Chapter Three

TWILL WEAVES AND THEIR DERIVATIVES

✓ The main feature of these weaves that distinguishes them from other types is the presence of pronounced diagonal lines that run along the width of the fabric.

Parameters:

✓ $R \geq 3$; $S_o = S_y = \pm 1$

✓ The twill weaves are expressed in the form of a fraction.

✓ The numerator of the fraction is equal to the number of warp overlaps and the denominator is equal to the number of weft overlaps within the repeat.
✓ The **sum** of the numerator and denominator of this fraction is the repeat of the twill. Such as 3/1, 1/3, 2/1, 4/1.

**Some concept about the twill weaves:**

✓ **Warp-face twill**, the warp thread floats over all the picks in a repeat except one pick.

✓ **Weft-face twill**,  

✓ **Right-hand twill**,  

✓ **Left-hand twill**.
The direction of the diagonal line can aid in recognition of the face of the fabric.

Denim, gabardine and chino are well-known twill weave fabrics.
The basic characteristics of twill weaves are:

(i) They form **diagonal lines** from one selvedge to another

(ii) **More ends per unit area** and **picks per unit area** than plain cloth

(iii) **Less binding points** than plain cloth

(iv) **Better cover** than plain weave

(v) **More cloth thickness** and **mass per unit area**
✓ Diagonal line angle varying b/n 15°-75°

✓ Twill weaves are named according to the number of harness required to make the design.

  ✓ The simplest twill weave is either ½ or 2/1 twill (three-leaf twill) A 3/1 or 1/3 twill are called four-leaf twill.

✓ Twill weaves are classified as balanced or unbalanced according to the number of warp and weft yarns are visible on the face of fabric.

  ✓ The balanced twill, e.g. 2/2 shows an equal number of warp and weft yarns in the design.

  ✓ The unbalanced (warp or weft face), which produces a more obvious twill line and a more abrasion resistant surface
Balanced or Square 2/2 Right-hand Twill Weave

- The density of yarn \([EPC=PPC]\) is the same
- The linear density \([\text{Warp count} = \text{Weft count}]\) the same
- Identical sequence of interlacing
- Diagonal angle lies at \(45^\circ\)
Un balanced twill

Warp Face 2/1 Twill Weave
✓ In case of warp faced twill weave
✓ The density of warp yarn is higher [EPC>PPC]
✓ Weave with warp floats.
✓ Diagonal angle will have steeper grading
  [>45°]

In case of weft faced twill weave
✓ The density of weft yarn is higher [PPC>EPC]
✓ Weave with weft floats.
✓ Diagonal angle will have a lower angle [<45°]
E.g. 1/2Twill or 1/7 Twill
Degree of Twill Angle
1. Reinforced twill weave

Reinforced twill weave is the simplest twill weave derivatives, which can be constructed by adding warp or weft marks beside the original ones. See Fig. 3.11.

Fig. 3.11 reinforced twill
The reinforced twill is denoted by fraction.

The numerator indicates warp overlaps; and the denominator indicates weft overlaps.

The direction of the diagonal line is denoted by arrowhead. e.g. 
\[
\frac{2}{\text{↗}} \text{ at Fig. } \frac{A}{2}, \quad \frac{4}{\text{↗}} \text{ at Fig. } \frac{B}{2}, \quad \frac{2}{\text{↖}} \text{ at Fig. } \frac{C}{4}.
\]

Applications

Reinforced weaves are widely used in varied fabrics, such as serge, gabardine, drill, and are also used in selvedges of other fabrics.
2. Compound twill

✓ Obtained in **parallel construction** of two or more twill weaves on the same area.

✓ The **number of shafts** for producing compound twill is **equal** to its **repeat**.

✓ The reinforced and compound twills retain the property of the original twill, namely the equality of repeats on warp and on weft.
3. Angled twill/ Zigzag/pointed

✓ Constructed by changing the **sign of shift** from plus to minus, after as assigned number of threads. With the change of sign, the direction of twill diagonal is also changed.

**To construct the angled twill:**

✓ The weft repeat is equal to the repeat of the basic twill, i.e. $R_y = R_{yb}$
✓ The warp repeat can be determined by the formula: $R_o = 2K_o - 2$
✓ Where $K_o$ is the number of warp threads after which the sign of shift changes.

Ex.1. Construct the angled twill on the basis of twill 2/4

The repeat of basic twill is 6.
The repeat of angled twill is calculated as follows:
- $R_y = R_{yb} = 6$
- $R_o = 2K_o - 2 = 2 \times 6 - 2 = 10$

For producing this weave, the Point draft is used.
Ex. 2. Construct the angled, twill on the basis of twill 1.3.1
1.1.3
4. HERRINGBONE TWILL

- The twill is reversed as in the case of pointed twills, the pointed effect is broken.
- This type of construction produces a distinct stripe effect and also prevents the formation of extended float.
Many combinations and variation of twill constructions are possible.
These produce interesting effect.
The most well-known are herringbone (broken twill), gabardine and corkscrew twill.
5. Elongated Twill

✓ These twills are obtained by arrangement of a continuous twill either warp way or weft way.

✓ The rearrangement is normally done in a particular order or sequence.

✓ Designed by selecting or re-arranging ordinary twill in certain order.

For steep twill $R_y = R_{yb}$
$R_o = K_o/2$

Ex:- 7.2.2
3.1.3
H is constructed by inserting every second end of the twill, and the steep twill I, by inserting every third end.

The flat twill J is constructed by inserting every second pick of given twill, and K by inserting every third pick.

The repeat of the new design in one direction is predominantly less because the warp yarns are usually stronger and more abrasion resistant, it is more usual to step upwards to create a steep angle.

The properties of the resulting fabric are then enhanced further by having more EPI than PPI.
In these types of weaves two different types of twills are combined together alternately.

The combination may be warp way or weft way.

Accordingly warp or weft faced twills may be used suitably.

These twills are constructed by two methods:

1. End and end combination
2. Pick and pick combination

In the first method the twill weaves are combined end way and in the second method twill weaves are combined in pick way.

The type of draft used here is the skipped draft. The heald shafts are divided into two groups, The first group controls the first design and the second heald shaft controls the second design.
Combined twill constructed by end combination

Combined twill constructed by Pick and Pick Combination
7. Diamond and diaper weaves

1. Diamond weaves

✓ Diamonds are **symmetrical** about their **vertical** and **horizontal** axis. These can be produced with the **point draft**.

✓ Diamond designs are based on angled twill and can be considered as vertical angled twill combines with horizontal angled twill. (See Fig. 3.29)

Fig. 3.29  diamond weave
Weave drawn

(1) Choosing base weave:

(2) Determining $K_o$, $K_y$: (the size of the pattern)

(3) Drawing the basic part according to base weave and $K_o$, $K_y$.

(4) Drawing the angled twill.

(5) Drawing the other part by taking the weft thread $K_y$ as the axes of symmetry.
Example:

Drawing the diamond weave, base weave is 2/2 twill, $K_O=4$, $K_y=4$. 

Diamond fabric samples:
2. Diaper weaves

✓ Diaper designs are based on herringbone twill combining with a horizontal herringbone twill. See Fig.3.30

Applications

Diamond and diaper weaves are suitable for pointed draft and they are widely used for lady’s cloth, sheet and woollen fabrics.

Fig.3.30 Diaper weave
Homework:

1. Drawing the following angled twills, and adding the weaving plan:

   1) Basic weave  \[
   \begin{array}{cc}
   2 & 1 \\
   1 & 2 \\
   \end{array} \rightarrow K_0=9
   \]

   2) Basic weave  \[
   \begin{array}{ccc}
   1 & 1 & 3 \\
   1 & 2 & 2 \\
   \end{array} \rightarrow K_0=10
   \]

   3) Basic weave  \[
   \begin{array}{cc}
   2 & 1 \\
   3 & 2 \\
   \end{array} \rightarrow K_0=12
   \]

2. Drawing the following Herringbone weaves:

   1) Basic weave  \[
   4 \rightarrow K_0=8
   \]

   2) Basic weave  \[
   \begin{array}{ccc}
   4 & 1 & 1 \\
   1 & 4 & 1 \\
   \end{array} \rightarrow K_0=12
   \]

3. Drawing the diamond weave, the basic weave is 2/2\[ \rightarrow K_0=10, K_y=10 \]