University of Management and Technology
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Project Title: "THE EFFICIENCY IMPROVEMENT OF AIR JET LOOM BY CONTROLLING THE WARP AND WEFT YARN BREAKAGE RATE AND MENDING TIME."

Submitted To:
Textile Committee

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Table of Contents

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INTRODUCTION:

Generally, loom shed efficiency is calculated for each shift on the basis of production per shift. In loom shed, the production is measured in terms of either pieces made, meters woven or picks inserted. This method of calculation only gives an idea of the efficiency achieved. It does not indicate the performance index of a mill in relation to an expected performance. In order to know exactly what a mill can achieve, it is necessary to have standards for efficiency losses due to various causes and a method of estimating the expected efficiency under a given set of circumstances.

The causes for efficiency losses in looms can be divided into two broad categories as

1. Frequency dependent
2. Miscellaneous

Warp and weft breaks, beam gaiting belongs to first category, where as healds broken, doffing, loom repairs, weave away, etc. are termed as miscellaneous causes. Interference is, yet, another cause of stoppage. Its extent depends upon the number of looms assigned to a weaver and frequency of warp and weft breaks. Miscellaneous causes are those occurring at random. Further, such causes cannot be ascribed any definite frequency. Whenever an operator is in charge of more than one machine, there is loss due to interference.

The efficiency losses arising from loom stoppages in looms are generally of two types such as

- Those requiring the weaver's attention
- Those not requiring weaver's attention.

The first category includes causes like warp breaks, weft breaks and interference. Losses due to warp and weft breaks are in proportion to the frequencies. The interference loss is depend upon the loom assignment to weavers, frequency of warp and weft breaks, average distance required to be walked per stoppage and other miscellaneous jobs performed by a weaver. Losses due to stoppages not requiring weaver's attention arise from loom repairs, cleaning and oiling, beam gaiting and others. Efficiency loss on account of beam change varies according to its frequency, while other losses depend upon the organizational setup, frequency of breakdowns, types of looms, sorts woven and level of maintenance.

As stated earlier, efficiency losses due to warp and weft breaks and beam gaiting of frequency dependent and hence they vary from mill to mill and also sort to sort within the same mill. On the other hand, efficiency losses, ascribable to loom repairs, cleaning and oiling, doffing and other stoppages are observed to be of more or less the same order between mills. For all practical purposes, it would be quite in order to provide an overall allowance for the losses arising from these causes.

The weaving efficiency is related to generally number of warp and weft breakage during the weaving process. However, total warp and weft breakage (stoppage) almost constitutes nearly 85-95 % of total machine stoppage depending on textile mill. An excessive machine stoppage rate not only reduces the loom (weaving machine) efficiency and therefore the productivity, but it also adversely affects the quality of fabric.

INTRODUCTION TO PROJECT

TOPIC DESCRIPTION:

The aim of this project is to study the complete factors from the supply of the raw material to the complete fabric formation that may affect the efficiency of the weaving shed and find means and proper methodology to improve the efficiency of the shed by overcoming these factors. Although many advances work in this field have been done already. Our methodology includes reviewing papers in which this research already been done and then assessing our needs to fulfill the objective.

PROJECT OBJECTIVES:

In this project we analysis the effects of parameters affecting the machine efficiency. These parameters are mainly, initial situation of the machines, the number of machines assigned to one operator, the machine stoppage rate, and the operator's behavior.

"**Decreases the stoppage, Increases the efficiency"**

Loom efficiency depends upon four main factors

- **Material**
- **Machine**
- **Human Resource**
- **Atmospheric conditions.**

Material:

In this broad category following factors exist

a) Yarn Strength
b) Yarn Hairiness
c) Yarn Twist
d) Yarn Elongation
e) Yarn conditioning

F) Yarn imperfections

Machine:

In this broad category following factors exist

a) Frame height
b) Easing timing
c) Crossing timing
d) Easing amount
e) Back rest
f) Dropper box
g) Front back
h) Tension of warp
i) Reed space
j) Speed (RPM)
k) Nozzle angle
l) Nozzle Pressure
m) Nozzle distance

Human Resource:

In this broad category following factors exist

a) Objectives
b) Formal authority
c) Attitudes
d) Perception
e) Group norms
f) Informal interactions
g) Interpersonal intergroup conflicts
h) Technical skill
i) Devotion to work

Atmospheric Conditions:

a) Shed Humidity
b) Temperature Conditions

Maximizing loom efficiency:

Thus to maximize loom efficiency;

- The stoppage rate should be low
- The weaver should be trained so that he takes the minimum possible time for clearing a stop
- The operative efficiency should not fall below the optimum level
- Loom allocation should be optimum

In this paper, Firstly, we show the estimation of the shed efficiency in case of multi machine assignment considering:

- Number of machine assigned to per operator,
- Average machine stoppages frequency,
- Stoppage mending time, and
- Operator walking time parameters.

Secondly, we analysis the affects of these parameters given above and initial situation of the machines on the shed efficiency by using analytical methods, tables and graphs. And finally we give suggestion to minimize the affect and increase the efficiency.

Scope of This Project:

- In Pakistan 932,669 (Qty.in '000' sq.Mtrs.) cloth is produced in the year 2006-07 with the growth rate of only 0.86% as per the APTMA report which is not quite enough to meet the domestic demand of the market.
- The decrease in the growth rate in the production of the cloth in Pakistan is due to the factors, including the energy crises of electricity and Gas due to which many textiles units been closed or shifted from Pakistan to the Bangladesh.
- Then the machines are very expensive, it involves a lots of capital investment to modernized the machines or get more automation in the mill in order to get more production.
- Now days the customer wants the better quality, quick response, and high quantity of the product. So considering all the above factors the efficiency is the very big and important for the textiles and weaving too.

- A weaving loom supposes to give a production about 90-95%. The speed of the machine is not as important as the efficiency is because a loom with low speed but having good efficiency is more economical than high speed.

HISTORY OF WEAVING:

The weaving is described as interlacing of vertical yarn (warp) and horizontal yarn (weft or filling yarn). Depending on the type of weave and fabric structure, warp yarn sheet is divided and lifted. An opening is created through which weft yarn is inserted with the help of heald frames. Then the other portion of the warp sheet is lifted and weft yarn is passed again. This gives the binding by which the cloth is being produced. Weft yarn is carried across in a bobbin held in a shuttle. This is the basic weaving process. Figure illustrates a weaving process on a weaving machine.

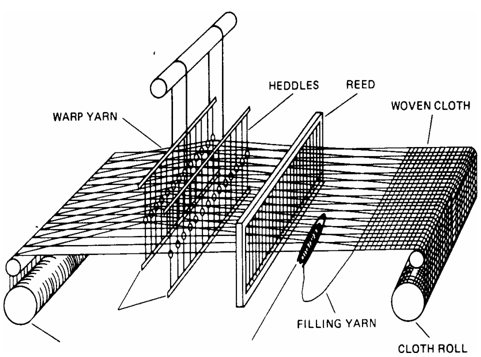
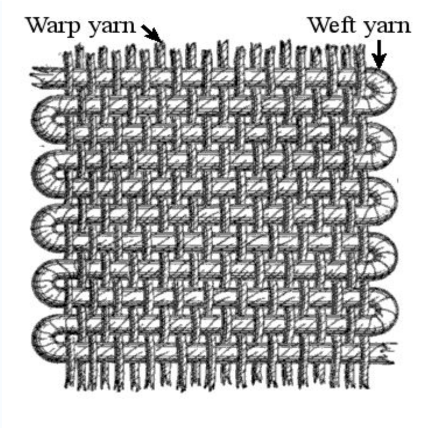


Figure: Basic structure of weaving

Figure: A view from a weaving room machine

The warp threads run lengthways of the piece of cloth, and the weft runs across from side to side. The origin and development of woven cloth is closely tied to the history of mankind. Thousands of years ago people developed the skills necessary to turn the raw materials into fabric for clothing and shelter. Weaving, the interlacing together of threads and yarns to form cloth has developed over thousands of years of discovery and experimentation. Coarse fabric, made from grasses and leaves, was the first step toward the development of the textiles we use today.



Then with the development of the cotton yarn spinning, the weaving became more important and advanced hand looms were made to make the fabric with high speed then manual cloth making.

With the passage of time and development the weaving technology get more advanced and updated with developments of the mechanical engine and electrical accessories were also installed in the loom to get the high production and the maximum efficiency to meet the increasing demand of the woven fabric.

Now a days weaving is the one of the major component in the conventional textiles value addition chain in Pakistan. Today in Pakistan the exports of woven fabrics and other woven made ups comprise a major portion of textile exports from Pakistan. Out of total world fabric trade of $18 billion, Pakistan's share was about $1.906*4* billion in the year 2006-2007, which highlights the key position of Pakistan in the world textile trade. Other than direct fabric exports, Pakistan has also emerged as a leading exporter of woven made-ups with a value of more than $1.922*4* billion in the year 2006-2007. There are around 124 large units that undertake weaving and 425 small units. There are around 20600 power looms in operation in the industry (SMEDA FACTS).

With the reduction of weaving activity in developed countries for various reasons, including their high labor costs and the environmental pollution standards, it is essential for our weaving sector not only to continue to meet the domestic demand but to also gear to itself up to meet the demand from quality conscious export markets. However, to be competitive our quality and pricing has to be acceptable to the export buyer, because China, India, Bangladesh are also excelling in the field of weaving and producing a very high quality fabric with extensive production, especially China is producing fabric at very high production rate. So it becomes necessary for us to produce the quality fabric and try to enhance our efficiency so that we may withstand in the highly competitive environment.

Effect of Raw material and Prepatory Processes on Loom Efficiency:

Yarn Quality Parameters: The quality of the yarn has an obvious effect on loom (weaving machine) stoppages and so does the type of yarn. A week, fuzzy yarn will break very often, whereas a strong smooth uniform yarn will resist the weaving conditions better Lord. Yarn quality including the USTER tester value should be around the 25% for the good quality of yarn, U% value is also taken into account. Tension on the warp on a high speed shuttleless weaving machine is higher than that on a conventional loom. On Air jet looms, interference by air pressure nozzles, at the initial points of entry and during the intermediate feed of auxiliary nozzles at the point of shed exit, can cause bending of the top yarn sheet around the head known as shading creates excessive warp strain on the warp yarn. Weft tension on Air Jet weaving machine, is equally high, where tucked in selvedge is formed. Consistency of single end strength, CV of count and elongation is essential. Quality of yarn should be at least within 25 per cent Uster which means the quality is among the best 25 per cent of the mills in the world. Normally shuttless weaving machine works three to four times faster and if the quality of warp remains the same, warp breaks will increase three to four times resulting in low production. Yarn should be more even and the certain parameters of yarn are to be critically reviewed. They are CV of count, single thread strength, CV of single thread strength, imperfections per 1,000 metres such as thick places, thin places, and neps. Hairy yarn will not be suitable in air jet weaving as it mill misdirect the weft insertion.

Warping: At warping stage the goal should be to avoid missing ends. Number of thread breakages should not exceed seven per 10 million metres. This can be achieved by ensuring a top quality yarn package and by the following warping parameters as below:

- Precise creel alignment
- Reliable stop motion on creel and on warping drum, so that broken ends are detected for knotting easily.

- Minimum shakes of warping beams.
- Uniform selvedge with good flanges.
- Yarns should be preferably warped on spindle driven machines or positive drive to avoid thermal damage due to abrasion. Warping machines such as Benninger or Hacoba are preferable.

With drum driven warpers or negative driven warping machine, such as the BC Warper, the following precautionary measures are to be taken:

- Frictional drum should be kept in a polished state.
- Brake should be very efficient
- Aluminum cast flanges should be used to get faultless selvedges.
- Breakages rate should not exceed 0.3 - 0.5 breaks per 1000 m/500 ends.
- For wider width looms, wider warping machines are preferred.

SIZING: Sizing could also have the affect on the weaving shed efficiency. The process consists of laying warp yarn parallel and sizing the yarn with a mixture to strengthen it to withstand the tension applied during the weaving on the loom. Warp yarn is withdrawn in sheet from warp beams which are placed at the back of the sizing machine. The yarn is then passed through size box. Size solution is applied by immersion. After removing surplus solution that occurs at this state, the yarn is dried and arranged on a loom beam. The main purpose of the sizing is:

- Providing strength to the warp yarn
- Reduce hairiness
- Reduce yarn breakages during weaving on loom
- Ultimately increase in the shed efficiency.

Double size beams are recommended to avoid over crowding. An optimum number of ends in the size box is given by optimum ends = 0.5 x (width of nip of size box) diameter of yarn.

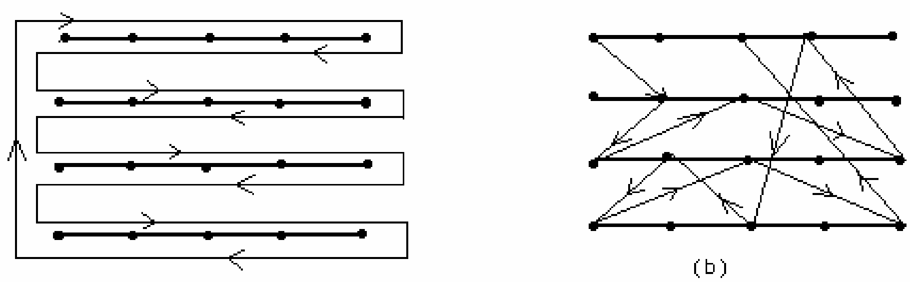
DRAWING-IN: Drawing-in should be proper in order to get the good weaving efficiency. No cross ends should be formed, cross end could cause the yarn breakages during the weaving.

KNOTTING: Care should be required during the knotting process, dressing if the yarn should be proper on the loom.

INSIDE BEAM TRANSPORT SYSTEM: There are many as sized beam, un-sized beam in a weaving unit. The inside beam transport system should be accurate; the machine and department layout of the weaving mill must support the easy transport system of the beams around the unit to get the increase in the efficiency of the weaving.

OPEARTOR: Operator must be skilled, proper training must be provided time to time to keep the labor up to date with the modern tools of increasing the efficiency as well as productivity.

NUMBER OF LOOM ASSIGN TO A WEAVE: Generally, there are two different systems for operator service to run machines in the textile industry. One of these systems is periodical (systematical) operator service as shown Figure 1 (a). The other is random operator service system as shown Figure 1(b). The periodical service system generally can be unidirectional as shown Figure 1(a), which can be applied in the weaving and spinning industry. The random operator system is applied mostly in the weaving industry. Consequently, while in the weaving mill are applied both the periodical and random operator service system.



(a) (b)

ENVIORNMENTAL FACTORS: The environmental conditions in the shed also affect the efficiency of the weaving like relative humidity and temperature. On the automatic loom the stoppages could occur drastically if the humidity is not properly controlled. Temperature is also an important factor with regards to the labor working conditions.

MACHINE EFFICIENCY: To determine and analysis the weaving machine efficiency in case of multi machine assignment we need basic four parameters.

- The number of machine assigned to per operator (weaver).
- Average of the machine stoppages frequency.
- The stoppage mending time.
- The operator walking time.

Machine stoppages frequency or rate, which is highly affects machine efficiency, distributes exponentially as mentioned previously in our model. In the textile weaving industry, for example, the mean of machine stoppage frequency λ is generally affected by quality and material type of yarn, yarn density, fabric structure, machine type, machine speed, machine setting, and air conditioning. In our study different λ values have been considered for analysis of machine efficiency.

We describe and compute machine efficiency according to the figure and formulas as shown bellow:

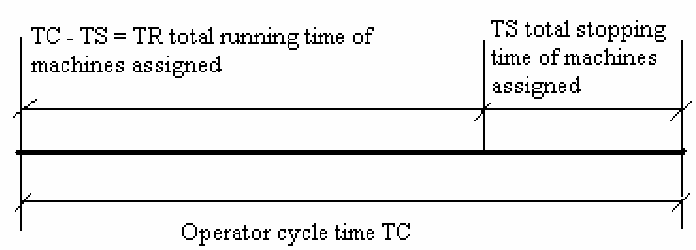


Figure 2. Machine running time, stopping time and weaver's cycle

$$\text{Machine Efficiency (E)} = \frac{\text{Actual production}}{\text{Theoretical production}} \times 100 \text{ per cent.................(1)}$$

Machine efficiency is also described at the same time as below, which both efficiency is equal to each other.

$$\text{Machine Efficiency}(E) = \frac{\text{Running time of machines }(TC - TS)}{\text{Operator cycle time }(TC)} \text{..................(2)}$$

EXAMPLE:

In a work-measurement study in automatic weaving, the following information was obtained:

Item	**Unit**
1) Loom speed	**180 picks/min**
2) Repair of warp breaks per 100,000 picks	**20 occasions**
3) Repair of weft breaks per 100,000 picks	**15 occasions**
4) Other repairs with loom stopped per 100,000 picks	**6 occasions**

5) Average warp-repair time	**0.85 min**
6) Average weft-repair time	**0.30 min**
7) Average time for other repairs	**0.12 min**

How to calculate the loom efficiency?

First, we want to find out the running time per 100,000 picks

Running time for 100,000 picks =100,000/loom speed

=100,000/180 = 555.5min

Stopped time for warp breaks = 20 x 0.85 =17 min

Stopped time for weft breaks = 15 x 0.30 = 4.5 min

Stopped time for other repairs = 6 x 0.12 = 0.72 min

Total time for machine stoppage = 17 + 4.5 + 0.72 = 22.22min

Total time to weave 100,000 picks =555.5 + 22.22 = 577.72 min

Hence, the loom efficiency:

$$Loom\ Efficiency = \frac{Actual\ running\ time}{Runningtime + stop\ time} \times 100$$

$$= \frac{555.5 \times 100}{577.72}$$

= **96.16%**

(This efficiency value does not take into account time lost for such matters as major mechanical breakdown, waiting for new warp and gaiting new warp.)