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EFFECT OF HARNESSES CROSSING ANGLE AND SHED SIZE ON YARN STOPS DURING WEAVING ON AN AIR JET MACHINE

By

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"تأثير زاوية تبادل الدرأ وحجم النفس على قطوع الخيط على ماكينة نسيج الهواء"

الخلاصة :

فى هذا البحث ، وجد أن الزيادة فى زاوية تبادل الدرأ وحجم النفس تؤدى الى تحسن عملية قذف خيط اللحمة على أنوال نسيج الهواء وهذا يؤدى الى تقليل وقفات اللحمة . أما بالنسبة لوقفات السداء ، فقد وجد أنها ترتفع عندما تزداد زاوية تبادل الدرأ ويزداد حجم النفس. ولقد أظهرت الدراسة أن زاوية تبادل الدرأ ٣٢٠° وحجم نفس ٣٢° قد أعطى عدد قليل من وقفات اللحمة والسداء لكل ١٠٠و٠٠٠ حدفة أثناء النسيج .

Abstract:

In this work, it was found that, on air jet weaving machine, the increase in the harnesses crossing angle as well as the shed size enhanced the processe of weft insertion. The matter which resulted in a reduction in weft stops. The warp stops were raised when the harnesses crossing angle and the shed size were increased. A harnesses crossing angle of 320° and shed size of 32°, showed a low number of weft stops and warp stops per cmpx during weaving .

1-Introduction:

The productivity of the weaving machine affects , to a large extend, the economics of the weaving processe. The increase in the speed of the weaving machine results in an increase in the productivity of weaving. However , this is influenced by the yarn stops during weaving. The recent development in air jet weaving showed a remarkable increase in the speed of weaving machine (1100 p.p.m. was shown at ITMA 87). A speed of 700-800 p.p.m. is considered now a normal running speed of an air jet weaving machine. This besides the wide range of fabrics which can be produced on air jet weaving. This makes the air jet weaving machine very much popular in the textile industry. The matter which imposes a certain requriment to the quality of warp and weft yarns in order to reduce the yarn stops during weaving[1]. The warp yarns are subjected to a high and repeated tension and abrasion stressas, the matter which may cause a warp break. A high quality yarn from spinning as well as a good yarn preparation for weaving (winding, warping and sizing) will reduce the number of warp breaks in weaving[1 & 2]. This is also influenced by the adjustment of the warp tension on weaving machine. Also the weft yarn is subjected to a high tension due to the high intial acceleration of yarn and high insertion velocity (40-60 m/sec., corrsponding to insertion rate of 1200-2000 m/min.). The matter which may cause a weft break during weaving. However, most weft stops on air jet weaving are not caused by weft breakage, as it was reported by [4] and [5]. It is clear from reportes that

most of these weft stops are due to the incorrect adjustment of the processe of air jet weft insertion. This causes a large number of weft stops per cmpx compared to that of warp stops. Sometimes the ratio of weft stops to warp stops reaches 3. Which influences the productivity of the weaving machine.
Recently, the textile industry in Egypt started to replace the depreciated shuttle looms with air jet weaving machines. Thus, it became necessary to study the factors influencing the weft and warp stops during weaving, specially for the quality of yarns in Egypt. This will help in icreasing the productivity of weaving and improving the quality of woven fabrics on these machines.

The purpose of the present work is to investigate the influence of the harnesses crossing angle and shed size on:

1-number of weft stops per cmpx, and
2-number of warp stops per cmpx.

This will lead to a correct adjustment of harnesses crossing angle and shed size to reduce the numper of weft and warp stops per cmpx.(cmpx=100,000 pick).

2-Weaving Machine Describtion:

The Picanol PAT-A air jet weaving machine was used in this work. The machine was running at speed of 644 p.p.m. to weave 110x72/40x40 plain cotton fabric(20% combed yarn). The width in reed was 67.3 inch (171 cm.) and the pick length was 69.3 inch (176 cm.). The insertion system consists of fixed nozzle, main nozzle, relay nozzles and profil reed. Figure(1) shows the arrangement of the fixed nozzle, main nozzle and yarn accumulator. The main nozzle is fixed to the sley, the matter which changes the length of weft yarn between the main nozzle and fixed nozzle during insertion . This affects the yarn movement during insertion, and hence the weft stops is influenced. The supply air pressure at the fixed and main nozzles was 3 bar. The IRD wf 8407 yarn accumulator (fixed drum-rotating guide) was used on the machine. The pick length was accumulated by adjusting the number of windings and the diameter of the drum according to a certain furmula given by the manufacturer. Figure(2) shows the distribution of the relay nozzles along the machine width. According to machine speed , crossing of harnesses , machine width , weft length and time available for insertion the microprocessor on the machine calculates the valve settings (opening and closing positions, as shown in Figure(3). The time available for weft insertion is largly influenced by the supply air pressure. It is recommended to have a large insertion time inorder to use a low air pressure in the main and relay nozzles. The matter which reduces the air consumption. As shown in Figure(3), the magnet pin of the prewinder closes before the weft insertion is completed.
The harnesses motion on the machine is driven by cams, Figure(4) shows the displacement of the harnesses in case of plain weave. Figure(5) shows the displacemnt of the sley. The adjustment of the shed size and the sley motion when weft insertion starts must be as shown in Figure(6). The shed size is determined by the angle θ at the position of starting insertion which corrsponds to a crank shaft angle of 80°. The air jet weaving machine was running at shed size 30° and harnesses crossing angle of 310°.

3-Experimental Method:

The factors which are considered in this work are: i)harnesses crossing angle, and ii)shed size. These factors affect the number of weft and warp stops per cmpx during weaving. The interaction between these factors was expected to influence the number of yarn stops. It was useful to use the factorial design technique according to the the selacted level of variables, as shown in Table(1). The expirmental plan for the two variable at three levels is shown in Table(2).

The response Y is given by a second order polynominal, i.e.

$$Y = Bo + \sum_{i=1}^{k} Bi\,Xi + \sum_{i=1}^{k} \sum_{j=1}^{k} Bij\ XiXj$$

Where,

Xi= i th variable,
k =number of variables, and
Bo ,Bi & Bij = regression coefficients associated with the variables.

4-Discussion of Results:

According to the experimental plan shown in Table(2), the number of weft stops as well as the number of warp stops was recorded from the microprocessor on the machine in one day running time (3 shifts). The corrsponding number of cmpx(100,000 picks) per shift was also rscorded. Table(3) shows the exprimental results. The results were fed to a computer . The regression coefficients were determined and the response surface equations for the averege number of weft stops per cmpx and the average number of warp stops per cmpx of shift 1 and of the 3 shifts are given in Tables(4 & 5), respectivly. It was important to consider the influence of harnesses crossing angle and shed size on weft and warp stops in shift 1. This is because , in a weaving mill all other factors influencing the weft and warp stops were always kept the same in shift 1.

4.1.Effect of shed size and harnesses crossing angle on weft stops.

Figure(7 & 8) show the effect of harnesses crossing angle on number of weft stops per cmpx. The contour lines show clearly, that the number of weft stops per cmpx decreased as the shed size was increased. This is because, the increase in shed size reduced the possibility of weft clinging inside the shed during insertion, which in turn reduced the weft stops. The increase of harnesses crossing angle resulted in a reduction of number of weft stops per cmpx , as shown in Figure(7 & 8). This is attributed to the large weft passage at end of insertion which resulted from the late harnesses crossing . The weft insertion time did not change, however, the opening time of the relay nozzle groups 7&8 was increased as the harnesses crossing angle was increased(an increase of 5 ms. in opening time was observed for an increase of 20° in crossing angle). This helped in straightening the weft yarn during insertion, and hence the possibility of loop formation inside the shed was reduced, which in turn reduced the weft stops.

4.2.Effect of shed size and harnesses crossing angle on warp stops.

Figure(9 & 10) show the effect of shed size and harnesses croesing angle on the number of warp stops per cmpx. The contour lines snow that, the number of warp stops per cmpx increased as the shed size was increased. This is due to the increase in the extension stress on the warp [6]. At small shed size the harnesses crossing angle showed no large influence on warp stops, but at large shed size , the late harnesses crossing increased the number of warp stops per cmpx because the forces on warp during beating up increased [7]. Generally, the quality of warp yarns determines to a large extend, the number of warp stops during weaving[1 & 2]. Inspit of the fact that, the experimental plan shown in Table(2) was done using only one warp beam. The expected variation in yarn quality within warp beam affected the resuls of warp stops when the shed size was increased to 34°,as shown in Figure(10).

5-Adjustment of Harnesses Crossing Angle and Shed Size:

It is clear from Figures(7 to 10) and the previous discussions that, the influence of harnesses croseing angle and shed size on number of warp stops per cmpx was different from that on weft stops per cmpx. Hence, it became necessary to find out a satisfactory adjustment for the harnesses crossing angle and shed size. In spite of the fact that the number of weft stops per cmpx was nearly twice that of warp stops. The service time of a warp stop was high compared to that of weft stop(17.5 sec. for weft and 65 sec. for warp). This makes the warp stops represent nearly 65% of the total stops in weaving (assuming no other stops). Thus, a reduction in the number of warp stops, without influencing the number of weft stops, will end up with a significant influence on the productivity of weaving. This is higly affected by the quality of warp yarns. As shown in Figure(7 & 8), the number of weft stops per cmpx is very low at a harnesses crossing angle of 320°. A shed size of 32° is shown to be a good compromise value between the number of weft and warp stops per cmpx. This adjustment, harnesses crossing angle 320° end shed size 32°, showed a relatively low number of weft and warp stops during weaving.The results of this adjustment are :

-average number of weft stops per cmpx in shift 1 = 3.1
-average number of warp stops per cmpx in shift 1 = 3.8
-average number of weft stops per cmpx in 3 shifts = 4.77
-average number of warp stops per cmpx in 3 shifts = 3.7

5-Conclusion:

From the previous results and discussions the following conclusions can be drawn:

1-On air jet weaving machine, the harnesses croeeing angle and shed size affected the weft stops during weaving. Late harnesses crossing and large shed size reduced the number of weft stops per cmpx.

2-Late harnesses crossing and large shed size raised the number of warp stops per cmpx.

3-In this work a harneses crossing angle of 320° and shed size of 32°, showed a low number of weft and warp stops per cmpx.

6-References:

[1] Sawhney, A.P., "How Five Factors Make or Break Weaving". Textile World, April 1979.

[2] Douglas, K., "Quality Control and Data Logging Techniques". In book "Contemporary Textile Engineering", by Happey . Academic Press 1982.

[3] Aggarwal, S & Subramanian, T., "Prediction of Warp Breakage Rate in Weaving". T.R.J. vol.58 Number 1, 1988.

[4] Reports by PICANOL, Weaving Machine Manufacturer.

[5] Reports by SULZER-RUTI, Weaving Machine Manufacturer.

[6] Renner, M. & Schutz, R., "Requirements of Smooth and Textured Filament Yarns and Wrapped Yarns for High-Speed Weaving Machines", I.T.B., Fabric Forming1/88

[7] Lord, P. & Mohamed, M., "Weaving:Conversion of Yarn to Fabric" Merrow Publishing Co. 1979.

Table(1) Actual levels corrosponding to coded levels.

	level	-1	0	+1
X1:Harnesses crossing angle, degrees.		290	310	330
X2:Shed size,degrees.		30	32	34

Table(2) Experimental plan for two variables at three levels.

No.	Level of variables	
	X1	X2
1	+1	+1
2	+1	-1
3	-1	+1
4	-1	-1
5	0	+1
6	0	-1
7	+1	0
8	-1	0
9	0	0

Table(3) Experimental results.

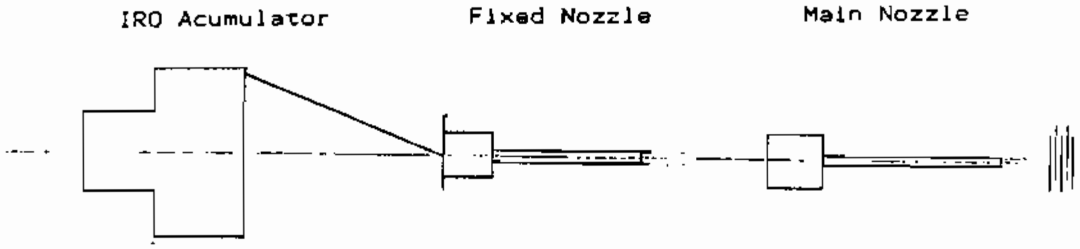
No.	Number of weft stops per cmpx			Number of warp stops per cmpx		
	shift 1	shift 2	shift 3	shift 1	shift 2	shift 3
1	4.659	6.130	7.480	7.527	12.644	7.874
2	15.523	18.561	19.476	2.527	7.576	4.494
3	8.745	8.922	7.774	9.126	7.807	2.827
4	18.587	19.919	24.727	3.717	6.911	2.909
5	6.667	5.745	6.600	7.748	6.284	10.400
6	10.048	12.157	22.897	3.349	5.682	16.822
7	10.345	7.917	6.275	8.621	16.667	14.118
8	15.849	8.403	31.551	5.660	14.706	11.765
9	9.541	12.548	11.228	6.714	6.844	3.860

Table(4) Response surface equations, for shift 1

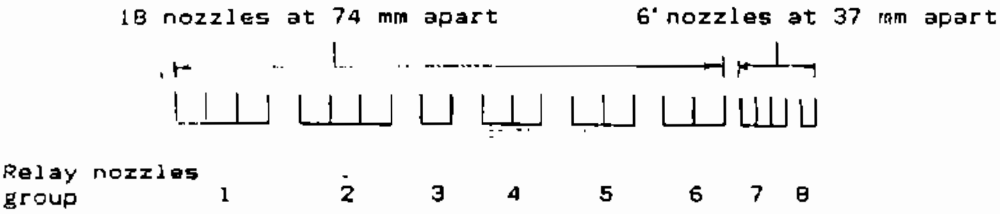
		Correlation coefficient	F-test
1-weft stops per cmpx	$9.56-2.11X1-4.01X2$ $-0.26X1X2+3.53X1^{2}-1.21X2^{2}$	0.95	5.21
2-warp stops per cmpx	$8.63-0.77X1-4.97X2$ $-0.36X1X2+1.49X1^{2}+2.28X2^{2}$	0.89	2.24

Table(5) Response surfacs equations, for 3 shifts

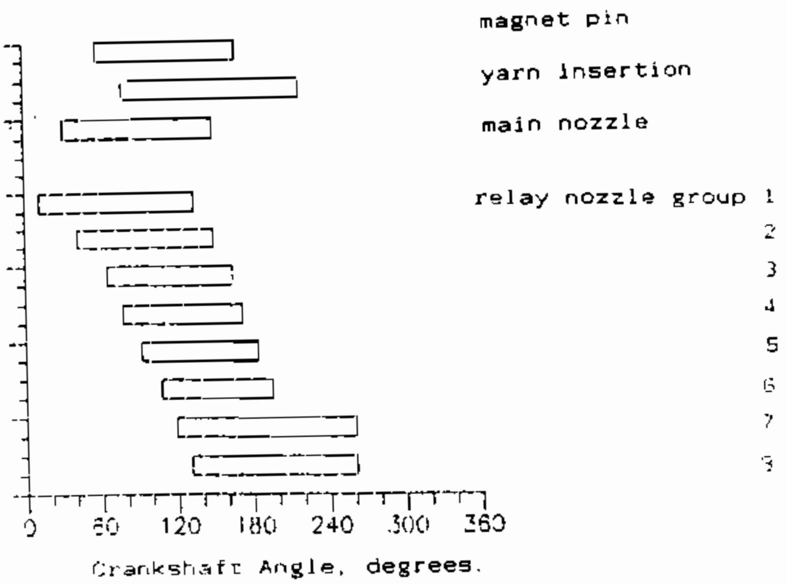
		Correlation coefficient	F-test
1-Weft stops per cmpx	$10.93-2.67X1-5.51X2$ $0.21X1X2+2.55X1^{2}-0.15X2^{2}$	0.95	6.1
2-Warp stops per cmpx	$9.45+0.93X1+X2$ $0.61X1X2+0.65X1^{2}-2.85X2^{2}$	0.68	0.51



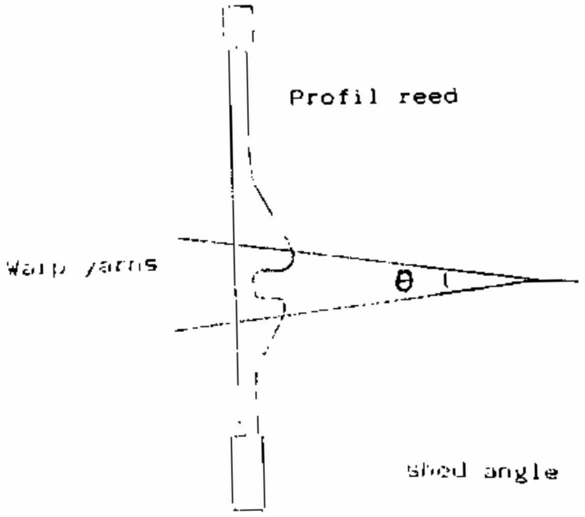
Figure(1) Arrangement of main nozzle, fixed nozzle and acumulator



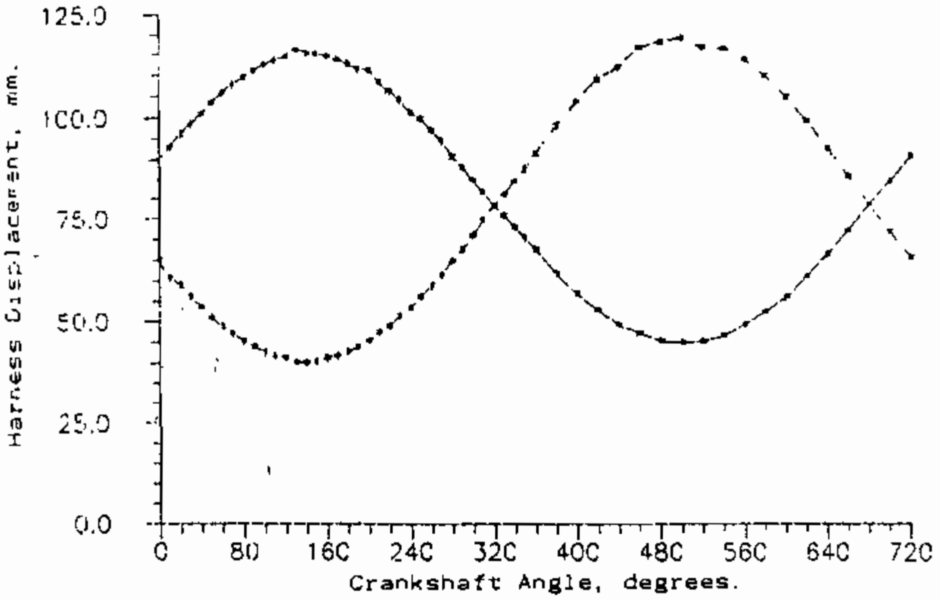
Figure(2) Distribution of relay nozzles along machine width.



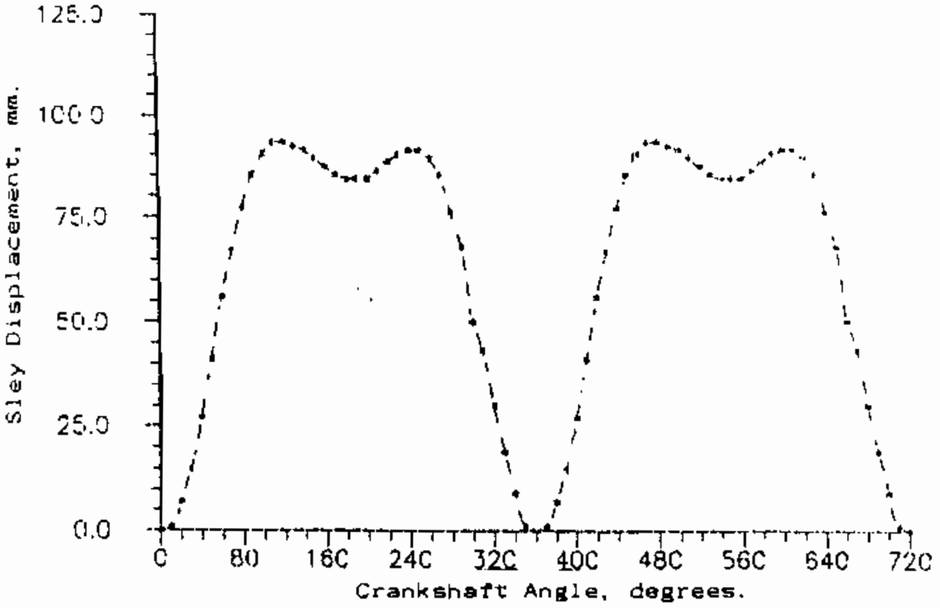
Figure(3) Timing of nozzles, magnet pin and weft insertion.



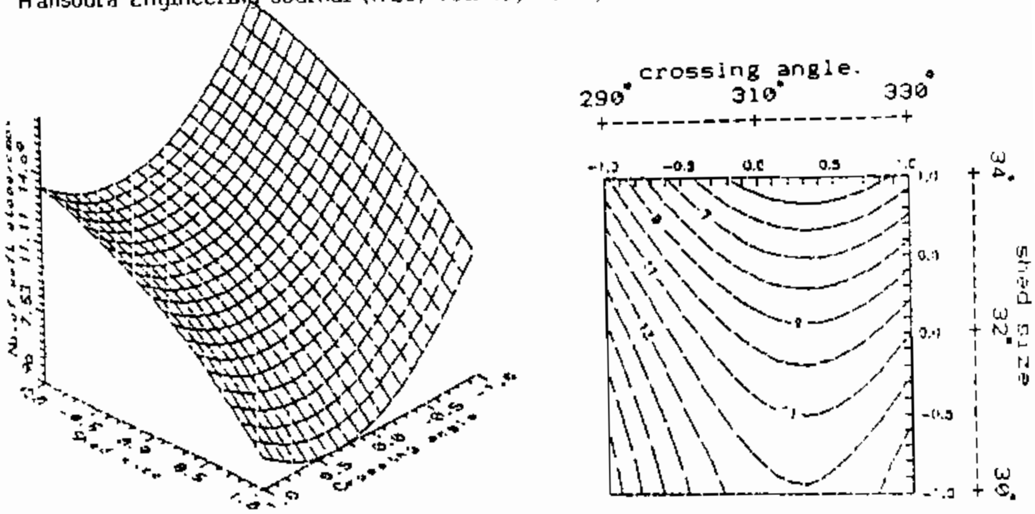
Figure(6) Position of starting weft insertion.



Figure(4) Harness motion diagram, crossing 320.



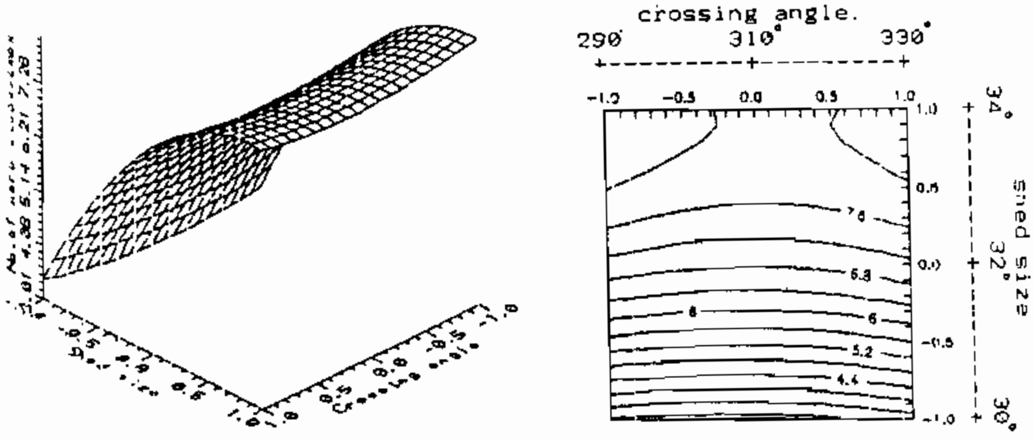
Figure(5) Sley motion diagram



a

b

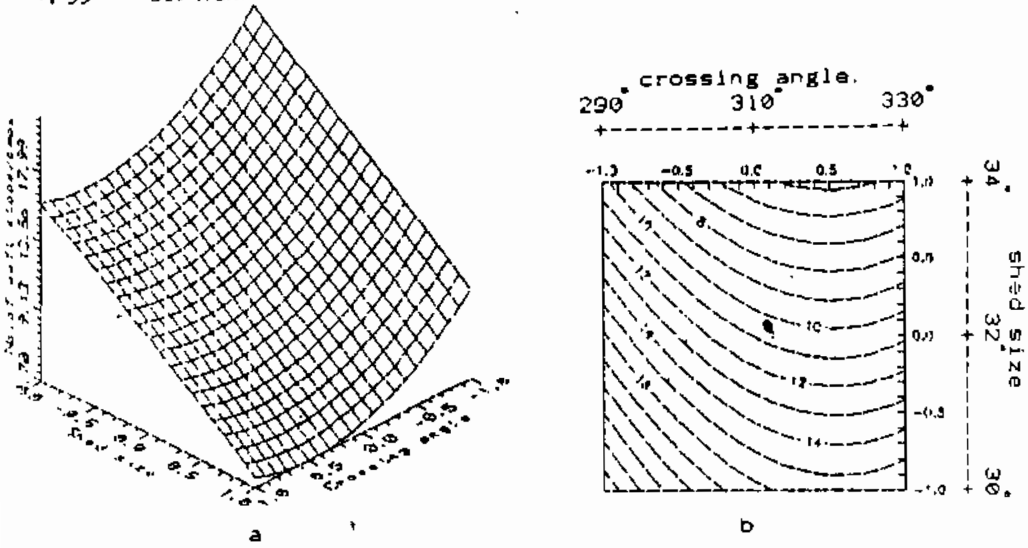
Figure(7) Influence of harnesses crossing angle and shed size on average number of weft stops in shift I
a)response surface.
b)contour lines.



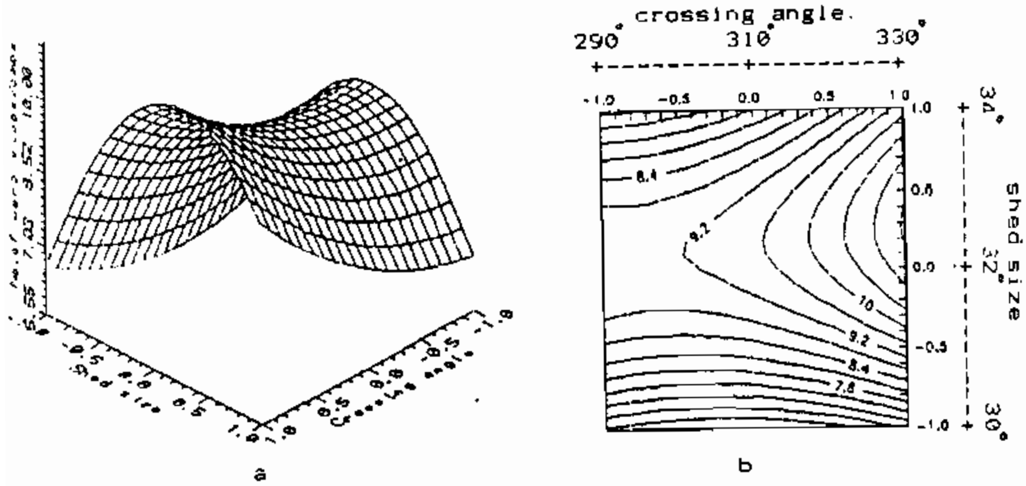
a

b

Figure(8) Influence of harnesses crossing angle and shed size on average number of warp stops in shift I
a)response surfacs.
b)contour lines.



Figure(9) Influence of harnesses crossing angle and shed size on average number of weft stops in 3 shifts
a)response surface.
b)contour lines.



Figure(10) Influence of harnesses crossing angle and shed size on average number of warp stops in 3 shifts
a)response surface.
b)contour lines.