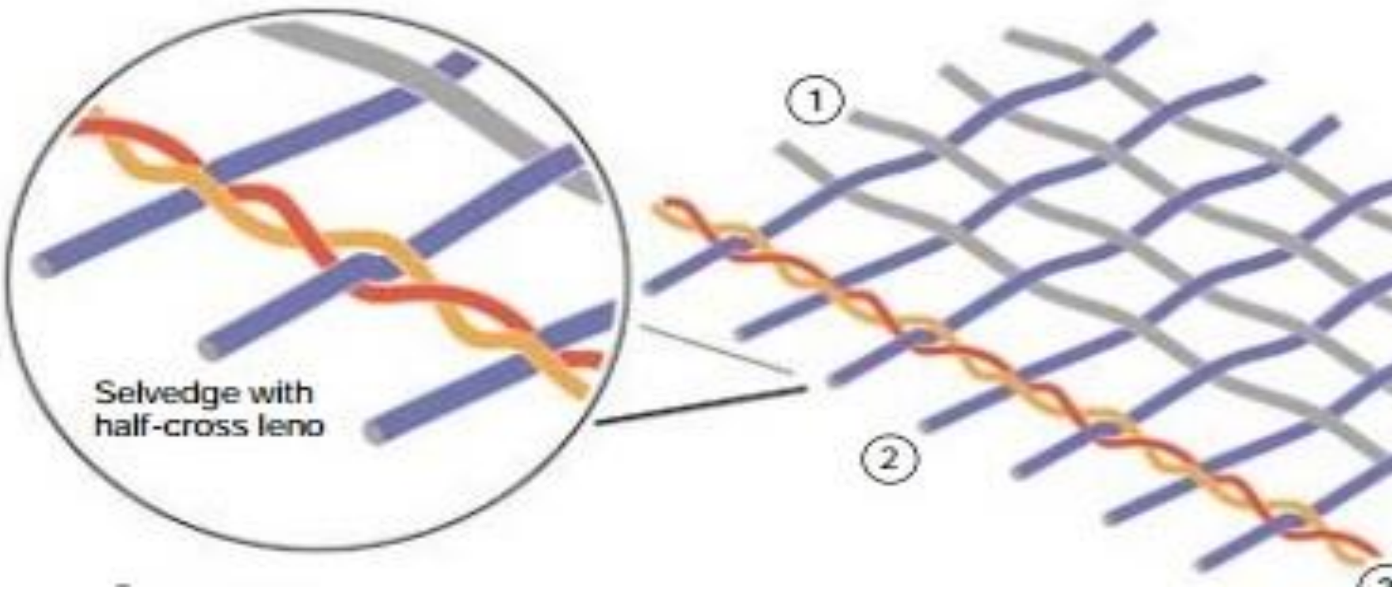
Type of rapier-

Rigid rapier, rigid rapiers are again divided into rigid rapier and telescopic rapier. In case of telescopic rapier the rigid rapier can be shorten like a real stick of radio or television.

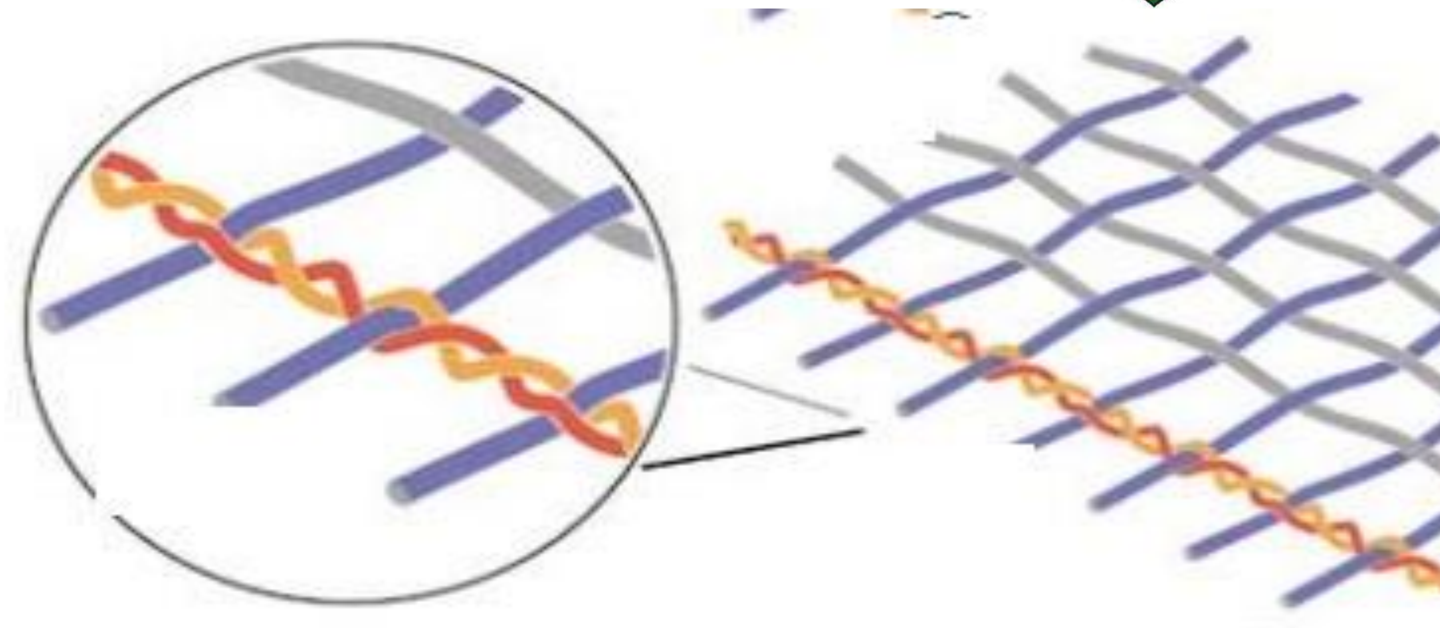
Flexible rapier. For higher width a guide is used for inserting the rapier where as for lower width such guide is not required.

2.5 Weft Yarn Wastage In Rapier Loom

Giver rapier and a taker rapier, each rapier including a yarn clamp movable between open and closed positions and means for opening said yarn clamp. A first drive for reciprocating said giver rapier transversely to a shed toward and away from a reversal position in the region of the center of the shed.



A second drive for reciprocating said taker rapier toward and away from a reversal position in the region of the center of the shed, said first and second drives being synchronized such that said rapiers move toward and away from each other and cooperate with one another at a yarn transfer position near the reversal positions in the region of the center of the shed.



There is a distance between cutter and fabrics and weft yarn wastage due to this distance of cutter.

2.6 Yarn Count

Count is a numerical value, which express the coarseness or fineness (diameter) of the yarn and also indicate the relationship between length and weight(the mass per unit length or the length per unit mass)of that yarn. The fineness of the yarn is usually expressed in terms of its linear density or count. There are a number of systems and units for expressing yarn fineness. But they are classified as follows.

Types of Yarn Count:

1. Direct Count System

2. Indirect Count System

Direct Count System:

The weight of a fixed length of yarn is determined. The weight per unit length is the yarn count! The common features of all direct count systems are the length of yarn is fixed and the weight of yarn varies according to its fineness.

The following formula is used to calculate the yarn count:

$$x = \frac{(l \times w)}{L}$$

Where,

N =Yarn count or numbering system

W =Weight of the sample at the official regain in the unit of the system

L=Length of the sample

l=Unit of length of the sample

In brief, definition of the above Systems is as follows

1. Tex system ....NO. of grams per 1000 meters
2. Denier ....No. of Grams per 9000 meters
3. Deci Tex ....No. of grams per 10,000 meters
4. Millitex ....No. of milligrams per 1000 meters
5. Kilotex............................... No. of kilograms per 1000 meters.
6. Jute count...........................No. of lb per 14,400 yds

The Tex of a yarn indicates the weight in grammas of 1000 meters yarn. So that 40Tex means 1000 meters of yarn weigh 40gm.

From above discussion it is concluded that, higher the yarn number (count) coarser the yarn and lower the number finer the yarn.

2. Indirect Count System:

The length of a fixed weight of yarn is measured. The length per unit weight is the yarn count. The common features of all indirect count systems are the weight of yarn is fixed and the Length of yarn varies according to its fineness.

The following formula is used to calculate they are count:

$$x = \frac{(L \times w)}{W \times l}$$

Where,

N =Yarn count or numbering system

W =Weight of the sample at the official regain in the unit of the system

L=Length of the sample

l=Unit of length of the sample

w = Unit of weight of the sample.

1.Ne: No of 840 yards yarn weighing in One pound.

2. Nm: No of one kilometer yarn weighing in One Kilogram.

The Ne indicate show many hanks of 840 yards length weigh one English pound. So that 32 Ne Means 32 hanks of 840yards i.e.32x840 yards length weigh one pound. For the determination of the count of yarn, it is necessary to determine the weight of a known length of the yarn. For taking out known lengths of yarns, a wrap-reel is used. The length of yarn reeled off depends upon the count system used. One of the most important requirements for a spinner is to maintain the average count and count variation within control.

3.Experimental Work

Here in the picture fabric fabric width and selvedge has shown. There is a distance between yan cutter and selvedge cutter for this reason weft yarn is wastage in loom.

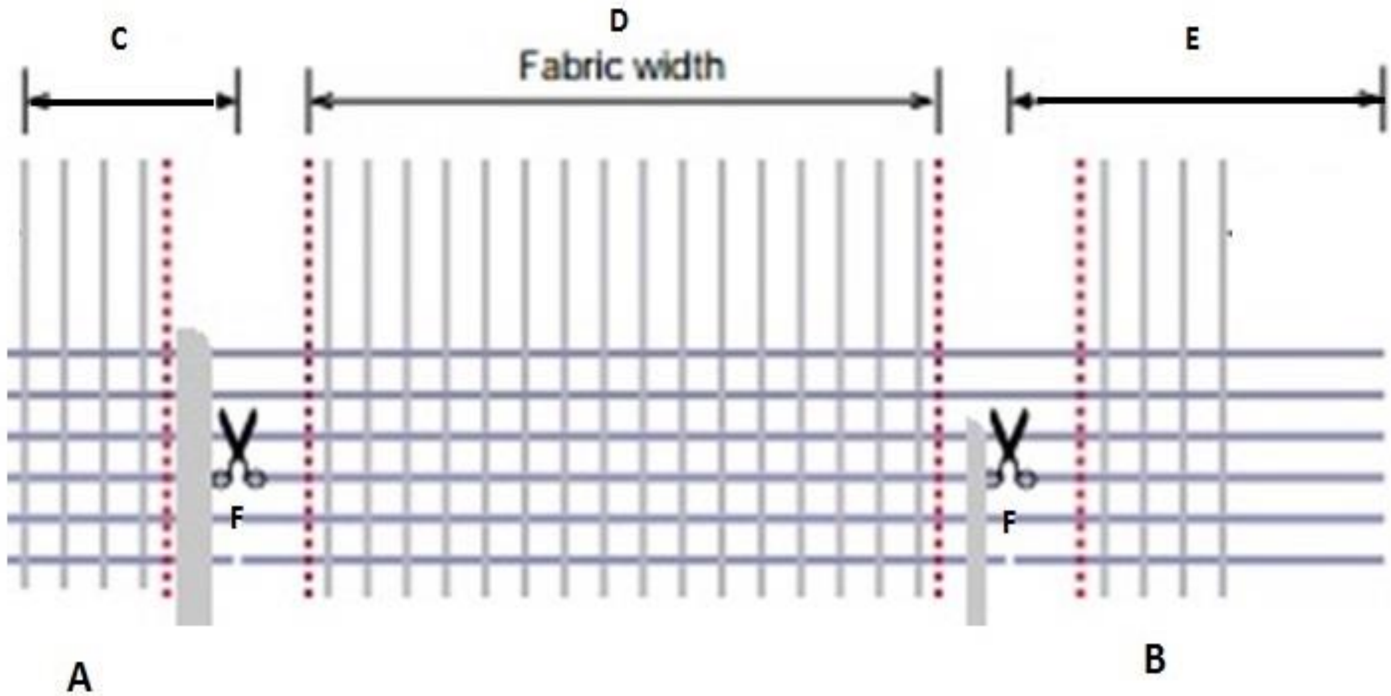


Fig: yarn wastage

Here,
A=giver site of m/c
B=Receiver side of m/c
C=Giver side selvedge
E=Receiver side selvedge
D=Fabric width in loom
F=Selvedge Cutter

Table 1: Wastage of weft yarn (gm):

Here,

A= Giver Side

B= Receiver side

EPI	Count of Warp	PPI	Count of Weft	Weight of 1m selvedge (X) A	Weight of 1m selvedge (X) B	Weight of Warp yarn in 1m selvedge (Y) A_{warp}	Weight of Warp yarn in 1m selvedge (Y) B_{warp}	Weight of weft yarn in1m selvedge (X-Y) A_{weft}	Weight of weft yarn in1m selvedge (X-Y) B_{weft}
130	40	70	40	2.47gm	4.79gm	0.63gm	0.61gm	1.84gm	4.18gm
120	40	100	40	2.93gm	3.51gm	0.63gm	0.49gm	2.30gm	3.02gm
120	40	90	40	2.71gm	4.45gm	0.47gm	0.44gm	2.24gm	4.01gm
110	50	80	50	1.79gm	3.42gm	0.45gm	0.42gm	1.34gm	3.00gm
90	50	70	50	1.95gm	2.89gm	0.60gm	0.41gm	1.35gm	2.48gm
								Total weight=9.04gm	Total weight=16.69gm
								Average weight =1.81gm	Average weight =3.34gm

There is a suction chamber in the receiver side of the loom which hold all yarn. It holds yarn by the help of air. As a result length of yarn in receiver side is varying.

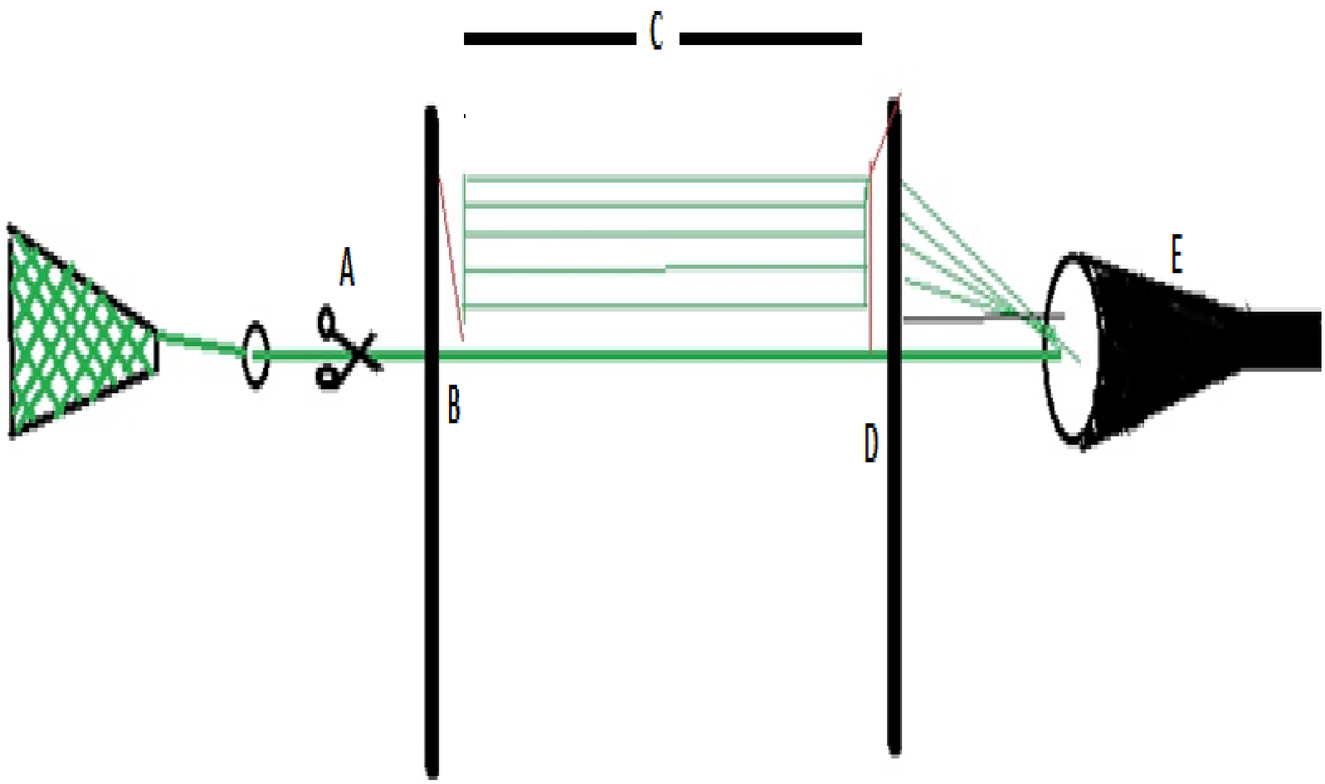


Fig: Weft yarn path diagram

Here,

A=Yarn cutter

B=Selvedge Cutter

C=Fabric Width

D=Selvedge Cutter

E=Suction Chamber

Table 2: Weft yarn length:

EPI	Warp Count	PPI	Weft count	Length of Giver Side	Length of Receiver side
130	40	70	40	4.50cm	11.20cm
120	40	100	40	4.20cm	6.50cm
120	40	90	40	4.20cm	10.00cm
110	50	80	50	4.00cm	9.00cm
90	50	70	50	4.30cm	8.00cm
				Total length=21.2cm	Total length=44.7cm
				Average length = 4.24cm	Average length = 8.94cm

Table 3: Wastage Percentage of Weft Yarn:

EPI	Warp Count	PPI	Weft Count	Wastage % Giver Side	Wastage % of Receiver Side	Wastage % of Both Sides
130	40	70	40	2.36	5.38	7.74
120	40	100	40	1.51	1.98	3.49
120	40	90	40	2.18	3.82	6.00
110	50	80	50	1.43	3.19	4.62
90	50	70	50	1.69	3.10	4.79
				Average wastage % =1.83	Average wastage % =3.49	Average wastage % =5.32

Table 4: Wastage % of warp yarn

EPI	Warp Count	PPI	Weft Count	Wastage % Giver Side	Wastage % of Receiver Side	Wastage % of Both Sides
130	40	70	40	0.46	0.43	0.89
120	40	100	40	0.37	0.28	0.65
120	40	90	40	0.72	0.68	1.40
90	50	70	50	0.71	0.48	1.19
110	50	80	50	0.33	0.31	0.64
				Average wastage % = 0.52	Average wastage% =0.45	Average wastage % = 0.97

Table 5: Wastage % of Fabric as Selvedge

EPI	Warp Count	PPI	Weft Count	Wastage % Giver Side	Wastage % of Receiver Side	Wastage % of Both Sides
130	40	70	40	1.13	2.19	3.32
120	40	100	40	0.898	1.07	1.97
120	40	90	40	1.60	2.62	4.22
90	50	70	50	1.19	1.75	2.94
110	50	80	50	0.78	1.49	2.27
				Average wastage % = 1.12	Average wastage% =1.82	Average wastage % =2.94

Sample With Construction

Sample With Construction

3.1 Calculation

3.1.1 Weight of weft yarn:

At first we calculate the weight of weft yarn of 5cm fabric

For Construction $\frac{130\times70}{40\times40}$

Weight of (5×5) cm weft yarn is 0.112gm

Now considering the full width of the fabric we can calculate the weight of the weft yarn of that fabric.

So , Weight of (100×160) cm weft yarn = $\frac{0.112\times100\times160}{5\times5}$ =71.68gm

For construction $\frac{120\times100}{40\times40}$

Weight of (5×5) cm weft yarn is 0.23gm

So , Weight of (100×160) cm weft yarn = $\frac{0.23\times100\times160}{5\times5}$ = 147.20gm

For construction $\frac{90\times70}{50\times50}$

Weight of (5×5) cm weft yarn is 0.12gm

So , Weight of (100×160) cm weft yarn = $\frac{0.12\times100\times160}{5\times5}$ = 76.80gm

For construction $\frac{\mathbf{110\times80}}{\mathbf{50\times50}}$

Weight of (5×5) cm weft yarn 0.14gm

So , Weight of (100×160) cm weft yarn = $\frac{0.14\times100\times160}{5\times5}$= 89.60gm

For construction $\frac{\mathbf{120\times90}}{\mathbf{40\times40}}$

Weight of (5×5) cm weft yarn 0.148gm

So, Weight of (100×160) cm weft yarn = $\frac{0.148\times100\times160}{5\times5}$ = 94.72gm

3.1.2 Wastage percentage of weft yarn

Now we can calculate the wastage percentage of weft yarn as selvedge of rapier loom. At first we have to calculate the total weight of the fabric then we can calculate the wastage percentage of weft yarn where we consider the whole width of the fabric. Here we determine the wastage percentage of weft yarn as individual construction of the fabric.

For construction $\frac{\mathbf{130\times70}}{\mathbf{40\times40}}$

Total weight of weft yarn = (71.68+4.18+1.84) =77.7gm

Wastage percentage of weft yarn = $\frac{4.18+1.84}{77.7}\times100$

=7.74%

For construction $\frac{\mathbf{120\times100}}{\mathbf{40\times40}}$

Total weight of weft yarn = (3.02+2.30+147.20) gm = 152.52gm

Wastage percentage of weft yarn = $\frac{3.02+2.30}{152.52}\times 100$

= 3.49%

For construction $\frac{\mathbf{90\times70}}{\mathbf{50\times50}}$

Total weight of weft yarn = (2.48+1.35+76) gm = 79.83gm

Wastage percentage of weft yarn = $\frac{2.48+1.35}{79.83}\times 100$

= 4.79%

For construction $\frac{\mathbf{90\times80}}{\mathbf{50\times50}}$

Total weight of weft yarn = (3.00+1.34+89.60) gm = 93.94gm

Wastage percentage of weft yarn = $\frac{3.00+1.34}{93.94}\times 100$

= 4.62%

For construction $\frac{\mathbf{120\times90}}{\mathbf{40\times40}}$

Total weight of weft yarn = (4.01+2.29+89.60) gm = 104.9gm

Wastage percentage of weft yarn = = $\frac{4.01+2.29}{104.9}\times 100$

= 6%

3.1.3 Weight of fabric:

At first we calculate the weight of 5cm fabric. The weight is taken by digital balance.

For construction $\frac{\mathbf{130\times70}}{\mathbf{40\times40}}$

Weight of (5×5) cm fabric 0.330gm

Now considering the full width of the fabric we can calculate the weight of the fabric.

Here, 100cm is the length of the fabric and 160cm is the width of the fabric.

Weight of (100×160) cm fabric= $\frac{0.330\times100\times160}{5\times5}$ =211.20gm

For construction $\frac{\mathbf{120\times90}}{\mathbf{40\times40}}$

Weight of (5×5) cm fabric 0.250gm

Weight of (100×160) cm fabric= $\frac{0.250\times100\times160}{5\times5}$ =162.56gm

For construction $\frac{\mathbf{120\times100}}{\mathbf{40\times40}}$

Weight of (5×5) cm fabric 0.500gm

Weight of (100×160) cm fabric= $\frac{0.500\times100\times160}{5\times5}$ =320gm

For construction $\frac{\mathbf{90\times70}}{\mathbf{50\times50}}$

Weight of (5×5) cm fabric 0.250gm

Weight of (100×160) cm fabric= $\frac{0.250\times100\times160}{5\times5}$ =160gm

For construction $\frac{\mathbf{110\times80}}{\mathbf{50\times50}}$

Weight of (5×5) cm fabric 0.350gm

Weight of (100×160) cm fabric= $\frac{0.350\times100\times160}{5\times5}$ =224gm

3.1.4 Wastage % of fabric selvedge

Now we will show the wastage percentage of fabric as selvedge. To determine the wastage percentage of fabric as selvedge at first we have to calculate the total weight of the fabric including the weight of both side (giver side + receiver side) selvedges than we can evaluate the wastage percentage of fabric as selvedge. Here we also calculate the wastage percentage of fabric as selvedge.

For construction $\frac{\mathbf{130\times70}}{\mathbf{40\times40}}$

Total weight of fabric = (211.20+2.47+4.79) =218.46gm

Wastage percentage of fabric = $\frac{2.47+4.79}{218.46}\times100$

=3.32%

For construction $\frac{\mathbf{120\times100}}{\mathbf{40\times40}}$

Total weight of fabric = (320+2.93+3.51) =326.44gm

Wastage percentage of fabric = $\frac{2.93+3.51}{326.44}\times100$

=1.97%

For construction $\frac{\mathbf{120\times90}}{\mathbf{40\times40}}$

Total weight of fabric = (162.56+2.71+4.45) =169.72gm

Wastage percentage of fabric = $\frac{2.71+4.45}{169.72}\times100$

= 4.22%

For construction $\frac{\mathbf{90\times70}}{\mathbf{50\times50}}$

Total weight of fabric = (160+1.95+2.89) =164.84gm

Wastage percentage of fabric = $\frac{1.95+2.89}{164.84}\times100$

= 2.94%

For construction $\frac{\mathbf{110\times80}}{\mathbf{50\times50}}$

Total weight of fabric = (224+1.79+3.42) =229.21gm

Wastage percentage of fabric = $\frac{1.79+3.42}{229.21}\times100$

= 2.27%

4. Discussion of Result

4.1 Wastage of weft yarn in the giver Side: It can be seen in table-2, that average length of weft yarn that wastes in the giver side is 4.24cm.This length varies to a small extent between 4.00cm- 4.50cm. When this length has been expressed in weight as wastage percentage considering whole width of the fabric then average wastage percentage is 1.83%.

4.2 Wastage of weft yarn in the receiver Side: It can be seen that in table-2, that average length of weft yarn that wastes in the receiver side is 8.94cm. This length varies a lot between 6.50cm-11.20cm. The reason for this variation is that in the receiver side weft yarn receives by air suction system and this air suction system receives more length and air suction speed machine to machine varies that is why length of weft yarn varies and wastage percentage is also more than receiver side. When this length has been expressed in weight as wastage percentage considering whole width of the fabric then average wastage percentage is 3.49%.

4.3 Effect of loom width on the selvedge waste %:

The mentioned waste in the giver side and receiving side is fixed on all width of rapier loom. Therefore if the width of the fabric increases the waste percentage will be decreased.

4.4 Waste of selvedge in the giver side: In the table-5 we can see the waste percentage of selvedge vary (0.78-1.60) % and average waste percentage of selvedge is 1.22%.

4.5 Waste of selvedge in the receiver side: In the table-5 we can see that the waste% of selvedge vary (1.07-2.19) % and average waste% of selvedge is 1.87%.

When we compare the waste % of selvedge both sides we can see that waste% of selvedge in receiver side is higher than giver side.

5. Conclusion

Weaving is a rising sector in Bangladesh. Now a day it is rising day by day. By this project we get idea about selvedge wastage percentage of rapier loom. We can also find out warp and weft yarn wastage percentage in selvedge. There is a relation between fabric width and wastage percentage. If width of fabric is more then yarn wastage percentage will decrease.