# STUDY OF SOME FACTORS AFFECTING WEFT TENSION DURING UNWINDING FROM SHUTTLE

By

Shahin, A.*

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خلاصة ـ البحث يدرس تأثير كل من سرعة سحب الخيط من المكوك ونمرة الخيط وكذلك أبعاد مأسورة اللحمة على التغيير فى قيمة الشد لخيط اللحمه وتم ايضاح سلوك الشد فى خيط اللحمه تحت تأثير هذه العوامل بيانيا . بالاضافة الى ذلك تم استخدام طريقة تصميم التجارب لايضاح أهم العوامل التى تؤثر على التغيير فى قيمة الشد .

## ABSTRACT

In this work the tension in weft yarns for shuttle looms was measured by withdrawing the yarn from pirn in the shuttle (stationary shuttle). The value of weft tension was measured under the effect of the following parameters :

- Conicity angle of winds for pirn.
- Withdrawal speed of weft yarn.
- Linear density of weft yarn.

The level of weft tension from the beginning of unwinding up to the end can be reduced by varying the conicity angle of winds and weft withdrawing speed.

It was found that small conicity angle of winds is not suitable since the tension level is high compared with large conicity angle of windes, also it is not suitable to increase the speed of withdrawal above 700 m/min.

## INTRODUCTION

The weft insertion method for shuttle looms is by withdrawing the weft thread from a prin in the shuttle during its flying. Due to the unwinding of weft thread from pirn, a weft tension will result, the value of weft tension and its variation is affected by the following parameters /1/, /5/ :

- Unwinding speed.
- Length of pirn.
- Conicity angle of winds, for pirn.
- Linear density of yarn.

The variation in weft tension would be reflected on variations in fabric properties and quality, from these properties are crimp percentage, fabric structure, fabric properties and fabric finishing.

Due to the effect of the variation in weft tension on the above properties, the effect of the parameters which has influence on the value of weft tension should be studied. Krause /1/ has stuided the effect of withdrawing speed for weft yarn from shuttle on weft tension, and found that, the level of weft tension increases with increasing the unwinding speed from shuttle.

* Lecturer at the Textile Engineering Dept., Faculty of Eng., El-Mansoura University.

With respect to the effect of conicity angle of winds on the behavior of yarn tension walz /5/ found that, the level of yarn tension during unwinding from cops increases with the increase of the angle of conicity for winds. From experiments of /1/,/2/ and/5/,it was found that, the value of yarn tension increases by unwinding the yarn from top to base of pirn or cops.

In this experimental work the effect of pirn dimension , yarn speed and yarn count on the value of weft tension was carried out.

## EXPERIMENTAL

Apparatus Used for Weft Tension Measurment (From Pirn) :

The schematic drawing of the apparatus used is shown in Fig. (1) the arrangement of the apparatus is as follows

- Weft drawing unit (2), which draws the weft yarn from pirn in the shuttle with a speed ranging between 500 to 900 m/min.
- Measuring, amplifying and recording units (4, 5, 6 and 7).
- Shuttle with pirn (1) supported horizontally and the weft yarn is drawn overhead from the pirn through guides in the shuttle.

The apparatus can record the variations in form of electric signal (which calibrated in force units cN). By withdrawing the weft yarn from the shuttle through the measuring units.

Evaluation of The Results :

A chart recorder was used to record the behavior of weft tension during yarn unwinding from the pirn from top to base. The mean value of weft tension is recorded from HP-data processor at three positions along the pirn (top, middle and base).

1- shuttle with pirn
2- motor
3- yarn guides
4- measuring head
5- amplifier
6- chart recorder
7- HP-calculator

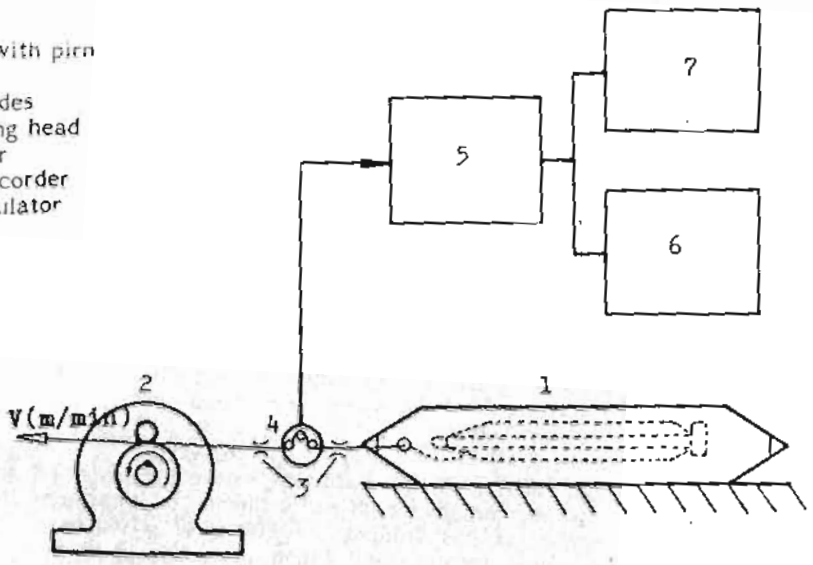


Fig. (1) Arrangement of measuring apparatus

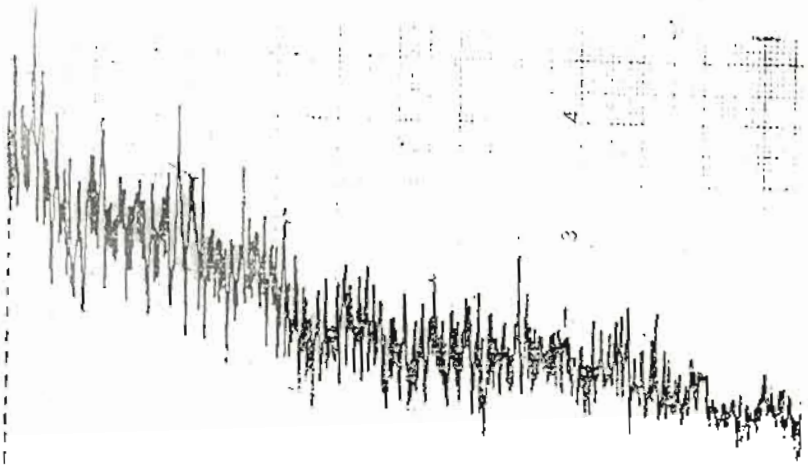

Fig.(2a)Typical traces of weft tension along pirn length

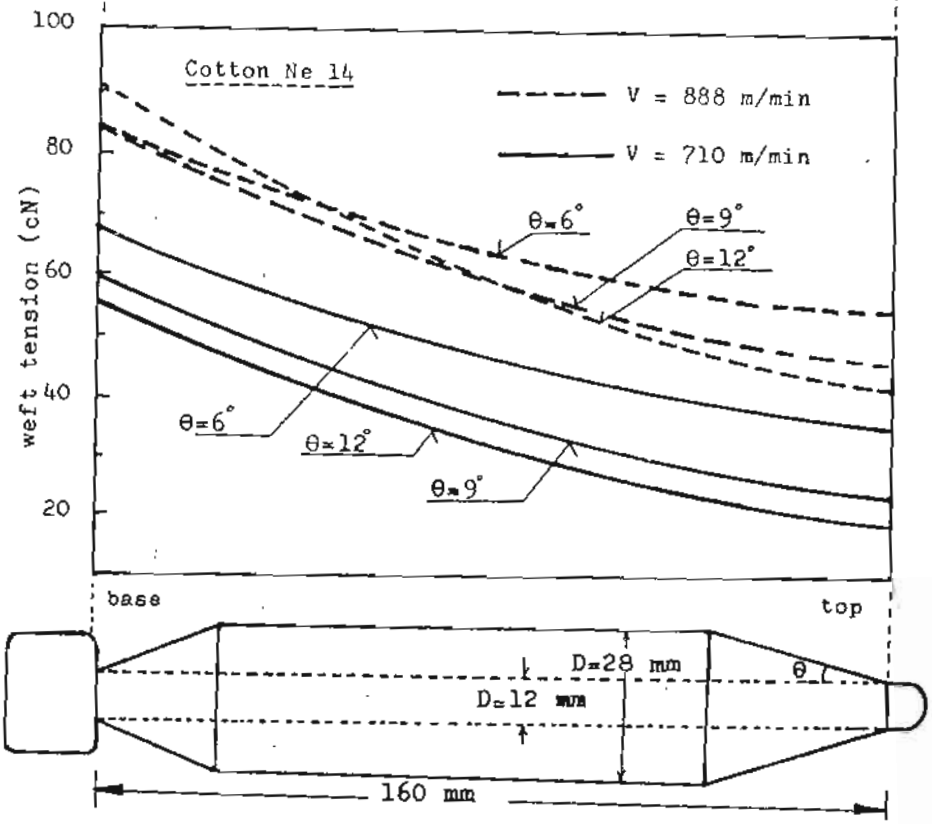


Fig.(2) Weft tension along pirn length(Ne14,V=710and888 m/min)

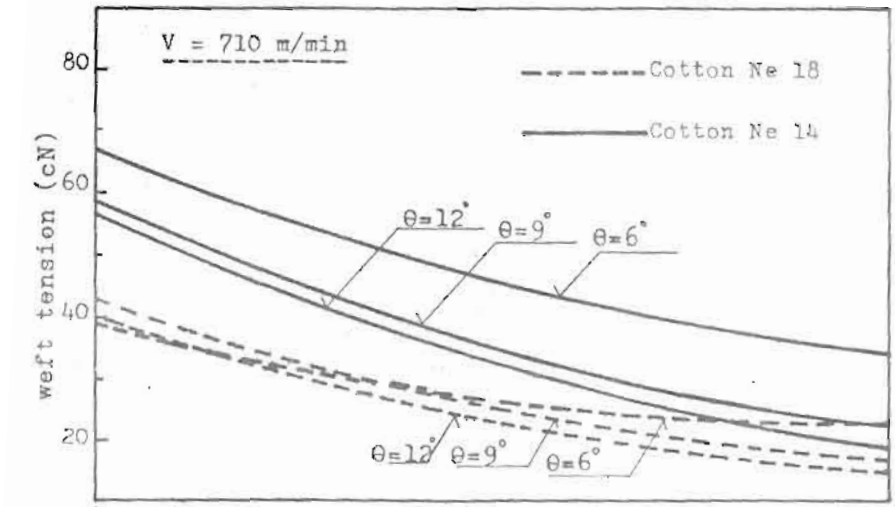


Fig.(3) Weft tension along pirn length
(Ne 14 and 18 , V=710 m/min)

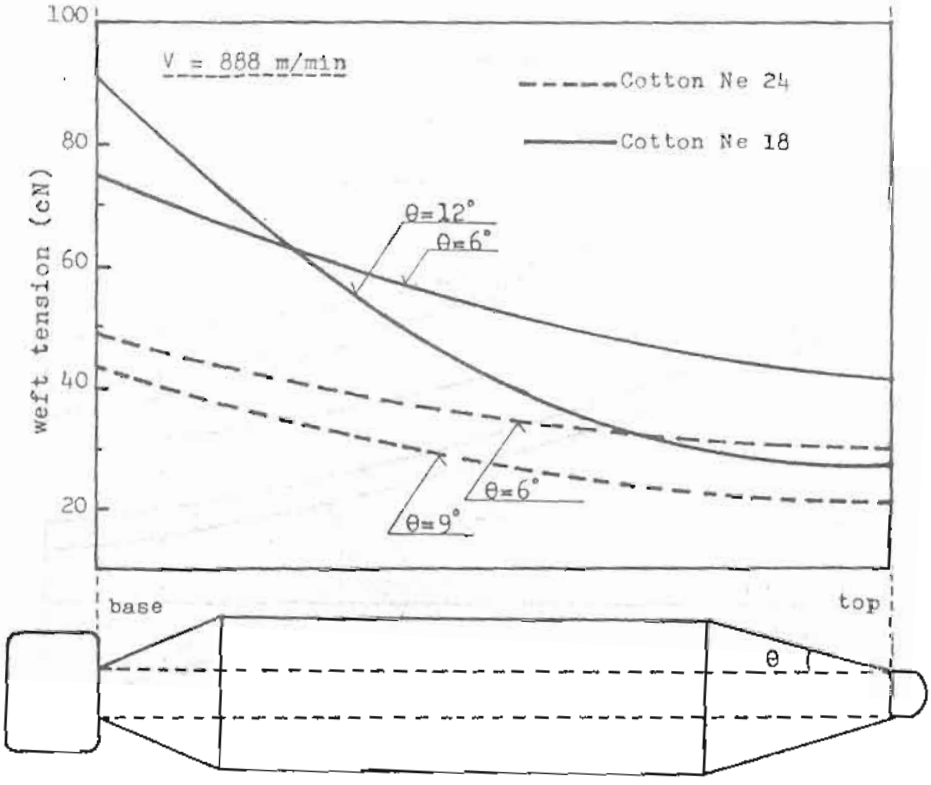


Fig.(4 ) Weft tension along pirn length
(Ne 18 and 24, V=888 m/min)

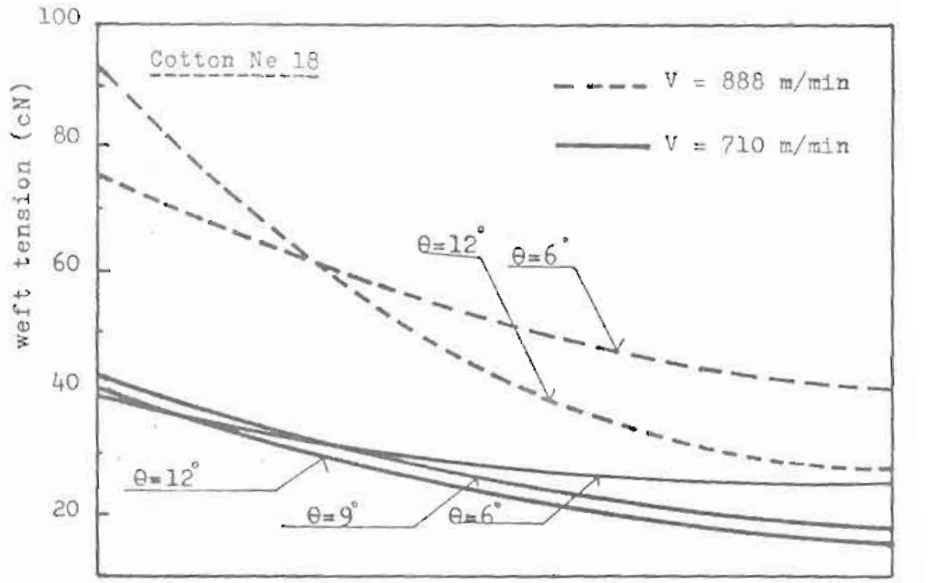


Fig.(5) Weft tension along pirn length
(Nel8, V= 710 and 888 m/min)

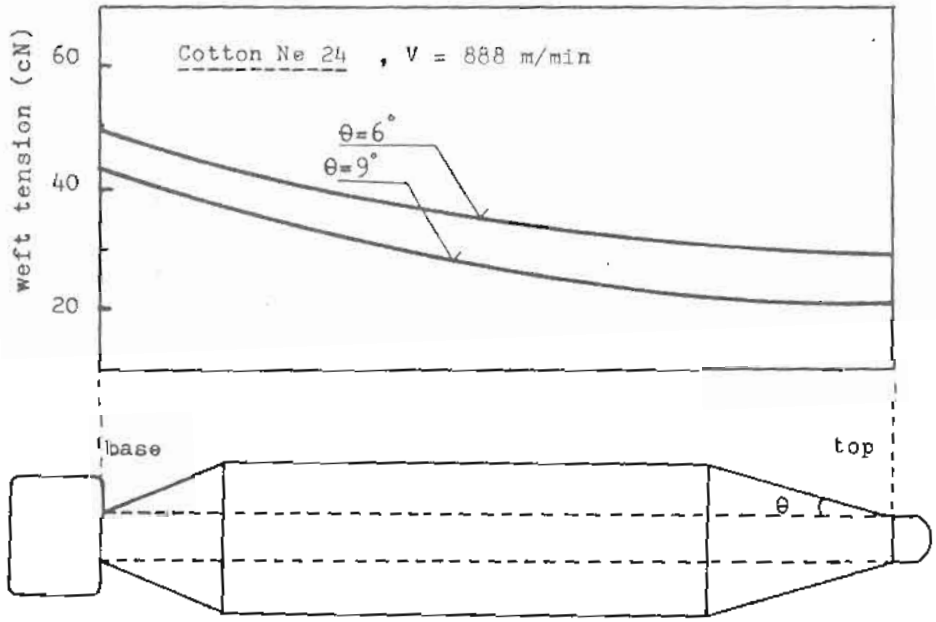


Fig.(6) Weft tension along pirn length
(Ne 24, V= 888 m/min)

## RESULTS AND DISCUSSION

As shown in Figs. (2, 3, 4, 5 and 6) the behavior of yarn tension was illustrated along weft pirn length. In general the level of weft tension increases with increasing yarn withdrawal speed and linear density of yarn, but the level of weft tension decreases with increasing the angle of conicity for winds.

### Effect of conicity angle of winds on weft tension (Figs. 2, 3, 4, 5, and 6)

For all weft withdrawing speeds and all weft counts the level of weft tension from beginning of the unwinding up to the end is affected by the conicity angle of winds, the tension level increases with decreasing the conicity angle of winds. This is attributed to effect of balloon dimensions, where in case of small angle of conicity the distance between unwinding point of weft yarn and yarn guide is larger than for large angle of conicity. For a certain yarn material and yarn count the conicity angle of winds should not exceed certain limits, because by withdrawing the yarn from a pirn with large angle of conicity, the yarn sloughs-off and leeds to a reduction in weaving efficiency.

### Effect of the withdrawing speed on weft tension (Figs. 2 and 5)

The level of weft tension increases with increasing the weft withdrawing speed, because the angular velocity of balloon which represents the main parameter in the centrifugal force, is a function of the weft withdrawing speed /6/.

For example (Fig. 5), for angle of conicity $\Theta = 12°$ when an increase in the withdrawal speed by 25% (from 710 to 888 m/min) takes place percentage difference in weft tension between top and base of the pirn increases by 140% . This is undesirable in weaving process because this affects fabric quality.

### Effect of weft linear density on weft tension (Figs.3 and 4)

The level of weft tension increases with increasing the linear density of weft yarn, because the value of weft tension increases with increasing the linear density of weft yarn.

### Statistical analysis

By using the factorial design method ($2^3$) the main parameters which affect weft tension are shown in Figs. (7,8 and 9). The b-values were calculated and plotted after ranking on the half-normal charts, by using the following parameters:

$y_1$ = weft tension at the top of pirn

$y_2$ = weft tension at the base of pirn

$y_3$ = difference in weft tension between top and base of pirn

$x_1$ = yarn speed

$x_2$ = linear density of yarn

$x_3$ = conicity angle of winds

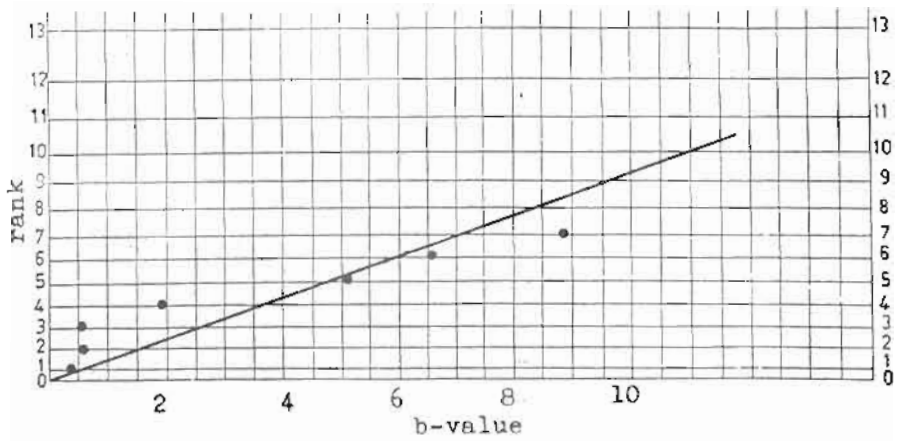


Fig.(7) b-values at the top of pirn

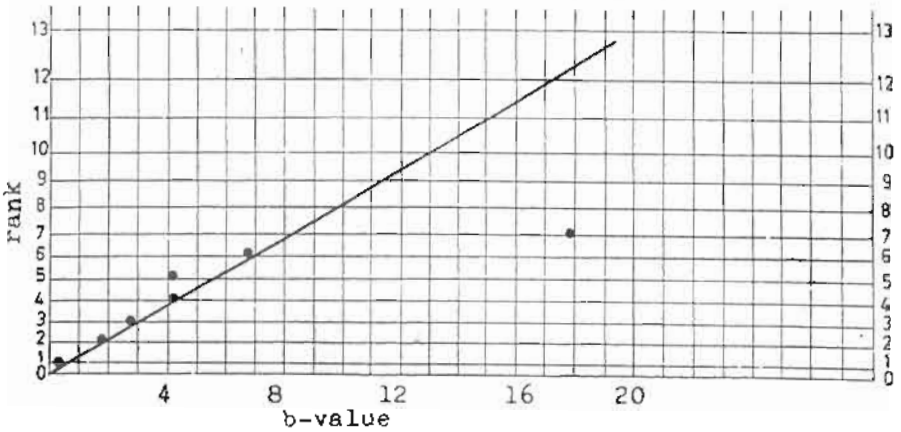


Fig.(8) b-values at the base of pirn

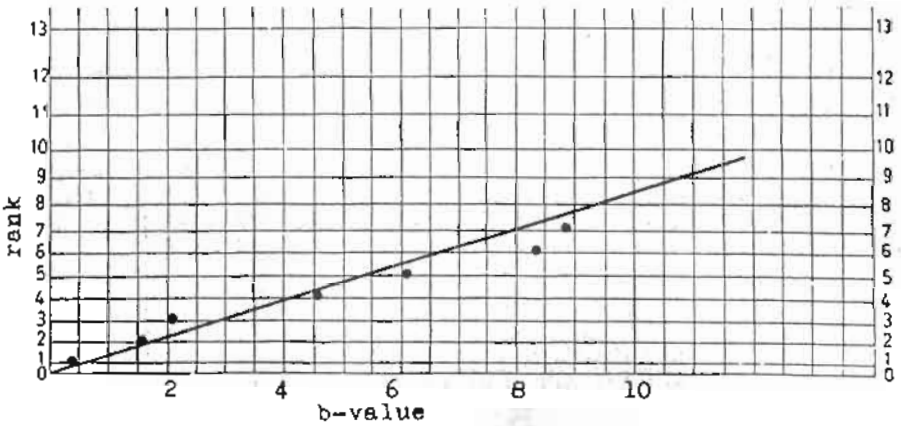


Fig.(9) b-values for the difference between top and base of pirn

| $y_1$ | $y_2$ | $y_3$ | $x_1$ | $x_2$ | $x_3$ | $x_{12}$ | $x_{13}$ | $x_{23}$ | $x_{123}$ |
|---|---|---|---|---|---|---|---|---|---|
| 25 | 39 | 14 | - | - | - | + | + | + | + |
| 41 | 75 | 34 | + | - | - | - | - | + | + |
| 34 | 67 | 33 | - | + | - | - | + | - | + |
| 55 | 85 | 30 | + | + | - | + | - | - | - |
| 15 | 40 | 25 | - | - | + | + | - | - | + |
| 27 | 92 | 65 | + | - | + | - | + | - | - |
| 19 | 56 | 37 | - | + | + | - | - | + | - |
| 41 | 92 | 51 | + | + | + | + | + | + | + |

| b- values | $b_1$ | $b_2$ | $b_3$ | $b_4$ | $b_5$ | $b_6$ | $b_7$ |
|---|---|---|---|---|---|---|---|
| b- values for $y_1$ | 8,875 | 5,125 | -6,625 | 1,875 | -0,375 | -0,625 | 0,625 |
| b- values for $y_2$ | 17,75 | 6,75 | 1,75 | -4,25 | 4,25 | -2,75 | 0,25 |
| b- values for $y_3$ | 8,87 | 1,625 | 8,37 | -6,125 | 4,62 | -2,125 | -0,375 |

As shown in Figs. (7 and 8) the main parameter which affects the value of yarn tension is yarn withdrawing speed which has a high effect at the base of the pirn. Fig.(9) shows the effect of these parameters on the difference in yarn tension between top and base of pirn. The angle of conicity for winds is considered one of the main parameters which affect the difference in yarn tension.

## CONCLUSION

In the range of experiment, the most suitable conicity angle was found to be ( $\Theta$ = 12°).

Pirn dimensions must be precisely chosen because any variations in pirn characteristics will affect both fabric quality and loom efficiency.

The weft withdrawal speed should be optimised in such a manner that both loom production and weft tension are not affected.

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