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# Analysis of the effects of shed crossing timing angle on the pick density of woven fabrics.

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## *Abstract*

*It is always difficult to weave cloths specially with finer yarns controlled by asymmetric cam motion. During weaving, there are various factors that affect weaving performance leading poor quality of the fabric as well as nonconformance in the constructional parameters. Consistency in uniform pick spacing is an essential requirement for good quality woven fabrics. There are many factors that can hamper this consistency and timing of the shed crossing angle was found to affect the consistency in picks spacing. The paper reported here demonstrates this aspect of weaving process e.g. the effect of timing of shed crossing angle on the consistency in pick spacing. In this regard fabrics were woven using $40^s$ ,$50^s$ and $60^s$ yarns (both warp and weft) as well as shed crossing timing was also changed to different angles. To produce the fabrics Picanol OptiMax rapier loom was used with asymmetric cam shedding mechanism. It was found that the shed crossing angle timing affect the consistency in pick spacing to a significant extent. The optimum pick density was found when the timing was 298° or 300° with minimum CV%. The results are shown as both in tabulated and graphical forms.*

Key-words: Woven fabric, pick density, sheds crossing, loom timing, asymmetric cams.

## “1. Introduction”

Woven fabrics are the ancient and most aristocratic mean of weaving. The woven fabrics are produced the machine called “loom”. Loom has different setting areas which are needed to be changed when the fabric designs and constructions are changed. Most of the high speed modern looms are operated with cam shedding motion- either symmetric or asymmetric. But the later one is preferred because of the higher scope of design variety. Problem with asymmetric cams is the variation in the pick density. This occurs due to the changes in the shed crossing timing angle. So an optimized timing angle is to be set up to find out the best pick density. Shed crossing angle is the angular measurement of loom shafts when the top and bottom sheds are crossing each other. Every loom has an standard range of angle of this crossing time. When this crossing is done either earlier or later the standard timing angle it results pick space variation. Generally early shed results higher pick density and late shedding causes less pick density. But with early shedding it causes bumping which is harmful for both the machine and cloth. So an optimized setting is needed to find out maximum pick density with no harm. The main purpose of this work is to find out the optimized shed crossing angle to find out the best pick density of the fabric.

### Early Shedding

The weft carrier enters and leaves the shed at around $110^0$ and $240^0$ respectively. The shed is leveled (closed) at $270^0$. Then it starts to open as the two healds starts to move in opposite directions. The shed is fully open at $30^0$. Two healds are at two extreme positions at this moment (One heald is at its topmost position and another is at its bottommost position). From $30^0$ to $150^0$, the healds are stationary. Therefore, the shed is fully open and at dwell during this period. After $150^0$, the healds start to move in opposite direction as compared to the movement they had between $30^0$ and $150^0$. This means that the heald which was at its topmost position starts to descend and vice versa. The shed is again leveled at $270^0$.

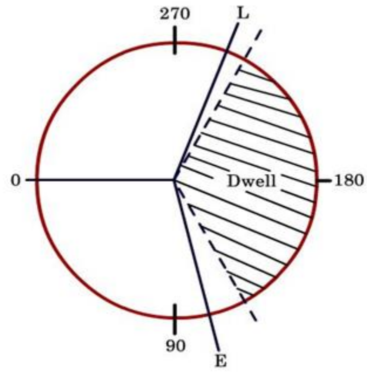


Figure 1: Early Shedding

It is understood that when the rapier enters the shed (110), more than half of the dwell period is over. When the weft carrier leaves the shed (240), the shed is about to close. Therefore, there is high probability that the rapier will abrade the warp sheet which is not desirable especially for the delicate warp yarns. However, this type of timing is advantageous for weaving heavy cotton cloth. Because during beat up (0), the shed is fully crossed. Therefore, the newly inserted pick will be trapped by the crossed warp yarns. As a result, the pick will not be able to move away from the cloth fell ever after the reed recedes. This facilitates attaining higher picks per inch which is required for heavy fabric.

### Late Shedding

The problem of abrasion between warp sheets and weft carrier can be minimized by adopting late shedding. In this case, the timing of shedding is delayed is such a way that it is almost coinciding with the timing of carrier flight. The shed is leveled (closed) at $0^0$. Then it starts to open as the two healds move in opposite directions. The shed is fully open at $120^0$. From 120 0 to 240 0, the healds are stationary. Therefore, the shed is fully open and at dwell during this period. The timing of weft carrier flight almost coincides with the dwell time. After $240^0$, the healds start to move in opposite direction and the shed is again leveled at 0 $0/360^0$.

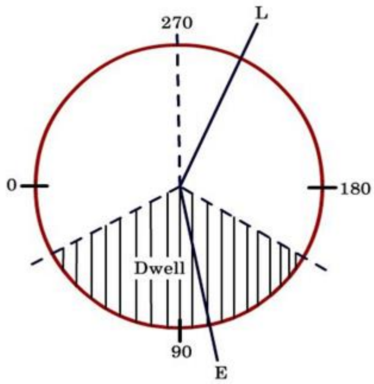


Figure 2: Late Shedding

The beat up occurs when the shed is leveled and healds are yet to cross each other. Therefore, this timing is not favorable for weaving heavy fabrics. However, this kind of timing is favorable for weaving delicate warp yarns and the possibility of abrasion with the carrier is very low.

## "2. Literature Cited"

Early shed timing has a significant effect on fabric properties, whereas late shed timing has limited effects. When shed timing is changed from normal to early Joshi [11] found that the warp crimp decreases and weft crimp increases, but the fabric thickness decreases. Lyer [13] has found that the back rest position has greater influence on thread crimps than shed timing. According to Agarwal [14] both earlier shedding and raised back rest give higher limit of weft packing density however, the former is more effective than the later, when used alone. Joshi, Salam and Natarajan have observed that the warp way fabric strength is not effected by change in shed timings. Lord [18] found that early shedding gives a low warp tension but the amount of abrasion is maximum.

## "3. Methodology"

To conduct this work, fabrics were prepared fabric with same yarn density but yarn count was different. The fabric parameters are shown as tabulated below:

### Fabric parameters:

The fabric particulars are tabulated below.

Table 1: Fabric parameters used in the experiment

| Sl No | EPI | PPI | Warp Count (Ne) | Weft Count (Ne) | Fabric Width (inch) | Weave Type |
|---|---|---|---|---|---|---|
| 1 | 100 | 90 | 40 | 40 | 36 | 1/1 |
| 2 | 100 | 90 | 50 | 50 | 36 | 1/1 |
| 3 | 100 | 90 | 60 | 60 | 36 | 1/1 |

### Yarn parameters:

The yarns have the following criterion which are shown in a tabulated form.

Table 2: Yarn parameters used to produce the fabrics

| Specification | 40 Ne | 50 Ne | 60 Ne |
|---|---|---|---|
| Actual count | 40.56 | 50.44 | 60.61 |
| CV% | 0.66 | .69 | 0.77 |
| IPI | 74 | 86 | 97 |
| CSP | 2975 | 2910 | 2842 |
| E% | 8.93 | 8.67 | 8.77 |
| TPI | 26.56 | 29.69 | 32.53 |
| Fiber MIC Value | 4.4 | 4.4 | 4.4 |
| Fiber Staple Length(mm) | 30 | 30 | 30 |
| Type | Comb | Comb | Comb |

The warping was done by Karl Mayer High Speed warping machine. Sizing was done by Karl Mayer Slasher sizing machine which is originated from Germany. The size take-up percentage was 11% to all of the warp yarns and to weave the fabric Picanol Optimax which is one of the latest weaving machine was used.

### Data Collection:

The pick density was measured by looking glass and needle by physical observation manually following ASTM standard.

## "4. Results & Analysis"

Table 3: Showing comparison of pick density and its CV% on different timing of shed crossing when warp yarn count is 40 Ne, 50 Ne and 60 Ne.

| Sl no | Shed crossing timing in º | Averages for pick density in inch | | | CV% of Pick density | | |
|---|---|---|---|---|---|---|---|
| | | 40 Ne | 50 Ne | 60 Ne | 40 Ne | 50 Ne | 60 Ne |
| 1 | 290 | 90.6 | 90.2 | 90.4 | 0.020051 | 0.026469 | 0.022939 |
| 2 | 292 | 89.6 | 90 | 89.6 | 0.016926 | 0.017568 | 0.020274 |
| 3 | 294 | 90.4 | 90.4 | 89.6 | 0.012613 | 0.01851 | 0.020274 |
| 4 | 296 | 88.4 | 88.4 | 88.4 | 0.006196 | 0.012898 | 0.010118 |
| 5 | 298 | 88 | 87.8 | 88.2 | 0.0 | 0.005094 | 0.00507 |
| 6 | 300 | 88 | 87.2 | 88 | 0.0 | 0.005129 | 0 |
| 7 | 302 | 88.2 | 86.2 | 87.4 | 0.00507 | 0.009706 | 0.006267 |
| 8 | 304 | 86.2 | 86.2 | 86.4 | 0.005188 | 0.005188 | 0.010352 |
| 9 | 306 | 85.8 | 85.8 | 86.2 | 0.005212 | 0.005212 | 0.005188 |
| 10 | 308 | 86 | 86.2 | 86.2 | 0.0 | 0.005188 | 0.005188 |
| 11 | 310 | 85.4 | 85.4 | 84.4 | 0.006414 | 0.006414 | 0.013509 |

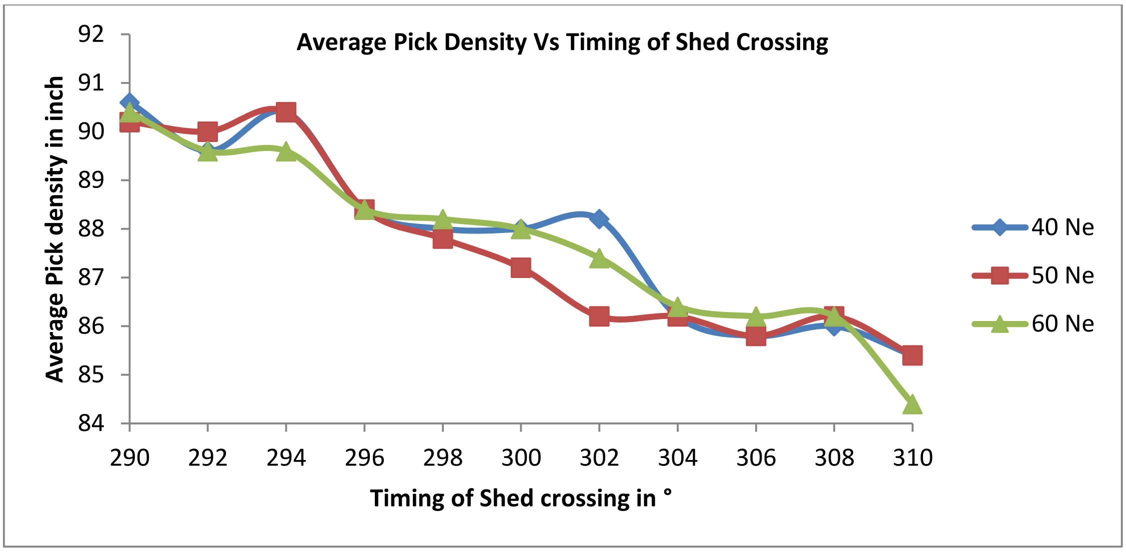


Figure 3: Showing the variation in the average pick density in inch for different count of warp yarn with the variable timing of shed crossing.

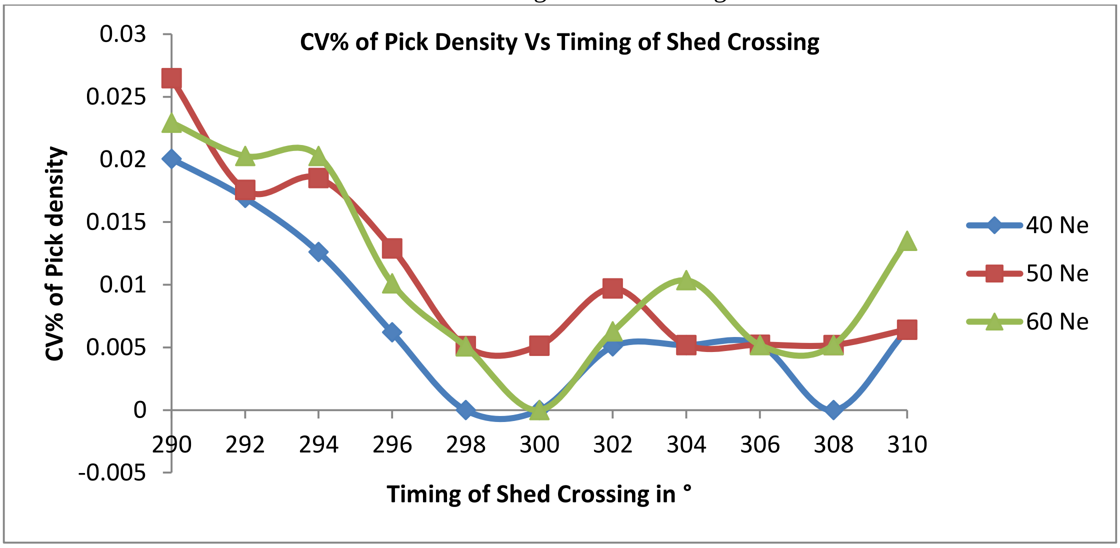


Figure 4: Showing the CV% pick density for different count of warp yarn with the variable timing of shed crossing.

## Analysis

From the table 5.12 it can be stated that, earlier timing of shed crossing gives much higher pick density than to the later timing. But both earlier and late timing has higher CV%. The optimum pick density found with minimum variation at timing 298° to 300°.

It can also be noted that, shed crossing timing does not necessarily have any influence on the pick density for different count of yarn but have some on the variation of the density. More finer the yarn more the variation on the pick density.[Graph 5.18 & 5.19]

## "5. Conclusion"

It was assumed that the shed timing has great influence on pick density and going with this work the assumption was found true. For earlier shed crossing the pick density was found much higher than the late shedding. At crossing angle 290° the pick density was found the highest and at 310° it was found lowest. But with earlier shed crossing the CV% of pick density was also very much high. This variation of the pick density was also found at the late shedding at an significant mark. The CV% of pick density was lowest when the shed crossing angle was 298°-300°.At this crossing angle range the pick density was 88 which is very much acceptable. It was also found that yarn count variation has almost no effect on pick density. So it can be recommended that for getting an optimum pick density the shed crossing angle should be kept on the range of 298°- 300°.

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