

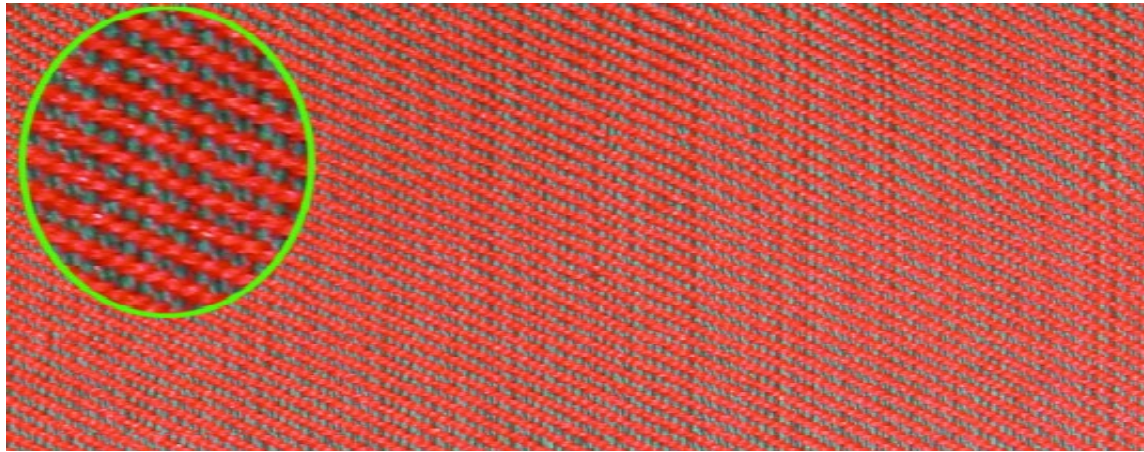
Chapter Three

TWILL WEAVES AND THEIR DERIVATIVES

- ✓ The main feature of these weaves that distinguishes 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.

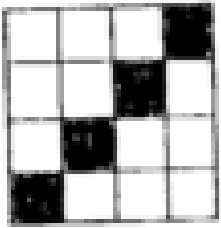


- ✓ The **sum** of the numerator and denominator of this fraction is the repeat of the twill. Such as $3/1$, $1/3$, $2/1$, $4/1$.

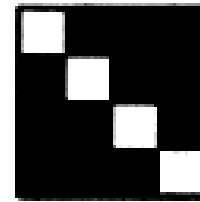
Some concept about the twill weaves:

- ✓ **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**.

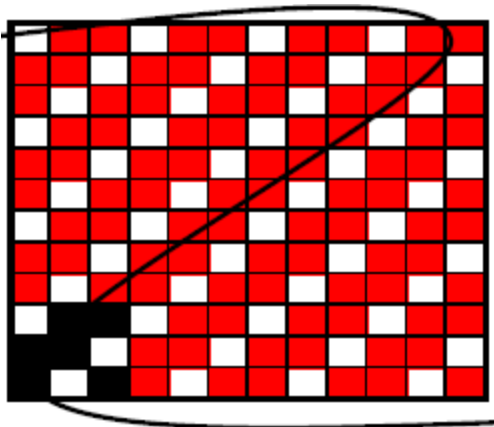
- ✓ The direction of the diagonal line can aid in recognition of the face of the fabric.
- ✓ **Denim, gabardine** and **chino** are well-known twill weave fabrics



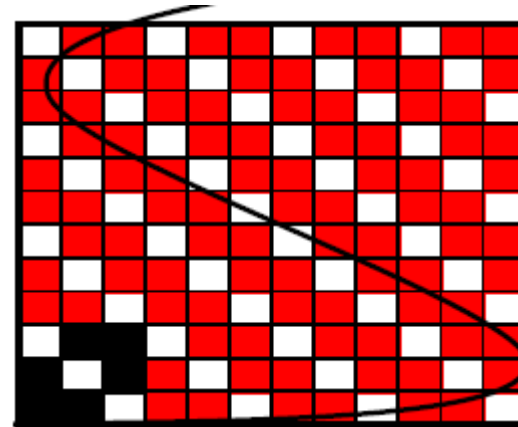
Weft-face & right-hand twill $R=4$
 $S_y=1$



Warp-face & left-hand twill
 $R=4S_y=-1$



Right-hand twill



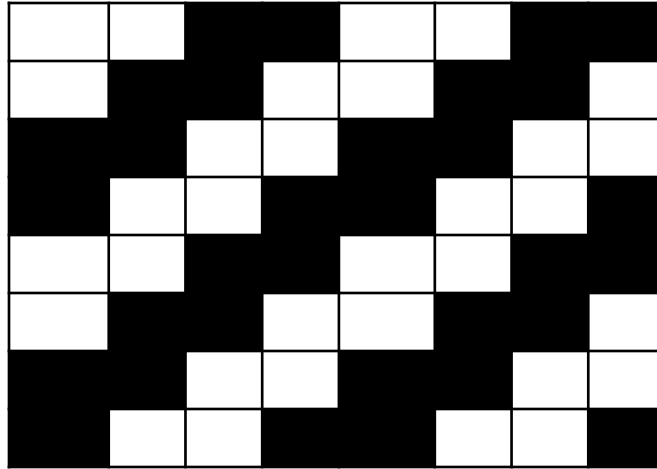
Left-hand twill

✓ **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 $\frac{1}{2}$ or $\frac{2}{1}$ twill (three-leaf twill) A $\frac{3}{1}$ or $\frac{1}{3}$ 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. $\frac{2}{2}$ 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

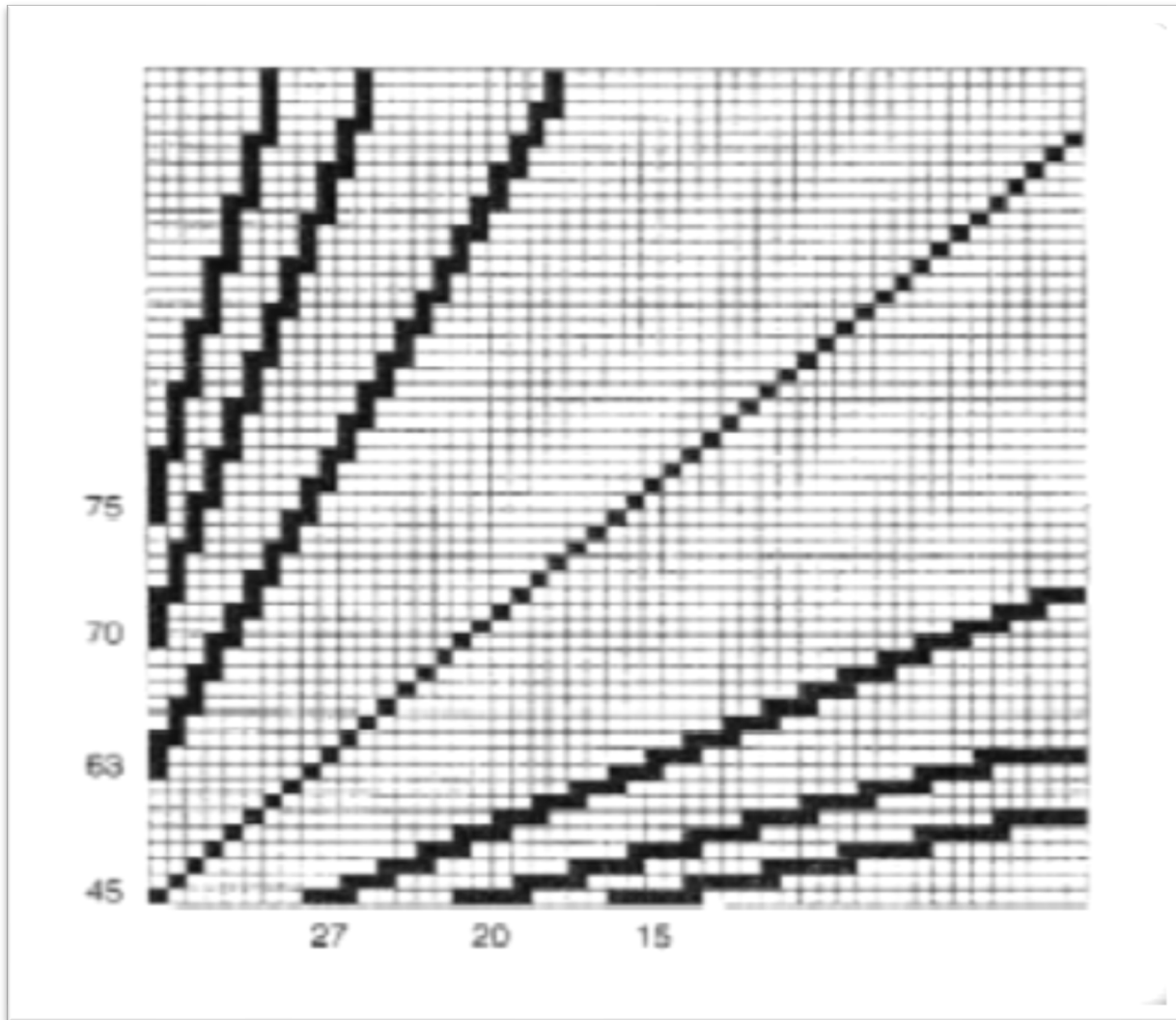
Balanced or Square 2/2 Right-hand Twill Weave



❖ In case of balanced or square twill weave

- ✓ The density of yarn [EPC=PPC] is the same
- ✓ The linear density [Warp count = Weft count] the same
- ✓ Identical sequence of interlacing
- ✓ Diagonal angle lies at 45°

Degree of Twill Angle



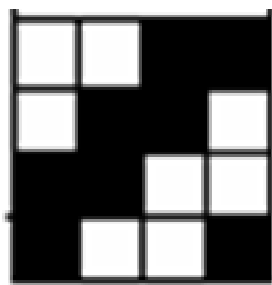


Twill Weave Derivatives

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.

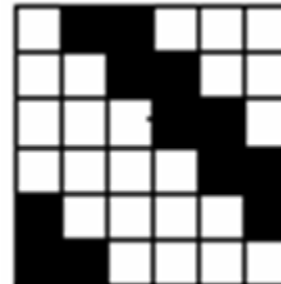
See Fig. 3.11.



A



B



C

Fig. 3.11 reinforced twill



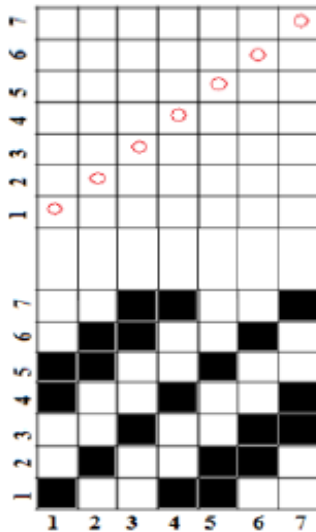
- ✓ The reinforced twill is denoted by **fraction**.
- ✓ The numerator indicates warp overlaps; and the denominator indicates weft overlaps.
- ✓ The direction of the diagonal line is denoted by arrowhead. e.g.
 at Fig. $\frac{2}{2}$ A,  at Fig. $\frac{4}{2}$ B,  at Fig. $\frac{2}{4}$ C.

Applications

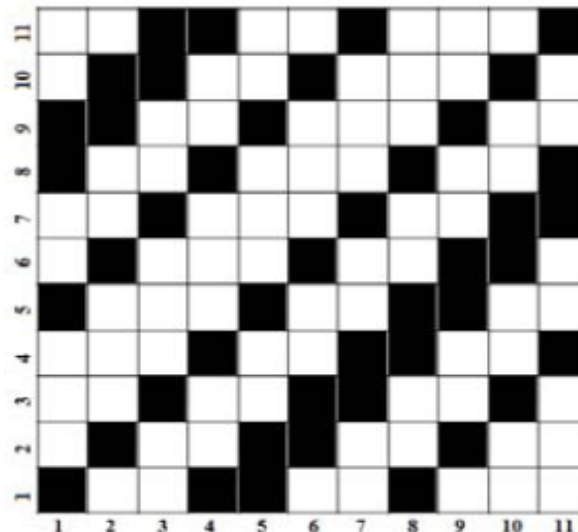
- ✓ Reinforced weaves are widely used in varied fabrics, such as serge, gabardine, drill, and are also used in selvages of other fabrics.

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.



$\frac{1.2}{2.2} \text{ Twill}$



$\frac{1.2.1}{2.2.3} \text{ Twill}$

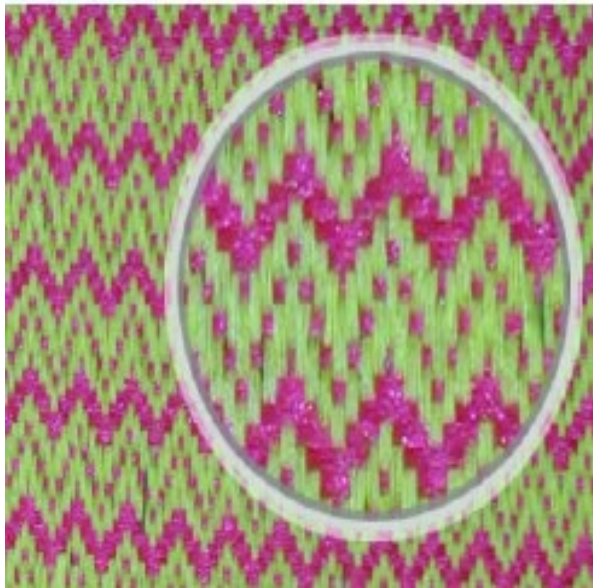
3. Angled twill/ Zigzag/pointed

- ✓ 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

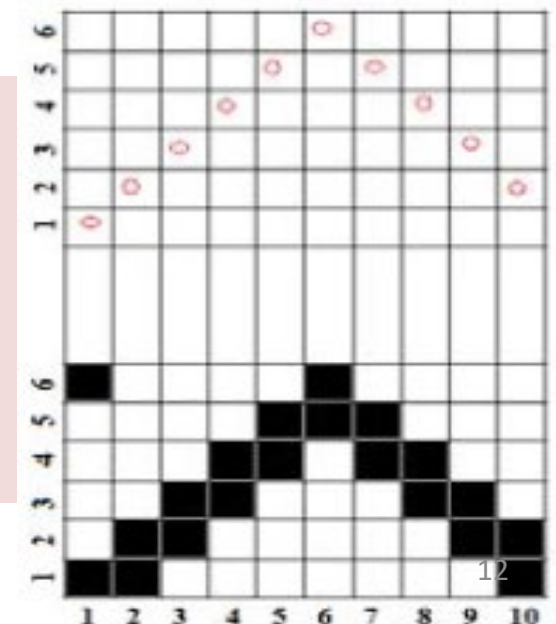


The repeat of basic twill is 6.
The repeat of angled twill is calculated as follows:

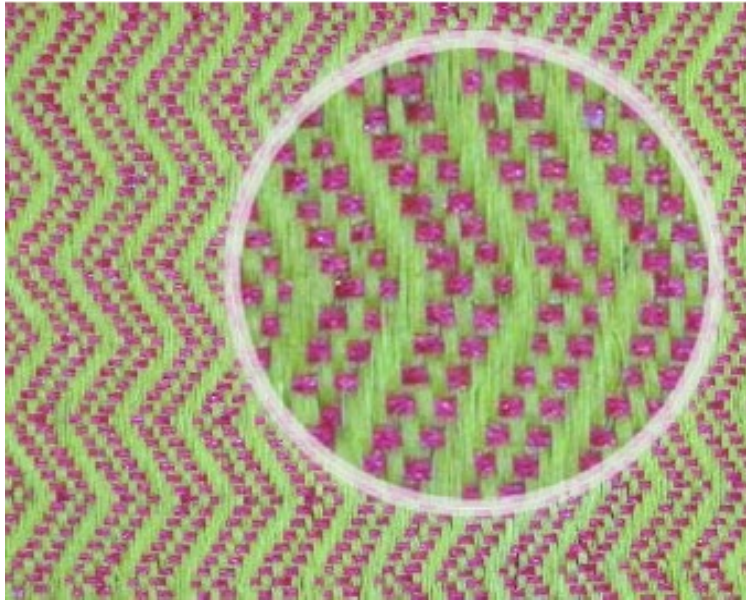
$$\text{➤ } R_y = R_{yb} = 6$$

$$\text{➤ } R_o = 2K_o - 2 = 2 \times 6 - 2 = 10$$

For producing this weave the Point draft is used.

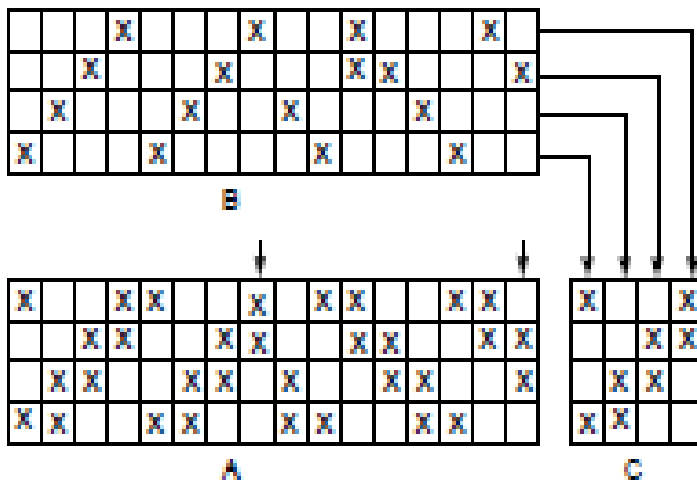
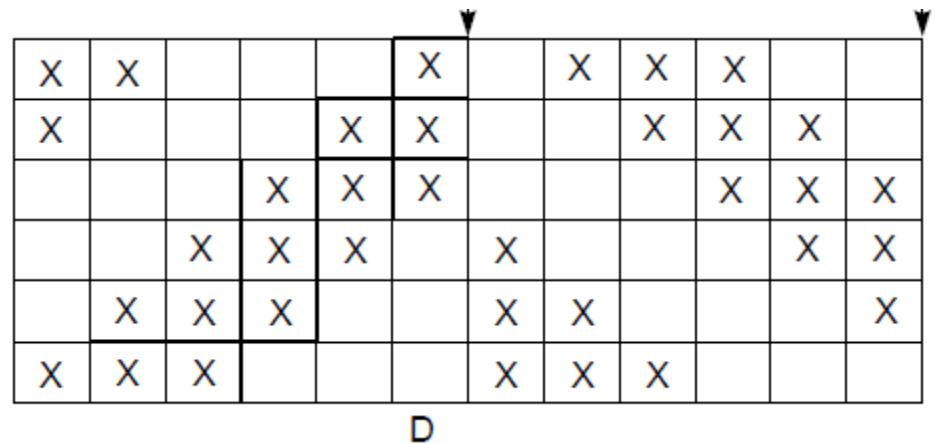


Ex. 2. Construct the angled, twill on the basis of twill 1.3.1
1.1.3

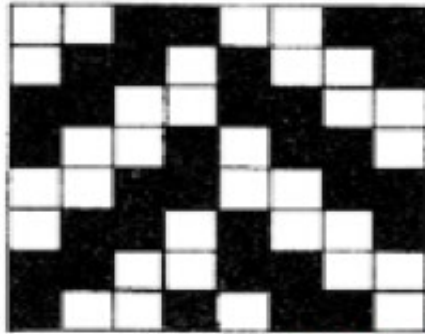


4. HERRINGBONE TWILL

- ✓ 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

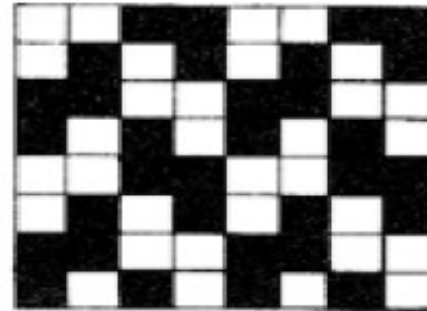


- ✓ Many combinations and variation of twill constructions are possible.
- ✓ These produce interesting effect.
- ✓ The most well-known are herringbone (broken twill), gabardine and corkscrew twill.



a

Herringbone Weaves



b

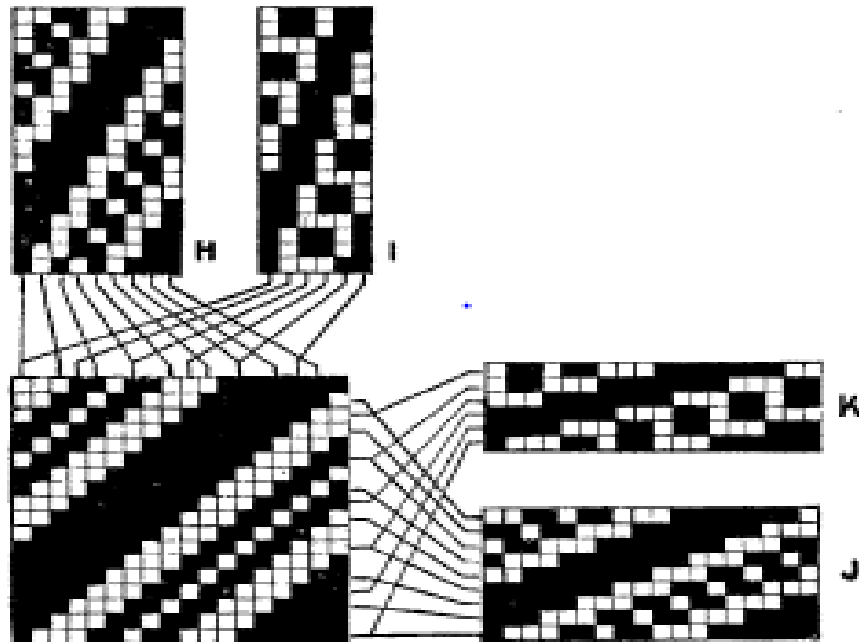


5. Elongated Twill

- ✓ 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 $R_y = R_{yb}$
 $R_o = K_o/2$

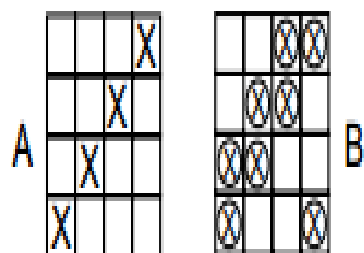
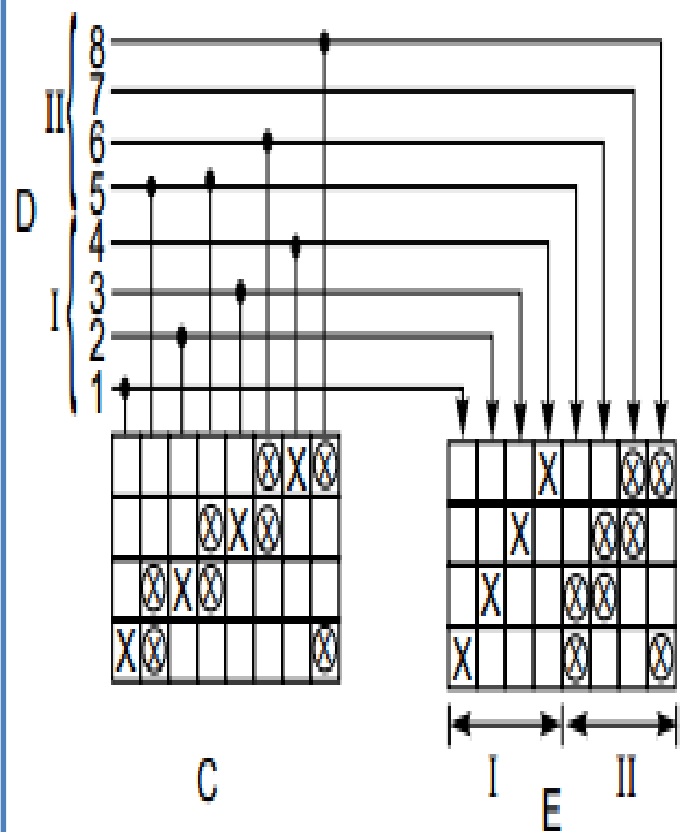
Ex:-7.2.2
3.1.3



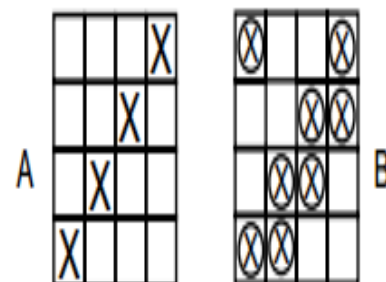
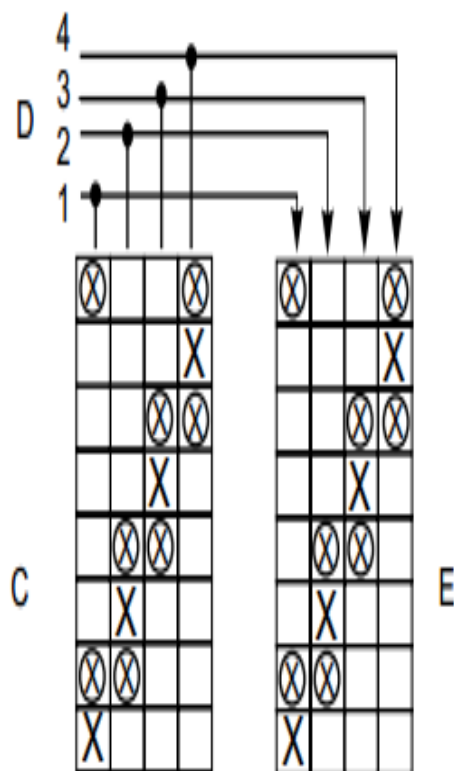
- ✓ H is constructed by inserting every second end of the twill, and the steep twill I, by inserting every third end.
- ✓ The flat twill J is constructed by inserting every second pick of given twill, and K by inserting every third pick
- ✓ The repeat of the new design in one direction is predominantly 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.

6. Combination twill

- 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)

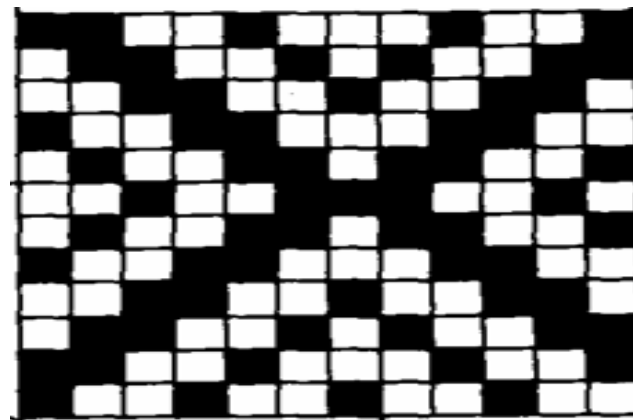


Fig.3.29 diamond weave

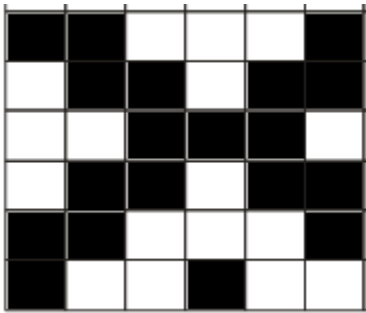
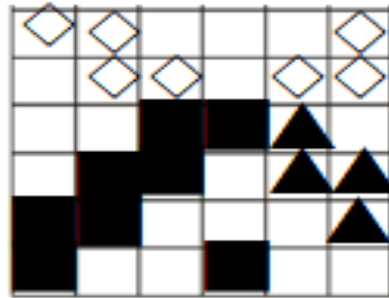
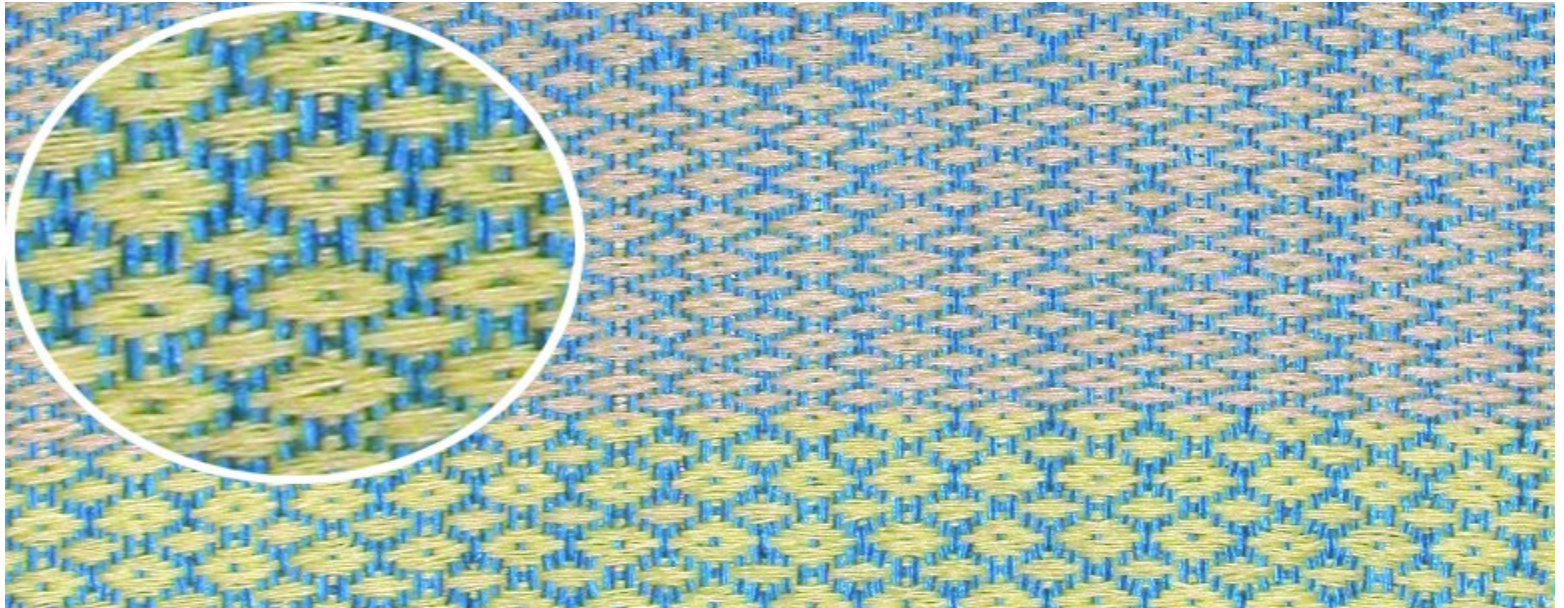


Weave drawn

- (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.

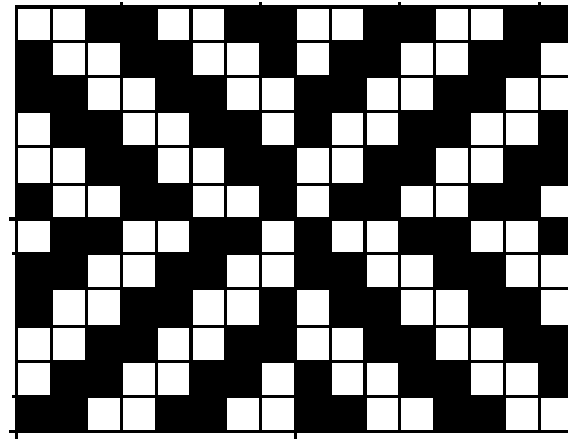


Fig.3.30 Diaper weave

Homework:

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

$$\begin{array}{lcl}
 \text{1) Basic weave} & \begin{array}{c} \frac{2 \quad 1}{1 \quad 2} \nearrow K_0=9 \end{array} & \text{2) Basic weave} \quad \begin{array}{c} \frac{1 \quad 1 \quad 3}{1 \quad 2 \quad 2} \nearrow K_0=10 \\
 \text{3) Basic weave} & \begin{array}{c} \frac{2 \quad 1}{3 \quad 2} \nearrow K_0=12 \end{array} &
 \end{array}$$

2. Drawing the following Herringbone weaves:

$$\begin{array}{lcl}
 \text{1) Basic weave} & \begin{array}{c} \frac{4}{4} \nearrow K_0=8 \end{array} & \text{2) Basic weave} \quad \begin{array}{c} \frac{4 \quad 1 \quad 1}{1 \quad 4 \quad 1} \nearrow K_0=12 \\
 \end{array}$$

3. Drawing the diamond weave, the basic weave is $2/2 \boxed{\nearrow}$, $K_0=10$, $K_y=10$