Effects of Passive Shed Unbalancing on Weaving Resistance

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Abstract

Weaving of high sett fabrics is difficult due to high Weaving Resistance encountered. Various passive methods have been used in the past, however, little information is available on what can be achieved. In this paper an account is given of the effects of passive shed unbalancing on weaving resistance or Beat-Up Force (BUF) on a narrow fabric loom. The narrow loom was fitted with constructed BUF and warp tension measuring devices. The fabric sett, shed geometry and timing were varied in this experiment. Experimental results show that the effect of dividing the total warp tension unequally between two sheets, during beat-up by raising the position of an extra-roller at the back of the loom is to reduce substantially the pressure between the warp and weft threads. Thus, the inter-yarn friction forces brought about a reduction in WR. A reduction of between 15-52 % in BUF was achieved over the narrow range used depending on the degree of shed unbalance and other loom settings. This enables or facilitates weaving of high weft sett fabrics close to or exceeding construction limits as given by setting theories.

Keywords: Weaving Resistance, Beat-Up force, warp, tension, fabric sett, pickspacing.

Introduction

It is well known that a number of physical and mechanical properties (such as cover, permeability, strength, etc) of woven fabrics depend on the closeness of the threads. In order to meet certain end-use requirements, fabrics of high sett (close pickspacing) are sometimes necessary. The dependence of pickspacing on the position of the cloth fell on a power loom has been established by Greenwood *et. al.*[1]. They explained how the displacement of the cloth fell (the last pick incorporated into the fabric) by the reed produces the reaction against which Beat-Up force (BUF) can be developed to push the new pick into the cloth against the weaving resistance (WR) offered by the interlaced warp threads. It has been established that WR will increase with the closeness and thickness of the threads, under given weaving conditions [3,4].

Weaving of high sett fabrics is difficult due to high WR encountered. The increased WR causes the fabric tension to fall to zero; any further increase in BUF can only arise from increase in warp tension. This will result in bumping, end-breakages, and thus overall loss in loom efficiency. For this reason, reduction of WR has always been the concern of those weaving closely sett fabrics. It is therefore essential that when weaving high sett fabrics, the loom settings should be such as to minimize the WR and hence BUF.

In practice, various passive methods of unbalancing the shed have been used in the past. A passive system is one in which the shed geometry is permanently changed e.g., by adjusting cloth fell height, full-width temple, raising the position of the back rail or extra roller [3]. The method of using cloth fell height and full-width temple are not popular because they may interfere with shuttle flight and if there is a shuttle 'trap' may prove disastrous. Thus, raising the position of the back rail has been used extensively in the industry. However, there is little information available on what can be achieved, to what extent and how this could be achieved by this method. Therefore, the aim of this research is to investigate the effects of passive shed unbalancing on WR on a narrow fabric loom, and the way in which the shed timing affects the interaction.

Materials and Methods

A narrow fabric loom Texnovo model UX 2-35 was used for this work. The traditional BUF measuring system using reed strain gauge developed on shuttle looms was adopted on this loom [5].

Warp tension was set as low as possible to obtain the required maximum setts of 10 and 12 picks per cm across a 'common' warp. The warp and weft yarn is a blend of cotton-vincel of 59 tex. These setts gave sufficiently high WR to enable significant changes in BUF to be obtained when the loom settings are varied.

Four positions (0, 20, 24, 28) of extra-roller were used for varying the degree of shed unbalance with zero (0) position being the balanced shed. All other positions are above zero to unbalance the shed. The extra-roller was supported on the piston of a hydraulic cylinder placed directly beneath the fully open bottom warp sheet. Three different shed timings were arranged, with shed crossing 0°; 40°; and 75° of crank angle before beat-up to be referred to as late, medium and early shed timing, respectively for the two fabric setts.

The BUF and dynamic warp tension for the two warp sheets were recorded using Wetzel type gauge [3].

Results

The comprehensive results of the experiments carried out in this work are given in Tables 1 – 3.

Discussion

Beat-Up Force (BUF)

Figs. 1 and 2 is a plot of BUF and WR against the position of the extra-roller at different shed timings for 10 and 12 picks per cm, showing that varying the roller positions and shed timings bring about large changes in BUF for a given fabric. The considerable changes in BUF or WR between weaving with a balanced shed and when the shed is set unbalanced is because the inter-yarn friction forces between the warp and weft is reduced and hence reducing the WR It is obvious that the effect is greater when the shed is timed to cross a little before beat-up, especially, at 75° before beat-up early timing.

There is only a little reduction when beat-up takes place on a closed shed (0°) due to late timing because the warp sheets follow the same path and are of nearly equal tensions. That it has any effect could be due to the fact that the zero position of the extra-roller gave a ratio not of 1.0 but of 0.86; and probably due to the fact that a closed shed is not closed throughout the beat-up period. It could also be seen that BUF increases rapidly with decreasing pickspacing but that a considerable reduction in BUF can be achieved at each pickspacing except that the extent to which this is obtained may differ (Tables I-II).

The loom was initially set for worst weaving conditions i.e., a balanced shed and late timing to obtain the maximum required sett of 12 picks per cm; it was possible to increase the weft density to 15 picks per cm when the shed was set unbalanced and early shed timing and obtain reductions in BUF as shown in Table III.

Dynamic Warp Tension Ratio

As expected, raising the extra-roller to unbalanced the shed put greater tension on the bottom sheet than the top sheet; so that during weaving there will be two peaks with different magnitudes for each warp sheet corresponding to the peaks of BUF, in a weave cycle. These peaks were measured and the values obtained were used to calculate the tension ratio (low/high) in Table III.

Table III also shows that BUF does reduce with dynamic warp peak tension ratio for each of the pickspacing at different shed timings. Although, there is a close relationship between BUF and dynamic warp tension ratio, this is evidently not linear, but a linear approximation would not cause very large errors. The extent to which BUF is reduced from its balanced value is less than the factor tension ratio would indicate.

It is obvious that the lower the tension ratio at beat-up, the smaller the WR. That means it is the ratio at beat-up that has greater effect on WR. Apart from shed geometry, the main influence on tension ratio is shed timing.

Limitations of this System

It was not possible to raise the extra-roller above the 28 mm above zero because of the stitching problems encountered during weaving. At higher heights, weaving became extremely difficult exclusively due to restrictions imposed by the relative tensions in the two warp sheets at the time of picking [6].

WR obtainable at certain loom settings facilitate weaving of high sett fabrics e.g., tarpaulin for tents and raincoats, canvass, drills, etc. [7]

Conclusion

The effect of dividing the total warp tension unequally by raising the position of the extra-roller (passive shed unbalance) is to reduce WR or BUF substantially. The immediate advantage of this is that fell displacement at beat-up, the movement of the backrail and consequently, abrasion of the yarn at the healds is reduced. The large reductions in

The results suggest a close relationship between BUF and dynamic warp tension ratio. The latter is a function of degree of shed unbalance, i.e., to allow the effect to be present, the shed should be timed to cross a little before beat-up. The studies have shown clearly the benefits or effects of passive shed unbalancing by raising the position of the extra-roller at the back of the loom. The result suggests that passive unbalancing by raising extra-roller has its own limitations but not as severe as that of similar methods mentioned above.

Results

TABLE I: Beat-Up Force (gf/end) for Different Actuator Positions (Passive Shed Unbalancing) and Shed Timing (10 Picks/cm)

Actuator Position (mm)	Beat-Up Force (gf/end)		
	Shed timing (deg)		
	75	40	0
0.0	107	105	103
20.0	76	79	94
24.0	58	79	92
28.0	56	67	89

TABLE II: **Beat-Up Force (gf/end) for Different Activator Positions (Passive Shed Unbalancing) and Shed Timing (12 Picks/cm)**

Actuator Position (mm)	Beat-Up Force (gf/end)		
	Shed timing (deg)		
	75	40	0
0.0	143	144	146
16.0	133	-	136
20.0	102	116	133
24.0	101	106	129
28.0	70	111	123

TABLE III: **Beat-Up Force and Dynamic Warp Tension Ratios for Different Actuator Positions and Shed Timings (15 Picks/cm)**

ACTUATOR POSITION (MM)	SHED TIMINGS			
	75°		40°	
	BUF	PTR	BUF	PTR
0.0	177	0.96	169	0.96
20.0	145	0.33	127	0.47
24.0	123	0.23	128	0.46
28.0	113	0.16	125	0.41

Note It was possible to weave 15 picks per cm at early and medium timings, but because of the excessive fell displacement, this was not possible at late shed timing.
Peak Tension Ratio (PTR) denotes low/high warp tensions

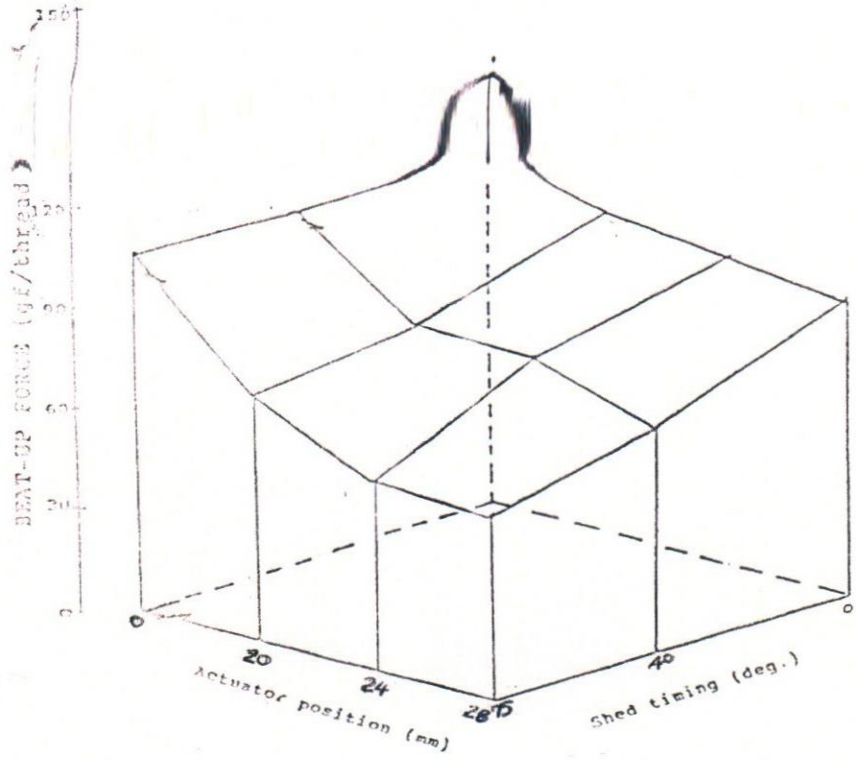

FIG 1 EFFECTS OF PASSIVE SHED UNBALANCING AND SHED TIMING ON BEAT-UP FORCE (10 Picks/cm)

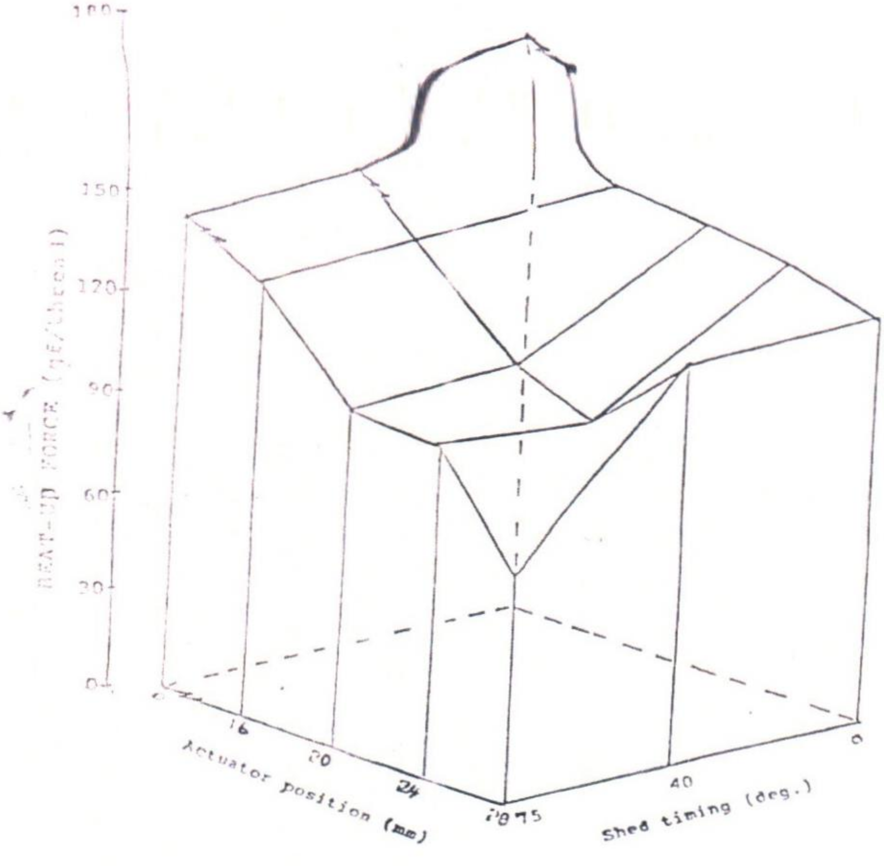

FIG. 2 EFFECT OF PASSIVE SHED UNBALANCING AND SHED TINING ON BEAT-UP FORCE (12 picks/cm)

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