FEATURES IDENTIFICATION OF SET MARKS IN WEAVING

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Set marks are becoming a growing concern with high speed weaving. This paper presents the characteristic features identification of set marks in perspective to enhance its technical understanding with specific reference to woven fabric production.

1. INTRODUCTION

Weaving is widely used for producing fabric for apparel, domestic and industrial applications. Normally, a uniform pickspacing in the fabric is maintained by a constant take-up rate to ensure a constant cloth fell displacement during the beat-up of each new pick, provided that the reed generates consistent and regular intensity at each beat-up. While this is largely achieved by today's weaving machinery, there are certain situations when disturbances to pickspacing are caused that result in visible faults in the fabric.

Set marks, a type of fabric fault in the form of pickspacing variation, tend to arise when a loom is restarted after a stoppage. This appears as a sudden change of pickspacing from its normal value which gradually diminishes over a number of picks. The change could be an increase and/or decrease of pickspacing which appears in the fabric as an open region, and/or a dense region respectively. Since a loom has to be stopped from time to time, it is important that the fabrics produced should be free from such faults.

It is mainly creep of the warp and fabric during a loom stoppage and/or loom dynamics during the loom stop/start-up phases that produces set marks. Such creep shifts the cloth fell and causes a variation in the dynamic cloth fell displacement to the normal during the initial few beat-up cycles when the loom is restarted. Cloth fell creep also depends on the duration of stoppage, as well as such factors as the warp tension, loom stopping position, and the previous stressing history of the warp. Set marks are still likely to be produced as the fell drift during a loom stoppage may vary from stoppage to stoppage and cannot be determined accurately except by some direct measurement. Should this displacement be measured and the actual fell drift compensated for immediately before resuming weaving, then any pickspacing variation likely to be produced at start-up could be minimised.

Further, at start-up, the reed may not reach its full working speed over the first one or two picks. This causes an insufficient beat-up intensity. However, this problem has been effectively overcome by using high momentum rush motor drives [Dornier 89, Mohamed 92] or by not inserting picks till the normal loom speed is built up [Picanol 93]. This article explores set marks in perspective.

2. DEFINITION OF SET MARKS

Set marks are defined as fabric faults which occur when a loom is started after a stoppage. The definition applies to a variety of faults of this kind [Islam 98a, 98c, 98d; Islam *et al* 96a, 96c, 96d, 98b; Vangheluwe 95; Wulfhorst *et al* 90, 93]. For example, a set mark is "an isolated narrow bar running parallel with the picks, starting abruptly and gradually shading away to normal fabric. This is due to an abrupt change in the pickspacing followed by a gradual return to normal pickspacing. Such a bar may occur on restarting weaving after

- Pick finding
- Unweaving or pullback
- Prolonged loom stoppage

These bars may be also referred to as start-up marks, setting on places, standing places or pullback places if the precise cause is known" [TexInst 95]. In most cases the set marks take the form of an open region as shown in Fig. 1, often called a 'crack'. The faults have three distinguishing features:

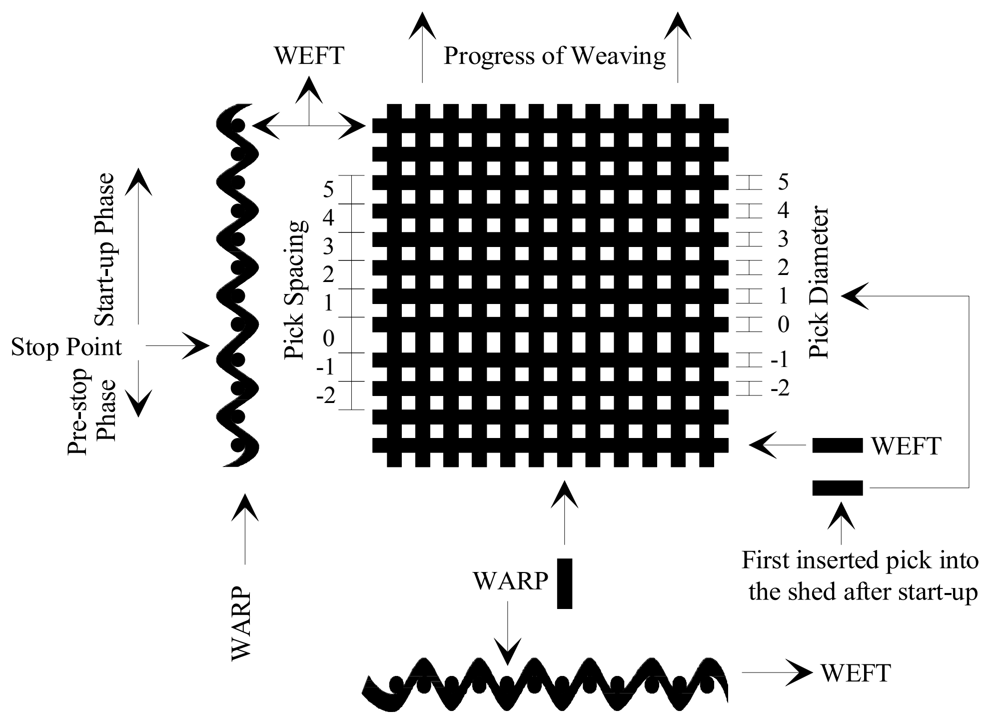


Fig. 1 Example of an idealised set mark, open space [Islam 98a]

- *Pre-stop phase*: a few picks just before the stop point, the analysis of which demonstrates whether the last pick is beaten with enough beat-up force or not.
- *Actual stop point*: at this point basic warp tension, stopping position, and duration of the stop tend to dominate the relaxation or creep process.
- S*tart-up phase*: a few picks immediately after the start-up, usually influenced by nature of loom start-up such as sley inertia and cloth fell drift.

3. CLASSIFICATION OF SET MARKS

A classification of set marks is given in Fig. 2 with particular attention to the area of interest that is considered in this study. Set marks and stop marks are both usually random in nature. A good deal of experience is necessary to identify the causes of these faults correctly. With an appropriate analytical approach the stop mark can be distinguished from a set mark [Islam 96e]. Fig. 2 shows that a thin place is more prominent than a thick place. Major, moderate and minor classifications are useful in further qualitative analysis of these faults.

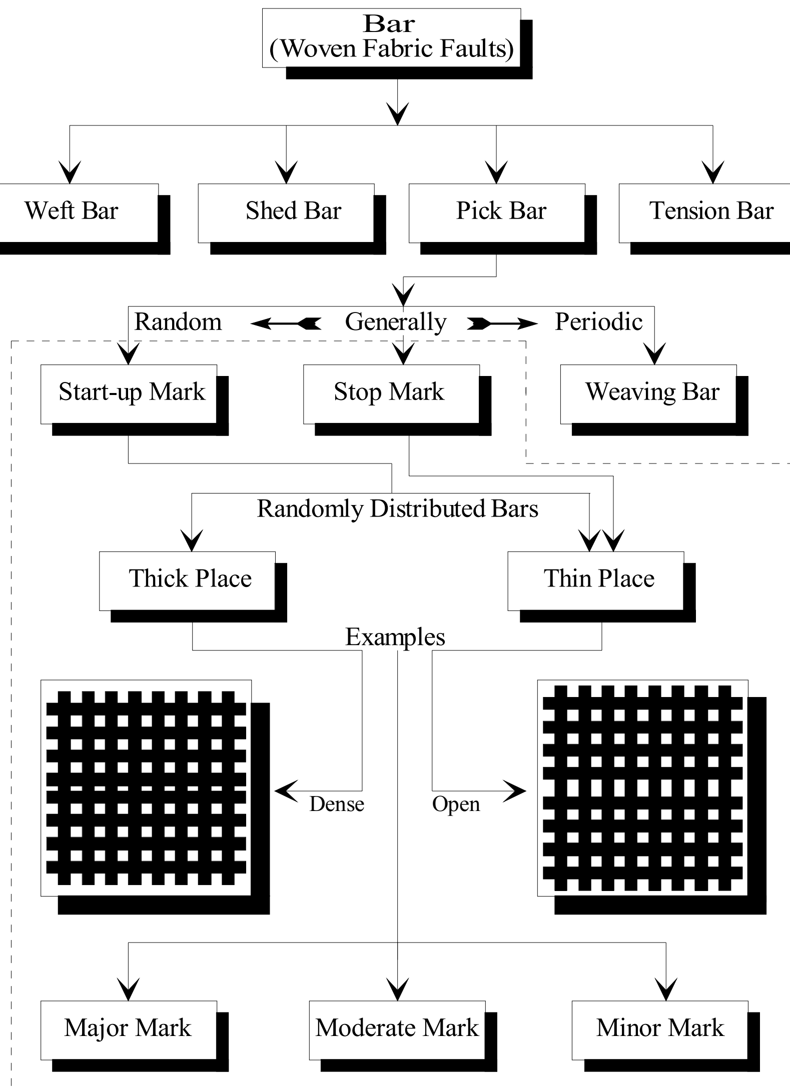


Fig. 2 A classification of set marks [Islam 96e]

4. NATURE OF SET MARKS

A set mark is a functional fault. It can be precisely determined by objective measurement and statistical analysis. Set marks may be easily visible to the eye or detected by simple test means, depending on the type of yarn used; the physical properties of textile fibres have a major effect on their severity [Vangheluwe 95, Morton *et al* 93]. Visco-elastic materials such as regular viscose are more susceptible to permanent deformation under tensile forces and are prone to forming set marks [Wulfhorst 90, 93]. Therefore, at the outset, viscose is used in this study. The weft bar produced due to yarn variation should not be confused with set marks.

Set marks mainly take the following forms [Picanol 93]. An open or thin place as shown in Fig. 3.a, may produce in the fabric due to insufficient beat-up force during a loom stoppage and restart phase. Conversely, a dense or thick place can create (Fig. 3.b) during what can be called an over beat-up.

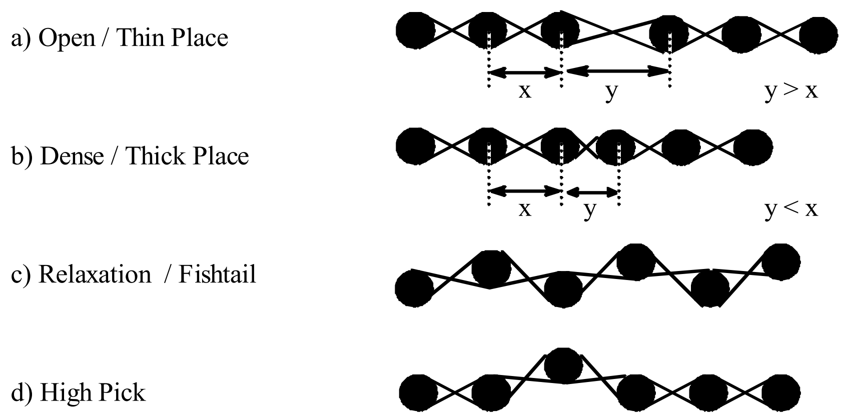


Fig. 3 Types of set marks

With an asymmetrical shed, the tension in the upper and lower sheets of the warp yarns are not equal. This produces unequal creep in the alternate warp yarns during a loom stoppage. As a result, a 'repping' fault (Fig. 3.c) is produced in the fabric during the start-up phase, whereby fabric may lose its strength by upto 40% [Greenwood 57]. This fault may also be produced due to asymmetric weaving construction. For example, for a complex twill weave structure, it is not possible to level all the healds in the same position because of the nature of their binding. Another type of fault occasionally observed is where a single pick protrudes from the surface (Fig. 3.d). This is believed to be due to double beat-up of the same pick.

5. SIGNIFICANCE OF SET MARKS

Despite developments in the modern looms, one of the main problems that remains to be avoided is set marks. Once produced, these faults cannot be eliminated in the subsequent processes; the ultimate rejection percentage depends on the severity of the faults. That is why the prevention of their occurrence is important. The significance of set marks could be summarised as follows:

- *Aesthetic Aspects:*
    - impair fabric appearance
    - distorts consistency in the fabric geometry

- ❋ degrades quality

❒ *Economical Aspects:*

- ❋ substantial loss of materials, energy and labour
- ❋ increase wastes, rejections and costs
- ❋ decrease productivity and profitability

❒ *Functional Aspects:*

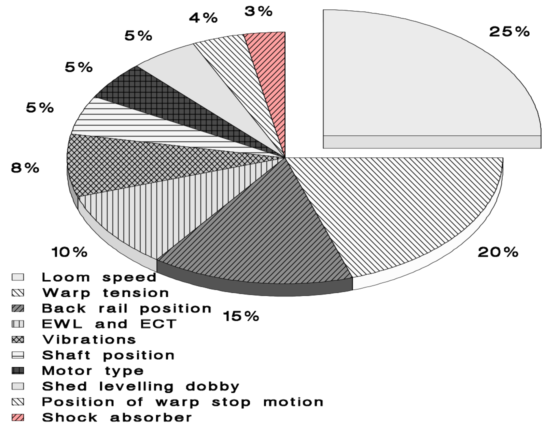
- ❋ changes physical properties of the yarn and fabric
- ❋ reduces strength of the end product
- ❋ affects serviceability and fabric performance

Open spaces are more distinct than dense spaces and fabrics with set marks are rejected or treated as seconds depending upon the type of end use. Some 59 % of total defects are accounted for by set marks in grey export fabrics [Moraye *et al* 78].

Set marks are becoming a growing concern because of the increase in the use of high speed power looms. Cross sectional circularity and surface smoothness of synthetic filament yarns produces more light reflections and make the fault more distinct than with hairy staple yarns. With synthetic filament yarns if pickspacing deviates from the normal by more than 20μm the fault is visible whilst for spun yarns if the deviation is more than 50 μm then the fault is noticeable [Picanol 93]. These thresholds would be more meaningful if they are expressed as a percentage of yarn parameters.

6. CAUSES OF SET MARKS

An analysis of the associated parameters that contribute to the creation of set marks is shown in Fig. 4. Apparently relaxation of the warp and fabric and loom dynamics during the start-up phase are the main causes of set marks. It is generally recognised that a number of other causes also influence this but they are relatively trivial and need not to be considered [Islam 89, 91, 95, 96b, 96e].



Warp tension 30 g/end and loom speed 370 r.p.m. [Wegendt 93].

Fig. 4 Parameters involved in creating set marks

Set marks originate from an interrupted weaving condition. Incorrect cloth fell position may result from many reasons such as inaccurate fell adjustment following finding a broken thread by crossing the heald shafts or by fell drift during a loom stoppage because of the creep of the warp and fabric.

7. SCOPE OF MINIMISING SET MARKS

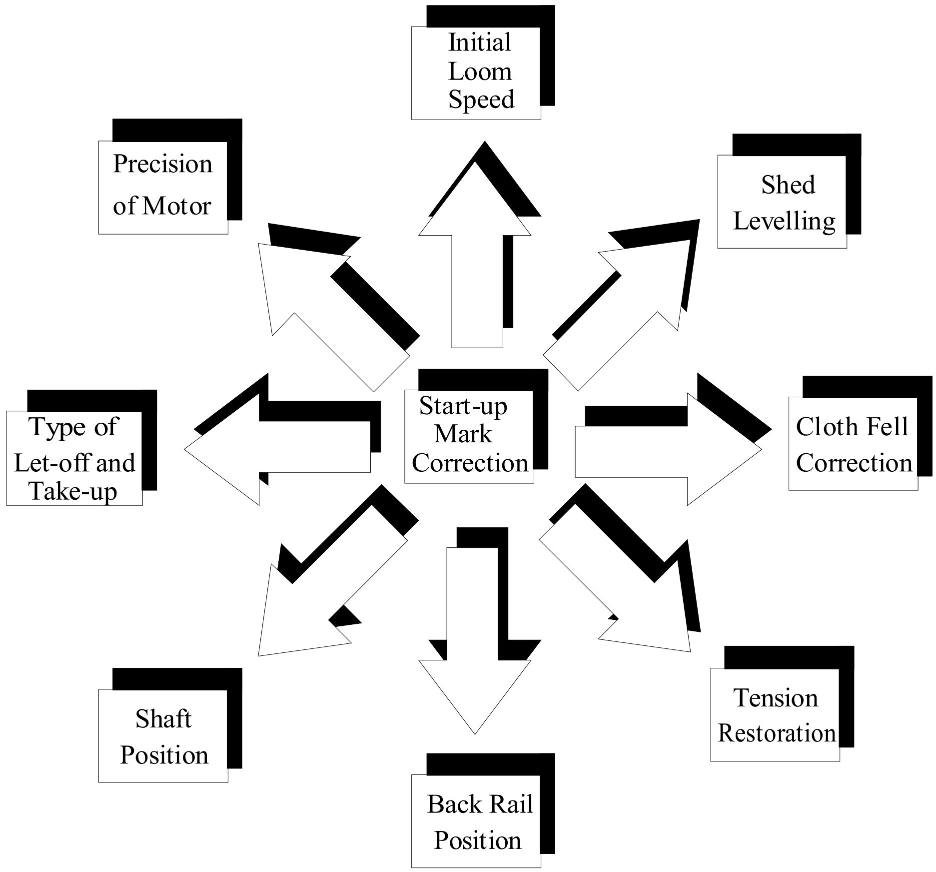
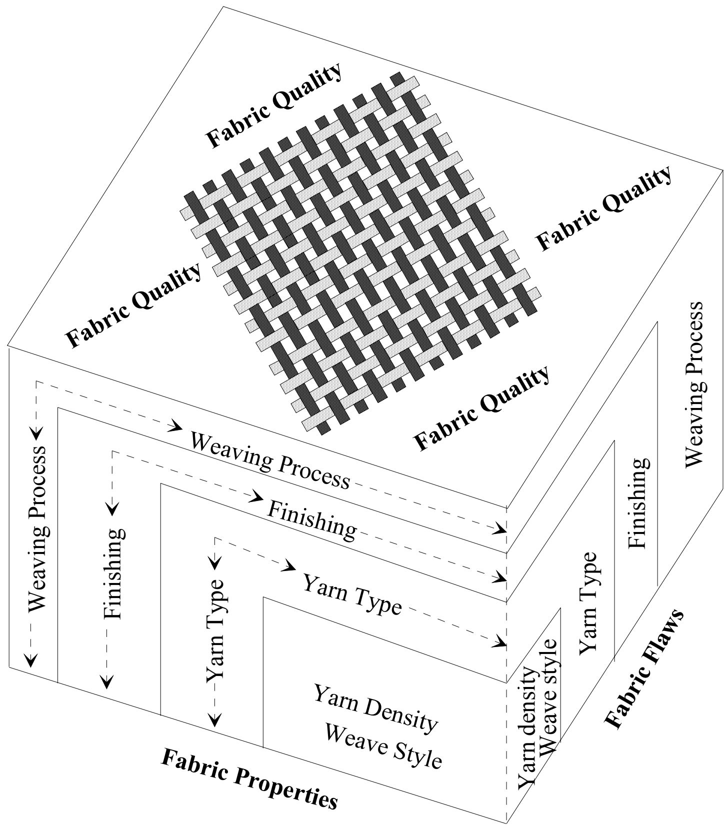


Fig. 5 Aspects of set mark correction

Once a loom is set to weave a given set of yarns then loom operational features as shown in Fig. 5 are the factors that can be controlled with a view to minimising the severity of set marks. The parameters pertaining to the loom (Fig. 5) that could influence set marks are identified. Given the many parameters involved it seems rather difficult to totally eliminate set marks. Most of the offered solutions are based on controlling the factors that are more significant in the creation of set marks.

The quantitative share of constructive elements of fabric formation on fabric quality in terms of fabric properties and fabric defects is shown in Fig. 6. The scope of minimising fabric faults by controlling weaving process is of interest in the context of set marks prevention. Effective control of setting and adjustment of appropriate loom parameters can increase the production without producing objectionable faults [Arakawa *et al* 92].



Adapted from [Weissenberger 94]
Fig. 6 Quantification of the factors influencing fabric quality

8. DISCUSSION

The characteristic features identification of set marks is important. This affects high speed fabric production significantly. Once produced these faults cannot be eliminated in the subsequent processes; therefore its prevention is of paramount importance in increasing productivity and improving fabric quality. The forthcoming paper will highlight the analysis of set marks, focusing attention on the research carried out at the University of Leeds [Islam 96e].

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