The effect of loom speeds and shed heights on beating force

By: Dr. Hashim Ali Salem
Sudan University of Science & Technology

college of engineering

Department: Textile Engineering

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Abstract:-

A series of experiments was carried out on Picanol (president) loom in order to study the effect of loom speed and shed height on the beating – up force. The mathematical model of warp threads mechanics established by Salem (the author) was used to predict the warp threads tension.

The results obtained clearly show that as the loom speed increased the beating – up force also increased. However, with speeds up to 180 revs/min the rate of increase of the beating – up force is not pronounced, but at higher speeds there is a substantial increase in the values of the beating – up force. Furthermore, the results obtained also showed that the beating-up force increased as the shed height increased.

الملـخــص:-

تم إجراء مجموعة من التجارب في ماكينة البكانول وذلك لدراسة أثر سرعة ماكينة النسيج وكذلك إرتفاع فتحة النفس على قيم قوة الضم للقماش. النموذج الرياضي لميكانيكا خيوط السداء المنشأ بواسطة سالم[1] إستخدم في هذا البحث لإستقراء قيم شد خيوط السداء.

النتائج المتحصلة من هذا البحث أظهرت بوضوح أنه كلما زادت سرعة الماكينة زادت تبعاً لذلك قيم قوة ضم القماش. علماً بأنه لدى السرعات الدنيا وحتى السرعة 180 لفة في الدقيقة فإن معدل الزيادة في قوة ضم القماش ليس كبيراً جداً ولكن لدى السرعات العالية للماكينة فإن هناك زيادة مقدرة جداً في قيم قوة ضم القماش إضافة لذلك فإن النتائج المتحصلة أظهرت أيضاً بأن قيم قوة ضم القماش إزدادت بزيادة إرتفاع فتحة النفس التي يحدث عندها الضم.

1-Introduction:-

The loom elements make the measuring of the beating force relatively difficult. This difficulty is due to the presence of the loom elements in the measuring zone during weaving process. One of these obstacles is the beater (sley) which is a weaving tool[2] designed to push the weft yarn securely into place. The modeling of warp mechanics made it easier to calculate the values of beating force of the weaving loom. The model of Salem[1] is used in this research to calculate these values. Salem's model was used because it is simple and its application make the calculation of the beating force values more easier. An experimental arrangement designed by the researcher is made to measure the yarn tension during weaving the fabric. The values of beating force of the picanol loom at various loom speeds are determined. As well the values of beating force at various shed heights are determined precisely. One of the main objectives of this research is to find out the effects of the loom speed on the values of the beating force on the fell of the fabric. As well the determination of the values of the beating force when the beating action takes place at various shed heights is the other sound objective of this research.

2. Materials & Methods:-

2.1 Design of experiments of warp tension

Figure (1) shows the arrangements of the various elements and devices to facilitate the measurement of the beating force. As stated before all the measurements and experiments in this research were performed on the picanol[2] loom using two shafts only. The warp yarn tension was measured by using a shinkoh strain gauge and a strain gauge conditioner (Daytronic). The strain gauge was mounted between the back rest and tension roller and was connected to an oscilloscope[3] (Nicolet) which in turn was connected to a noise suppression transformer. An Xy recorder was interfaced with the Nicolet and used for recording the variations in the tension values. The experimental arrangement for measuring the warp yarn tension is shown in Figure (1). The tension curves were continuously displayed on the Nicolet screen where they could be held prior to sending them to the Xy recorder.

The divisions of the Nicolet screen were scaled to a suitable value (10 gmf for each division). The yarn was threaded to the shinkoh gauge and when the loom was run, the gauge measured the variations in yarn tension during each machine cycle with a continuous record of the tension curves displayed on the Nicolet screen.

2.2 Beating Force:-

The beating force was calculated using Greenwoods excess tension theory[4].This theory stated that, the beating force is equal to the rise in yarn tension (ΔT_y) plus the fall (ΔT_f) in fabric tension due to beating-up action.

$$Bf = \Delta T_y + \Delta T_f \longrightarrow [1]$$

where ΔT_y stands for the rise in warp yarn tension caused by the beating action.

ΔT_f stands for the fall in fabric tension caused by the beating action.

In this research ΔT_f was calculated from the geometrical relationship shown in Figure (2).

$$\Delta T_f = (T_1 \cos \Theta_1)_b - (T_1 \cos \Theta_1)_a \longrightarrow [2]$$

where the subscripts (b) and (a) refer to the situation before and after beating-up. $(T_1)_b$ and $(T_1)_a$ can be calculated from the model using predicted values of T_2 before and after beating action. $(\Theta_1)_b$ was calculated from static conditions and $(\Theta_1)_a$ derived from the model using measured values of forward displacement (R) whilst only the sley was active. The forward displacent (R) in this research corresponds to the value (δ) as shown in Figure (2). The geometry of warp yarns for two consecutives shafts is shown in Figure (2).

From the the results of the forward displacement R, obtained whilst running the loom at six speed levels; 161,170,180,189,199 and 208 revs/min, Salem's model was used in conjunction with Equation (1) above to calculate the values of the beating force.

3. Results & Discussion:-

The values of beating-up force were calculated using equation(1). Two experiments were made in this research. The first experiment was made to calculate the values of beating force at various loom speeds. The second experiment was executed to calculate the values of beating force at various shed heights.

The results are shown on Table (1) and the beating force is plotted against loom speed in Figure (3). Figure (3) shows the effect of loom speed on the beat-up force. The results clearly show that the beat-up force increases with the increase in loom speed. The increase in beating force with loom speed is clearly indicated by these results. These results are in good agreement with yangping[5] who investigated a relationship between the warp tension and the speed of the loom. The additional tension of the warp yarn $(\Delta T)_y$ caused by the beating action at various loom speeds is tabulated on Table (1) and plotted against loom speeds in Figure (4). These results comply with those reported by Glimakra[6] (U S A) who stated that when you beat lightly, beat slowly.

The effect of shed height on beating force was assessed by measuring the forward displacement R with the shed height set to predetermined levels during beat-up. The model was then used to predict yarn tension at beat-up and equation (1) was employed to calculate the beating force. The shed height for the first shaft was varied between 0 and 4 cms. The results are shown on Table (2) and the beating force is plotted against shed height in Figure (5).

It is clear that there is a greatly increased beating force as the shed departs from the closed position (0 height). The additional beating is a consequence of greater increase in yarn tension as shown in Figure (6). The additional tension of the warp yarn $(\Delta T)_y$ caused by the beating action at various shed heights is tabulated on Table (2) and plotted against shed heights in Figure (6).

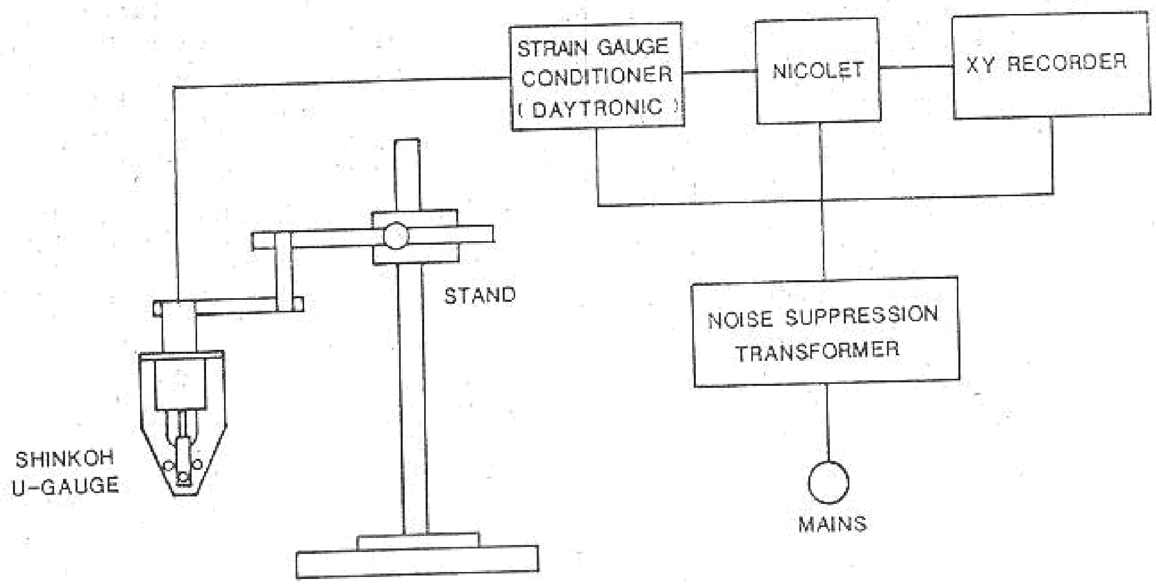

Fig. (1): Experimental Arrangement for Measuring the yarn Tension

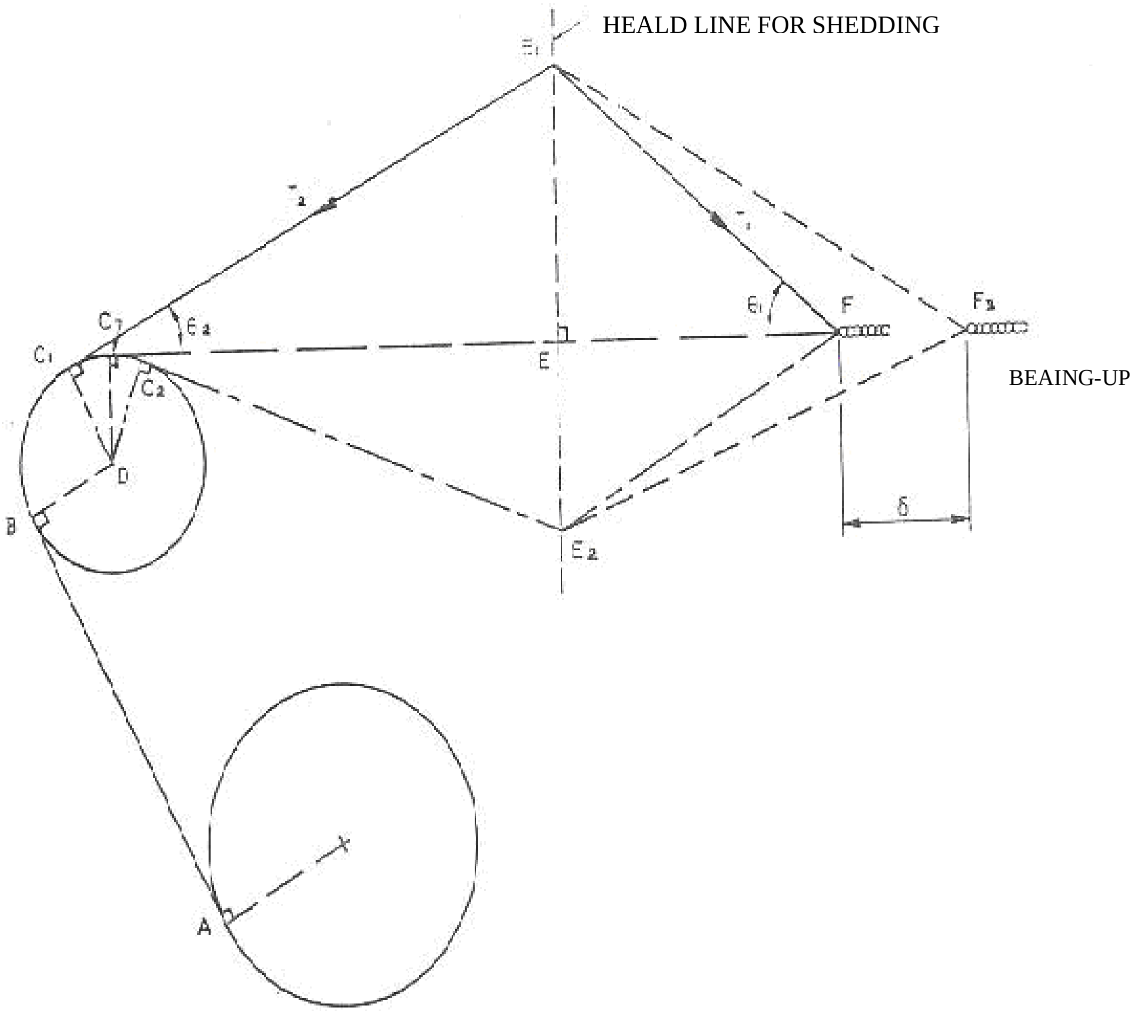

Fig. (2): Geometry of warp yarns for two consecutive shafts

Table.(1): $(\Delta T)_y$ and the Beating Force (B_f) at Different Speeds

Speed (revs/min)	R (mm)	ΔT_y (gmf)	B_f (gmf)
161	3.81	31.9796	286.1066
170	4.04	33.8942	303.3622
180	4.30	36.0822	322.8922
189	4.74	39.7592	355.9172
199	4.98	41.7695	373.9355
208	5.44	45.6158	408.4638

Table.(2): $(\Delta T)_y$ and the Beating Force (B_f) at Different Shed Heights

Shed height H (cm)	R (mm)	ΔT_y (gmf)	B_f (gmf)
0.0000	3.00	22.6773	222.7773
0.6314	3.47	26.7818	258.2308
1.9843	3.88	31.0533	289.8493
2.9765	4.16	34.1310	311.6030
4.0000	4.30	36.0822	322.8922

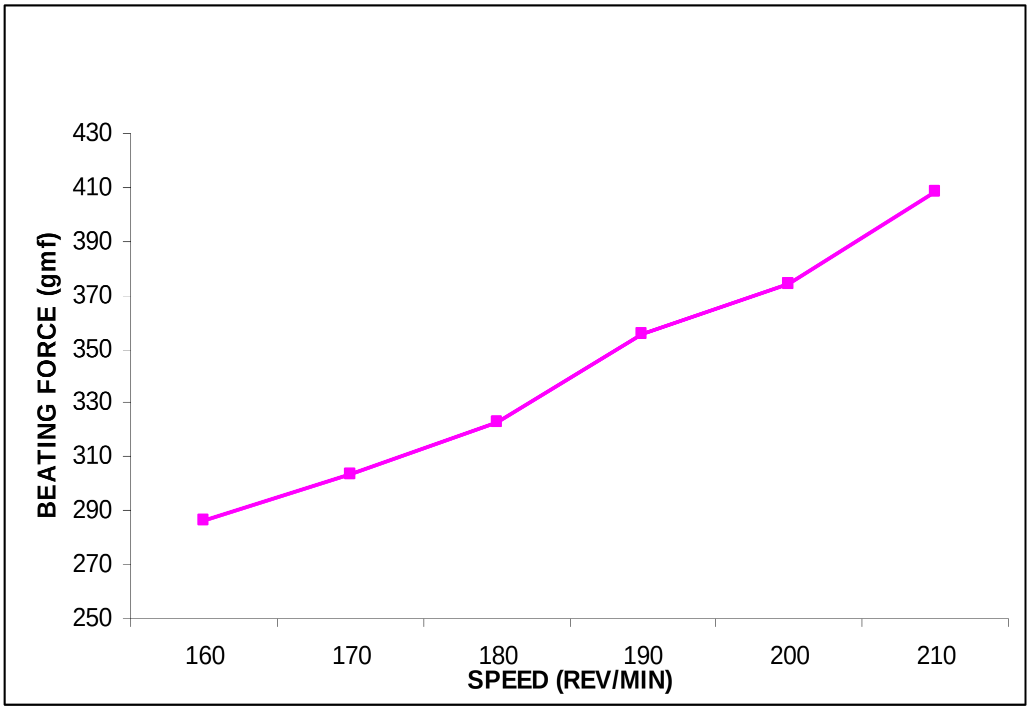

Fig. (3): The Beating Force as Function of Loom Speeds

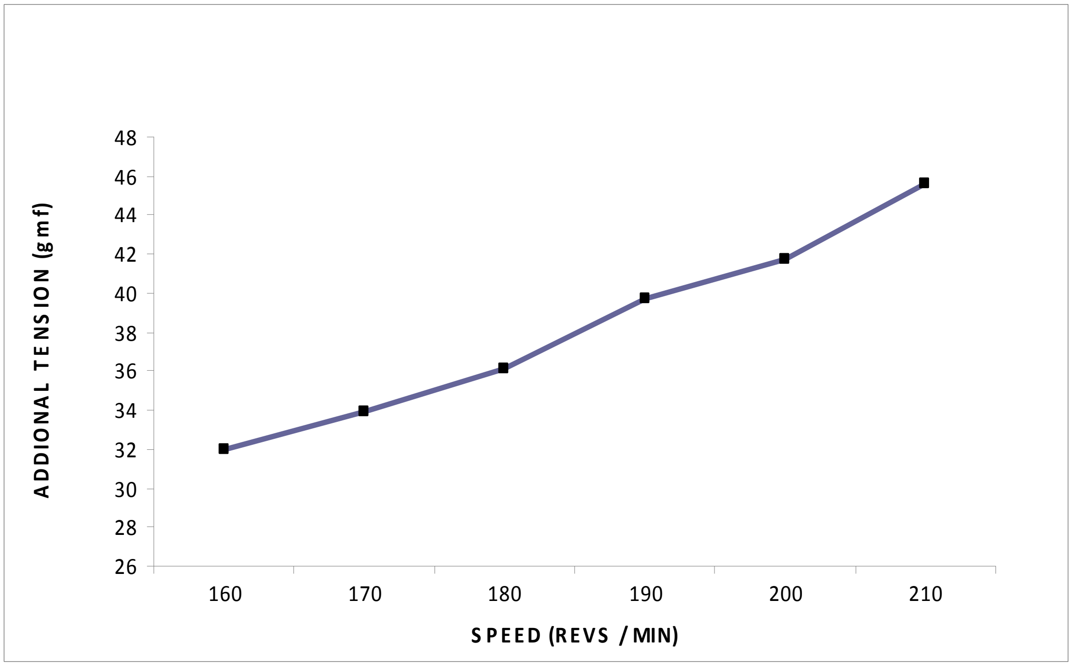

Fig. (4): The Additional Yarn Tension $(\Delta T)_y$ Caused By the Beating Action at Different Loom Speeds

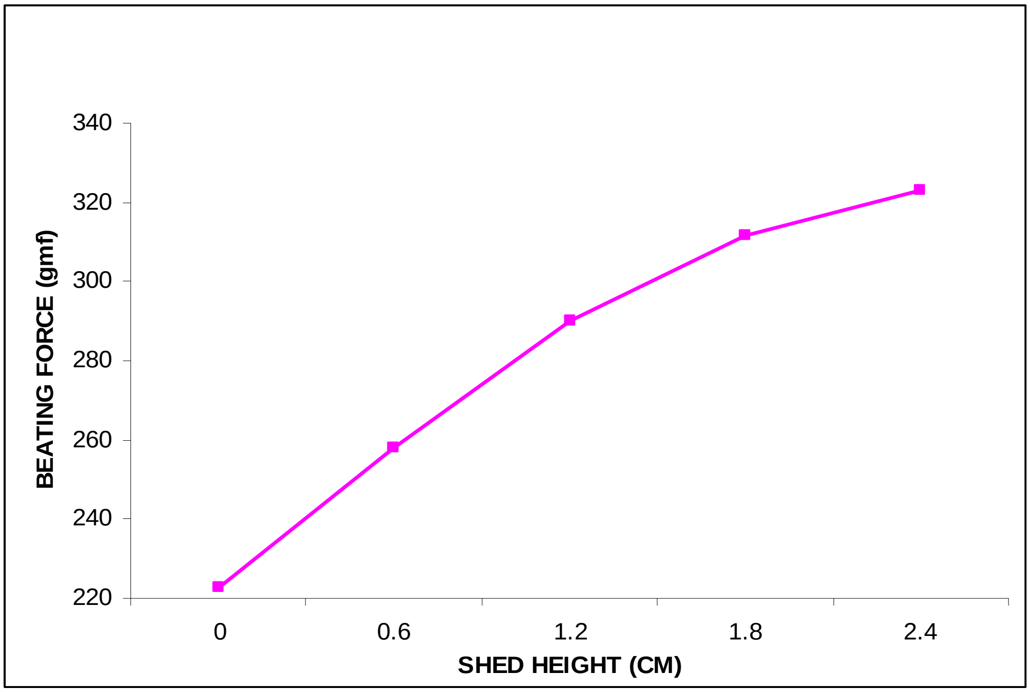

Fig. (5): The Beating Force as a Function of Shed Heights

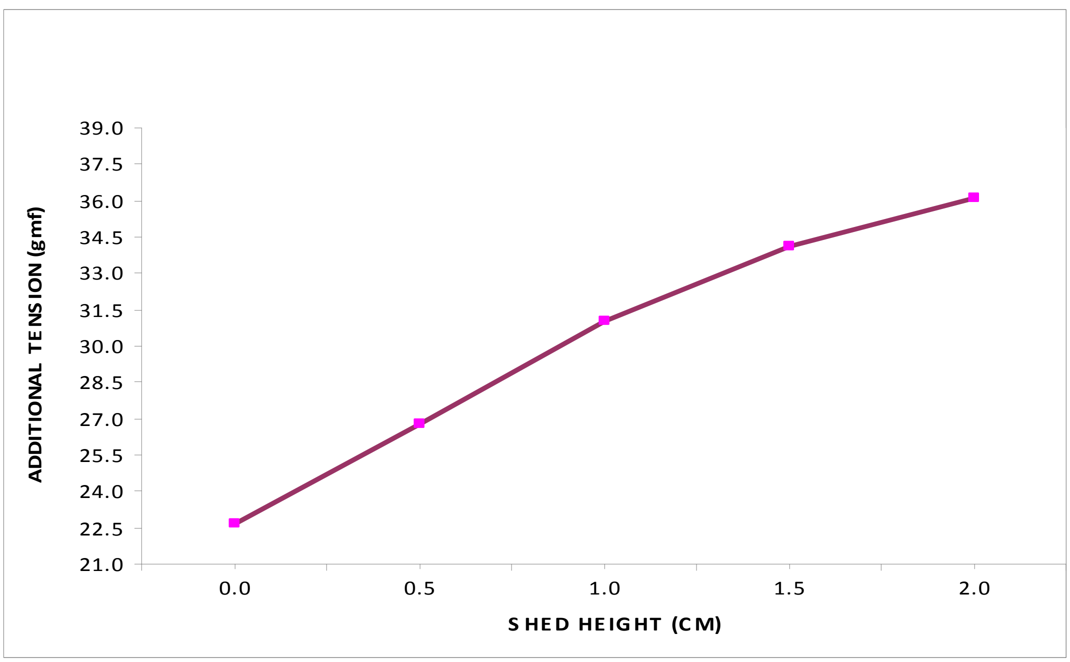

Fig. (6): The Additional Yarn Tension Caused By the Beating Action at Different Shed Heights

4. Conclusion and Future Work:-

The determination of the values of beating force of a weaving machine is a hard task without using mathematical models and using new techniques for measurement. In this research the mathematical model of Salem[1] has been used with the measuring configuration designed, constructed and used by the researcher.

The values of the beating force at various loom speeds and shed heights of the picanol loom were determined precisely.

The beating force increases as the loom speed increase. As well the beating force increases when the height of the shed at which the beating action takes place is increased.

Although a picanol loom was used for carrying out the experimental work of this research, the results obtained are general and can be applied for all types and models of weaving machines.

From the combined effect of the two Figures (3 and 4), it is clear that the main factor affecting the beating force at the moment of beating-up is the warp threads tension. There is some evidence that there may be such contribution from the warp density (ends/cm). Therefore, more research is needed in this area.

5-References:-

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