ANALYSIS OF BEAM WINDING TENSION ON A SIZING MACHINE PRODUCING WARP BEAMS FOR DOUBLE WIDTH SULZER WEAVING MACHINE

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تحليل شد تدوير المطواه على ماكينة بوش تنتج مطاوى سدا لماكينة نسيج سولزر ذو العرضين

الخلاصة :

فى هذا البحث تم تحليل شد التدوير على ماكينة البوش سوكر طراز ١٩٨٢ ، وذلك فى حالة انتاج مطوتين سداه (يمين ويسار) لماكينة نسيج سولزر ذو العرضين . وقد وجد أن دوران راس التدوير فى اتجاه معاكس يؤثر على شد التدوير وبالتالى تتاثر كثافة حزم مطاوى السدا . وهذا يؤدى الى اختلاف بين قطرى مطوتى السدا ، اليمين واليسار على ماكينة نسيج سولزر ، وبالتالى يتاثر طول السدا المتبقى فى النسيج وتزيد كمية العوادم . وقد أوضحت الدراسة انه للحصول على مطوتين سدا (يمين ويسار) متماثلتين ، يجب زيادة شد تدوير مطواه السدا اليمين عن شد تدوير مطواة السدا اليسار . وفى هذا البحث وجد ان شد تدوير مطواه السدا اليمين يجب أن تزيد بمقدار ٤٣و١ عن شد تدوير مطواه السدا اليسار .

N. B. : in the following analysis the terms left warp beam and right warp beam mean the warp beam of the picking side and warp beam of the picking side and warp beam of the reciving side on Sulzer weaving machine, respectively.

ABSTRACT - In this work the winding tension on the sizing machine Sucker Model ZTWL 1982 was analyzed in the case of producing two warp beams for Sulzer weaving machine. It was found that the winding tension, due to the reverse motion of the head stock, affected the packing density of the warp beams. This resulted in a difference between the diameters of the right and left warp beams. The matter which influences the remaining warp on the double width Sulzer machine. In order to produce two identical warp beams, it is essential to increase the winding tension of the right warp beam over that of the left beam. In this case, the study showed that the winding tension of the right beam must be 1.43 that of the left beam.

INTRODUCTION :

It was observed on the double width Sulzer weaving machine, that the warp length of the right hand side beam (reciving side) finishes before that of the left hand side beam (picking side). the difference in warp length between the two beams is about 3 to 10 mt/1000 mt of warp length. This results in a large amount of waste, then the economies of the weaving process is affected. Some researcher [1, 2 and 3] investegated the reasons that caused this difference in warp length between the right and left warp beams on Sulzer weaving machine in terms of the let-off mechanism. It was found that the transimation of the motion to the warp beams by the differential gear train is not identical. Thus, the warp beam of the reciving side rotates an angle larger than that of the picking side. The matter which results in a variation in warp tension between the two warp sides and ends up by a difference in the remaining warp length on the beams. However, using two identical warp beams (length, diameter and packing density) was saide to have an influence on the difference of the remaining warp on beams.

In this work, an analysis of the beam winding tension on the sizing machine Sucker Model ZTWL 1982 is going to be made in the case of producing two warp beams for a double width Sulzer weaving machine. On this type of sizing machine, one warp beams is produced at a time. Due to the construction of the warp beams of Sulzer weaving machine and the head stock of the sizing machine. One warp beam is fixed on the head stock in an opposit way to the other. This implies reversing the winding direction of the head stock, as shown in Figure (1). The beam winding tension is belived to be one of the reasons affecting the difference in the remaining warp length between the left and right warp beams.

MACHINE SPECIFICATIONS :

Sizing machine Sucker Model ZTWL/1982
Automatic creel
Size box : double squeez roller, double immersion.
Drying : 9 cylinders (4 teflon and 5 steel)
Head Stock : Type WL, full automatic control provided with penumatic system to regulate the winding tension using a floating roller. Provided with a reverse drive system

WARP SPECIFICATIONS :

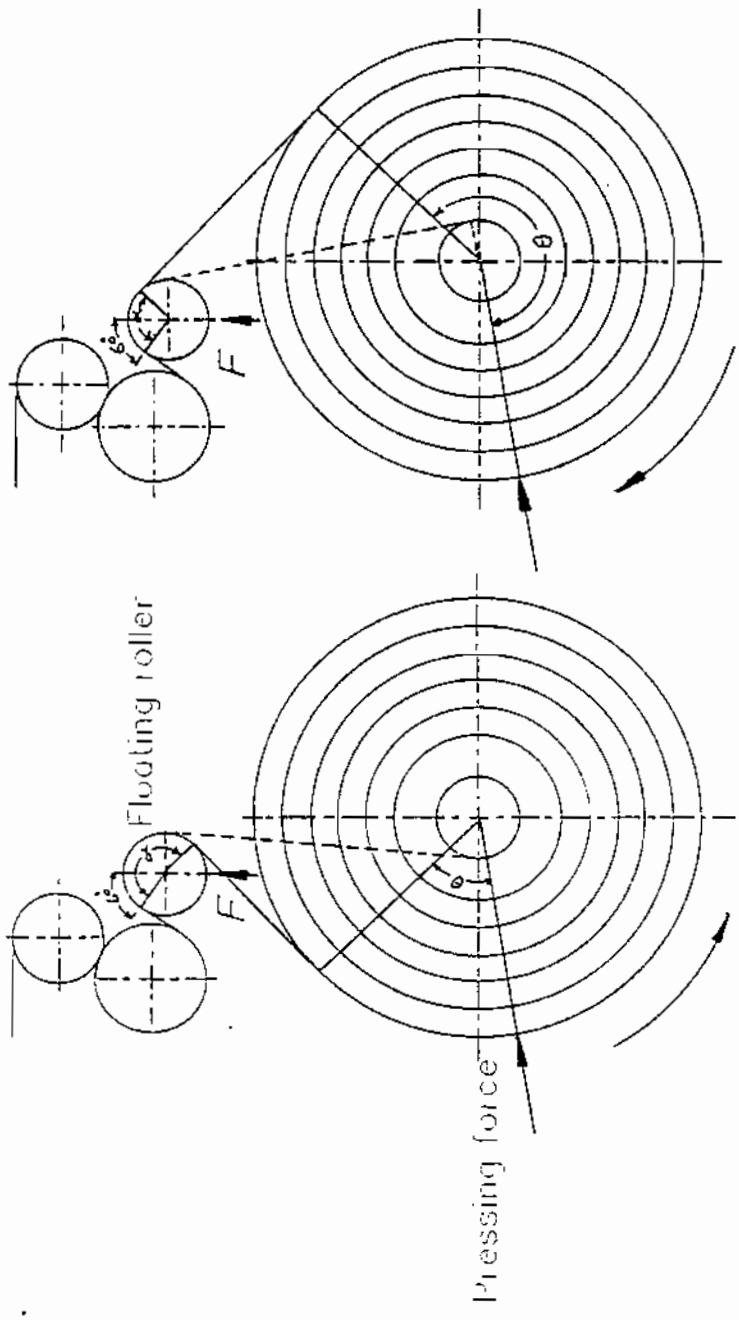
Total number of ends	: 3042
warp yarn	: cotton, Ne. 20/1
R. K. M.	: 16
Warp width (beam width)	: 127.5 cm
Empty beam diameter	: 15 cm
Flange diameter	: 80 cm

DIFFERENCE BETWEEN WARP BEANS :

To investigate the difference between the right and left warp beams due to the winding tension on sizing machine. It was useful to make an experiment by producing two warp beams (right and left) according to the running conditions recommended by the sizing machine manufacturer (Sucker) for this type of warp. The diameter of the beam flang was divided into five sections, as shown in Figure (1). Each section represents one layer of warp. The winding tension was set to 1150 N and pressing force to 1300 N. The warp length was recorded as soon as each warp layer was completed. When the warp beam was full i.e. at 70 cm beam diameter, the warp beam was weighed. From this weight and the empty beam weight, the warp weight was found. The weight of each warp layer was calculated, then the packing density of each layer was found. The results are shown in Tables (1 and 2). Figures (2 and 3) show the difference in warp weight and length between the right and left warp beams. A difference of 3.6% (79 mt) in warp length was found at 70 cm beam diameter.

Table (1) Right warp beam.

Warp layer cm	Length of warp mt	weight of warp kg	Density of layer gm/cm^3



Figure(1) Schematic diagram showing the winding section of the sizing machine Sucker Model ZIWL 1982

Table (1) Right warp beam.

Warp layer cm	Length of warp mt	Weight of warp kg	Density of layer gm/cm^3
15-30	302	27.421	0.3696
30-40	628	57.020	0.3847
40-50	1040	94.432	0.3782
50-60	1552	140.922	0.3846
60-70	2188	198.670	0.4042

Table (2) Left warp beam.

warp layer cm	Length of warp mt	Weight of warp kg	Density of layer gm/cm^3
15-30	297	26.967	0.3635
30-40	651	59.111	0.4178
40-50	1093	99.244	0.4057
50-60	1639	148.821	0.4100
60-70	2267	205.844	0.4007

MATHEMATICAL ANALYSIS OF WINDING TENSION :

Figure (1) shows a schematic diagram of the beam winding section on the sizing machine Sucker Model ZTWL/1982, in case of winding right and left beams.

The warp tension due to the floating roller force (F) can be expressed as follows :

i- Right beam,

$$T_{wr} = F / \sin 60 + \sin (\alpha - 60) \qquad (1)$$

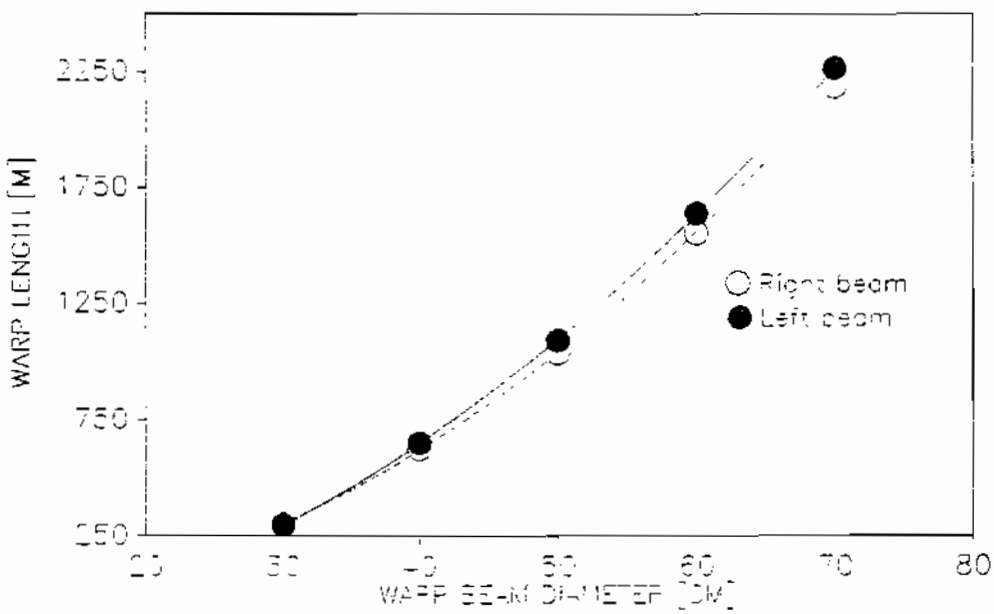
ii- Left beam,

$$T_{wl} = F/\cos 30 + \cos (\alpha - 150) \qquad (2)$$

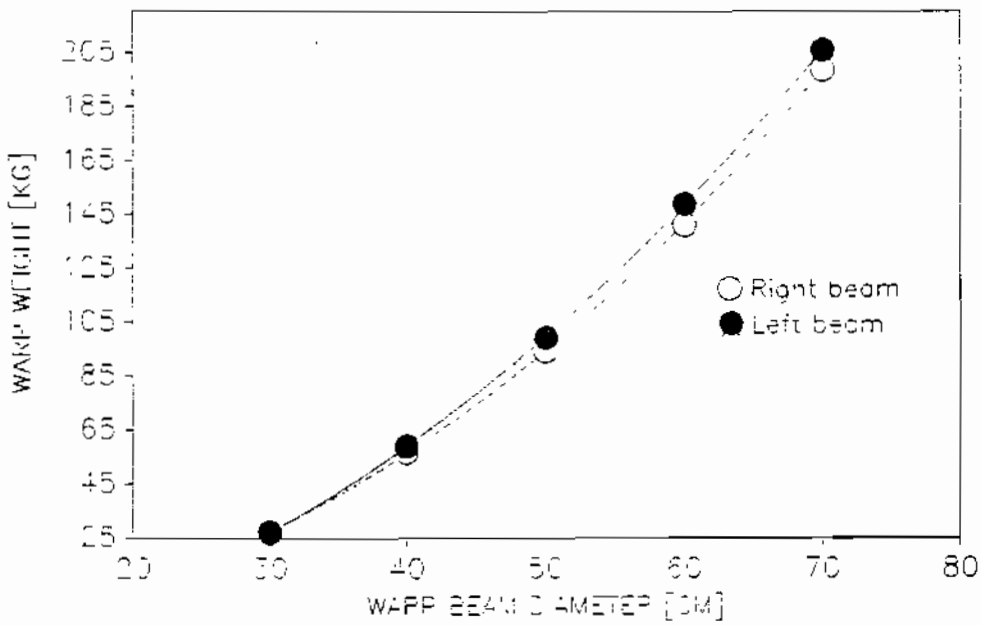
The winding tension at pressing point (T_p) is expressed by the following formula :

$$T_p = T_w \cdot e^{-\mu\theta} \qquad (3)$$

Where (θ) is the warp angle of warp as shown in Figure (1), and (μ) is the yarn to yarn coefficient of friction (was found experimently to be 0.25). From the geometry, the values of (α) and (θ) corresponding to various warp beam diameters were found. Then, (T_w) and (T_p) were calculated and the results are shown in Table (3 and 4)



Figure(2) Relationship between warp beam diameter and warp length



Figure(3) Relationship between warp beam diameter and warp weight

Table (3) Calculated values of winding tension, right beam.

Warp beam diameter cm	degrees	degress	T_w N	T_p N
15	138.5	180	623	284
30	131.5	188	634	279
40	126	193.5	646	278
50	120	199	664	279
60	115	205	286	279
70	109	210	709	273
80	104	215	737	288

Table (4) Calculated values of winding tension, left beam.

Warp beam diameter cm	degrees	degrees	T_w N	T_p N
15	150	15	616	577
30	161	22	622	565
40	167	27.5	631	560
50	173	35	649	552
60	180	40	664	558
70	186.5	46	689	563
80	196	52.5	736	585

Figures (4 and 5) show the relationship between the warp beam diameter and winding tension (T_w) and winding tension at pressing (T_p), respectively in case of right and left beams. It is clear that, the winding tension at pressing (T_p) of the left beam is higher than that of the right beam. The matter which results in a difference in packing density between the two beams. This means that, for the same warp length, the left warp beam will be harder and less diameter than the right warp beam. By weaving on the double width Sulzer weaving machine, the right warp beam (reciving side) finishs earlier than the left warp beam (picking side)

ADJUSTMENT OF WINDING TENSION:

In order to produce two warp beams (left and right) equal in length, diameter and packing density. The winding tension which is determined by the force applied at the floating roller must be changed according to the direction of winding (right or left) to keep the winding tension at the pressing the same. In this case :

$$T_{wr} \cdot e^{-\mu\theta r} = T_{wl} \cdot e^{-\mu\theta 1} \qquad (4)$$

$$T_{wr} / T_{wl} = e^{\mu(\theta r - \theta 1)}$$

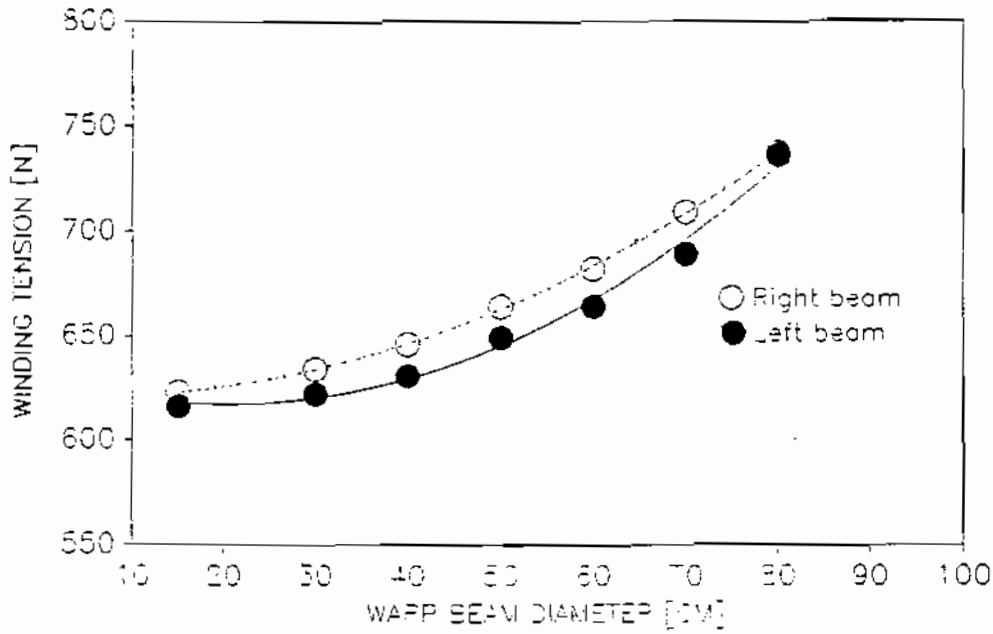
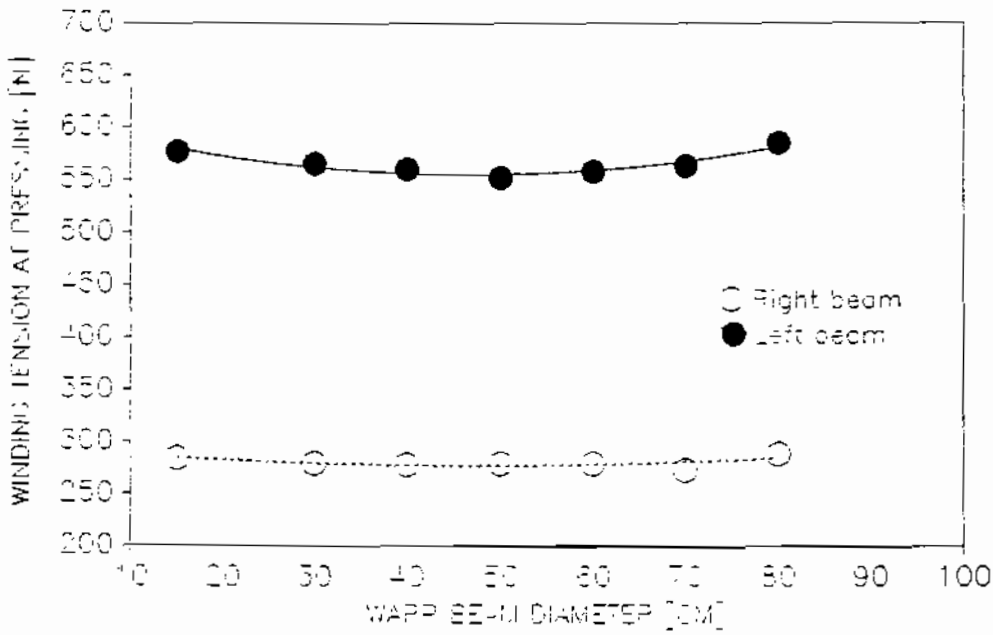


Figure 4) Relationship between warp beam diameter and calculated winding tension



Figure(5) Relationship between warp beam diameter and calculated winding tension at pressing

The average values of (θ_r) is 198.6° , and (θ_1) is 34°. Then,

$$T_{wr} / T_{wl} \simeq 2 \qquad (5)$$

which means that the winding tension of the right beam must be twice that of the left oeam to got two Idetical warp beams. However, it was important to verify this value experimentaly.

EXPERIMENTAL RATIO OF WINDING TENSION :

Since the packing density of the warp on the beam is given by :

$$\text{Packing density of warp} = \frac{W}{\pi . L . (D^2 - d^2) / 4} \qquad (6)$$

where,

W	warp weight
L	width of warp
D	full warp beam diameter
d	empty warp beam diameter (15 cm)

Thus, for a eertain warp specifications, the packing density of warp on beam is related to D^2. In order to get two warp beams with the same packing density, D must be equal. To consider all parameters which affecting the packing density of warp, such as the variation in yarn, sizing material and % pick-up. Four orders of the same warp specifications were considered in this experiment. Each order contained 6 warp beams (3 right and 3 left). The pressing force was fixed at 1300 N and the winding of the left beam was also fixed at 1150 N. The winding tension of the right beam was varied from 1150 N to 1900 N. The warp beam width was kept constant at 127.5 cm. A total of 24 warp beams were produced (12 left and 12 right). The diameter of each warp beam was measured and the results are shown in Table (5).

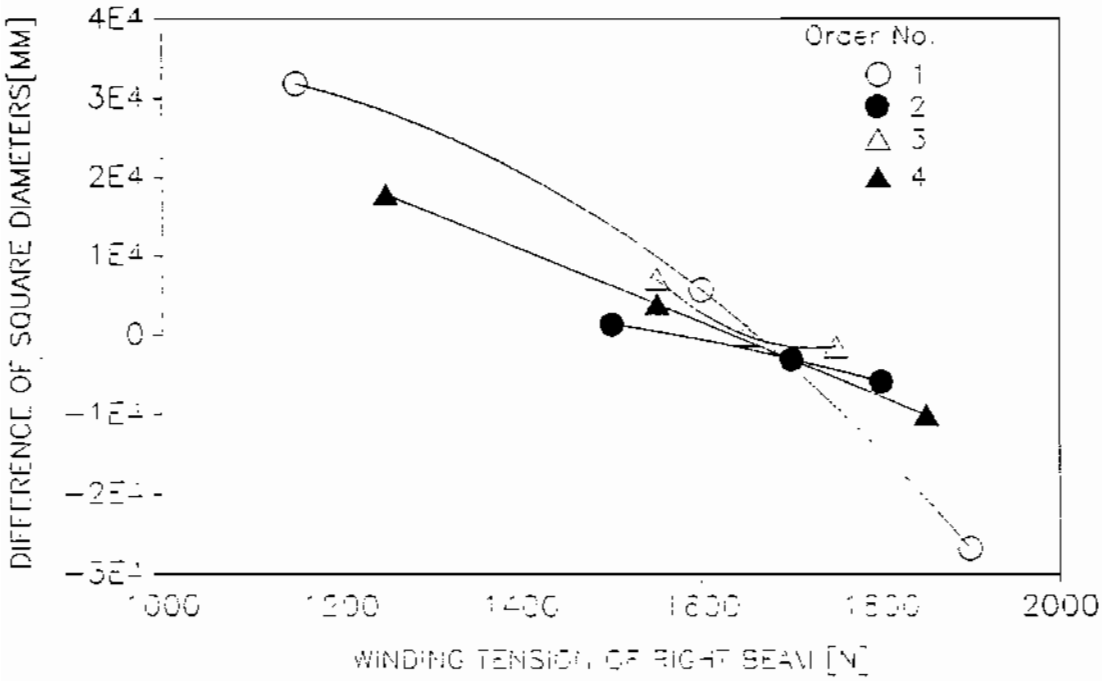
Figure (6) shows the relationship between the winding tension of the right beam and the difference of square diameters (right and left). It is clear that, for an equal packing density of warp on beam, the winding tension of the right warp beam must be higher than that of the left warp bcam. In this case, a winding tension of the right beam of ~1650 N showed a nearly equal packing density on both warp beams. The experimental ratio of winding tension (right to left beams) was found to be ~1.43. The difference between the calculated and the experimental ratio of winding warp tension is attribuated to the errors resulted from the measurements.

CONCLUSIONS :

The previous study showed that, reversing the winding direction of the head stock on the sizing machine to produce two warp beams for double width Sulzer weaving machine required an adjustment to the winding tension. The winding tension of the right beam must be higher than that of the left beam. This is important to producc two identical warp beams. In this study the ratio of winding tensiom was found 1.43. In spite of the fact that the difference in thc remaining warp betweon

Table(5) Results of warp beam packing density.

Order Nr.	Warp Beam	Winding Tension N	Warp Diameter mm	$D_r^2-D_l^2$ mm^2
1	Right	1150	736	31900
1	Left	1150	714	-
1	Right	1600	718	5728
1	Left	1150	714	-
1	Right	1900	695	-26771
1	Left	1150	714	-
2	Right	1500	735	1469
2	Left	1150	734	-
2	Right	1700	732	-2952
2	Left	1150	734	-
2	Right	1800	730	-5856
2	Left	1150	734	-
3	Right	1550	717	7145
3	Left	1150	712	-
3	Right	1650	704	0
3	Left	1150	704	-
3	Right	1750	703	-1407
3	Left	1150	704	-
4	Right	1250	732	17910
4	Left	1150	720	-
4	Right	1550	723	3990
4	Left	1150	720	-
4	Right	1850	712	-10017
4	Left	1150	719	-



Figure(6) Relationship between winding tension of right beam and difference of square diameters

the left and right beams on Sulzer weaving machine is caused by the differential gear train of the let-off mechanism. The difference in the packing density and beam diameter of the two warp beams also affect the length of the remaining warp on beam.

REFERENCES :

1- Morsy, A. E., " Study the Problem of Remaining Length's Variation of Warp at Double Beam Sulzer Weaving M/C." Mansoura Engineering Journal, Vol. 14, No. 2, Dec. 1989.

2- El-Helw, E.M., "Kettreste beim Abweben von Zwei Halbkettbaeumen bei der Webmaschinen." Accepted for publication in Textil Praxis International.

3- El-Helw, E.S. "Radius Variation in Preparation of Twin Beams for the Wide Looms".
Alexandria Engineering J. Vol. 28, No. 3, July 1989.

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