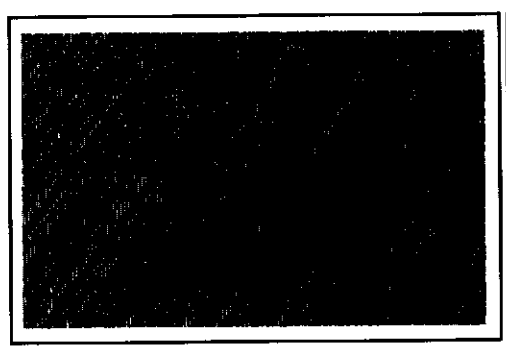
INTRODUCTION TO FABRIC STRUCTURE AND DESIGN

Woven fabrics are composed of longitudinal or warp threads and transverse or weft threads, interlaced with one another according to the class of structure and form of design that are desired. The terms chain or twist are applied to the warp and the warp threads are known individually as ends, while the terms picks and filling are applied to the weft threads.

In the following the term threads is used in referring to warp and weft collectively, but in order to distinguish clearly one series from the other the warp threads are mostly described as 'end' and the weft threads as 'picks'.

According to weave structures woven fabrics may be conveniently divided into two principal categories, as follows:

I. **Simple Structure**:
In which the ends and the picks intersect one another at right angles and in the cloth are respectively parallel with each other. In these constructions there is only one series of ends and one series of picks and all the constituent threads are equally responsible for both the aspect of utility or performance in a fabric and the aspect of aesthetic appeal.



Simple Structure

Compound Structure

II. **Compound Structures**:
In which there may be more than one series of ends or picks some of which may be responsible for the body of the fabric, such as ground yarns, whilst some may be employed entirely for ornamental purposes such as 'figuring', or 'face' yarns. In these cloths some threads may be found not to be in parallel formation one to another in either plane, and indeed, there are many pile surface constructions in which some threads may project out at right angles to the general plane of the fabric.

Warp (End) and Weft (Pick / Filling) Yarn:

Warp and weft yarns have different demands placed on them and may differ in their structure or fibre type. Thus, a fabric may not have the same performance characteristics for warp and weft. The warp must withstand the high tensions of the loom and the abrasion of weaving, so the warp yarns are stronger and more uniform with higher twist. Filling yarns are more often fancy or special-function yarns such as high-twist crepe yarns, low-twist napping yarns, or boucle yarns.

Identification of warp and weft:

Differentiating between warp and weft is possible by carefully examining both the fabric and the length-wise and crosswise yarns.

1. The selvedge always runs in the lengthwise (warp) direction of all fabrics.
2. Most fabrics have lower elongation in the warp direction.
3. The warp yarns lie straighter and are more parallel in the fabric because of loom tension.
4. Fancy or special-function yarns are usually in the filling direction.
5. Fabric characteristics may differentiate between the warp and weft directions. For example, poplin has a weft rib and satin has warp floats.
6. Warp yarns tend to be smaller, are more uniform in structure and appearance, and have higher twist.
7. Fabric crimp is usually greater for weft yarns since they must bend or flex over or under warp yarns due to the way the loom operates.

Grain:

Grain refers to the geometry or position of warp yarns relative to filling yarns in the fabric. A fabric that is on-grain has warp yarns parallel to each other and perpendicular to the filling yarns that move straight across the fabric. Lengthwise grain is parallel to the warp yarns. Crosswise grain is parallel to the weft yarns. Fabrics are almost always woven on-grain. Handling, finishing, or stress due to yarn twist, weave, or other fabric aspects may cause fabrics to distort and lose their on-grain characteristic. These fabrics are off-grain. Fabric quality has increased significantly and it is rare to find fabrics as badly off-grain.

Off-grain fabrics: These create problems in production and use. During finishing, off-grain causes reruns or repeating finishing steps and lowers fabric quality. Products do not drape properly or hang evenly and printed designs are not straight.

There are two kinds of off-grain. **Skew** occurs when the weft yarn is at an angle other than 90 degrees to the warp. It usually occurs in finishing when one side of the fabric travels ahead of the other. **Bow** occurs when the weft yarns dip in the center of the fabric; it usually develops when the fabric center lags behind the two sides during finishing.

Fabrics should always be examined for grain. On-grain fabrics usually indicate high quality standards and minimize problems in matching designs or patterns, in cutting and sewing.

Structure:

In the manufacture of a fabric, by weaving on a loom, the technique – how the two series of thread are interlaced at right angles to each other is called structure. Or the interlacements of warp an weft threads are known as structure.

Texture:

A term referring to the appearance or hand of a fabric and especially such features as structure coarseness, openness. This signifies the general quality of a fabric, developed by the interlacemen of yarn used weight, bulk, how it feels when handled etc. are also express by the term texture Materials, count of the yarns relative density of threads are its main factors.

Sett:

A term used to indicate the spacing of ends and/or picks in a woven cloth this is usually expressed a threads per inch, centimeter or other convenient unit. The state of the cloth of the time should b described, eg. Grey, finished woven fabric setts are commonly given in a pare

warp x weft, as for example handkerchief – 36 x 36

Thread density in warp and weft:

Warp (ends) density is expressed in Ends per inch (EPI) Or Ends per cm (EPC)
Weft (picks) density is expressed in Picks per inch (PPI) Or Picks per cm (PPC)

Woven fabric Specification:

Woven fabric construction or specification as follows:

$$\frac{EPI \times PPI}{Warp\ count \times Weft\ count} \times Fabric\ \ width \quad OR \quad \frac{Warp\ count \times Weft\ count}{EPI \times PPI} \times Fabric\ Width$$

For example:

$$\frac{110\ X\ 52}{20\ X\ 16}\ X\ 56",\qquad \frac{30\ X\ 30}{130\ X\ 70}\ X\ 57 - 58"$$

Fabric weight calculation:

There are two way of fabric weight calculation. One is weight per unit area such as, GSM(grams per square meter) or oz / yd^2 and another way is weight in running length.

GSM calculation:

Calculate the GSM of the following fabric

$$\frac{120\times 70}{40\times 30}\times 58"$$

For warp weight calculation

Here, EPI = 120

$\therefore$ Total number of ends = 120×39.37

Length of each end = 1m + 1m × 0.03 (warp crimp% = 3%)

= 1.03m

$\therefore$ Total length of warp yarn = 120 × 39.37 × 1.03 m

We get from the yarn numbering system,

$$Ne = \frac{L\times w}{W\times l}$$

$$\therefore W = \frac{L\times w}{N_e\times l}$$

$$= \frac{120\times 39.37\times 1.03\times 453.6}{40\times 840\times 0.9144}\text{gm}$$

For Weft weight calculation

Here, PPI = 70

$\therefore$ Total number of picks = 70×39.37

Length of each pick = 1m + 1m × 0.05 (weft crimp% = 5%)

= 1.05m

$\therefore$ Total length of weft yarn = 70 × 39.37 × 1.05 m

We get from the yarn numbering system,

$$Ne = \frac{L\times w}{W\times l}$$

$$\therefore W = \frac{L\times w}{N_e\times l}$$

$$= \frac{70\times 39.37\times 1.05\times 453.6}{30\times 840\times 0.9144}\text{gm}$$

$\therefore$ Total weight of the fabric per square meter $= \frac{120\times 39.37\times 1.03\times 453.6}{40\times 840\times 0.9144}+\frac{70\times 39.37\times 1.05\times 453.6}{30\times 840\times 0.9144}$

$$= \left(\frac{120\times 1.03}{40}+\frac{70\times 1.05}{30}\right)\times\frac{39.37\times 453.6}{840\times 0.9144}$$

$$= \left(\frac{120\times 1.03}{40}+\frac{70\times 1.05}{30}\right)\times 23.25$$

$$\textbf{GSM} = \left(\frac{EPI\times 1.03}{Ne_{wa}}+\frac{PPI\times 1.05}{Ne_{we}}\right)\times \mathbf{23.25}$$

Similarly oz/yd^2 can be calculated by the following formula:

$$\text{oz/yd}^2 = \left(\frac{\text{EPI} \times 1.03}{\text{Ne}_{wa}} + \frac{\text{PPI} \times 1.05}{\text{Ne}_{we}}\right) \times 0.686$$

1.03 = For warp crimp (warp crimp % = 3%)

1.05 = For weft crimp (weft crimp % = 5%)

The crimp % for warp and weft can be changed. These two values normally applicable for most common fabrics, although crimp% mainly depends on fabric structure.

Weight calculation in running length (Yarn consumption calculation):

Calculate the weight of warp and weft yarn in kg to produce 2000 m of the following fabric

$$\frac{150 \times 100}{50 \times 50} \times 58"$$

For warp weight calculation

Here, EPI = 150

$\therefore$ Total number of ends = 150×58

Length of each end = 2000m + 2000m × 0.03 (warp crimp% = 3%)

= 2060m

$\therefore$ Total length of warp yarn = 150 × 58 × 2060 m

We get from the yarn numbering system,

$$\text{Ne} = \frac{L \times w}{W \times l}$$

$$\therefore W = \frac{L \times w}{N_e \times l}$$

$$= \frac{150 \times 58 \times 2060 \times 0.4536}{50 \times 840 \times 0.9144} \text{ kg} + 20\% \text{ wastage of the total weight of warp.}$$

From the above system a simple formula is developed to calculate the weight of warp yarn in kg to produce a particular length of a fabric as follows:

Weight of warp yarn in kg. =

$$\frac{\text{EPI} \times \text{Fabric width in inch} \times (\text{Fabric length in m} + \text{Fabric length in m} \times \text{crimp\%})}{\text{Ne}_{warp}} \times 0.0005905512$$

+ Wastage % of total weight of the warp (about 20%)

For Weft weight calculation

Here, PPI = 100

$\therefore$ Total number of picks = 100×39.37×2000

Length of each pick = (58" + 58" × 0.05)/39.37 (weft crimp% = 5%)

= 1.547m

∴Total length of weft yarn = 100 × 39.37× 2000 × 1.547 m

We get from the yarn numbering system,

$$Ne = \frac{L \times w}{W \times l}$$

$$\therefore W = \frac{L \times w}{N_e \times l}$$

$$= \frac{100 \times 39.37 \times 2000 \times 1.547 \times 0.4536}{50 \times 840 \times 0.9144} \text{ kg +15\% wastage of the total weight of weft.}$$

From the above system a simple formula is developed to calculate also the weight of weft yarn in kg to produce a particular length of a fabric as follows:

Weight of weft yarn in kg. =

$$\frac{PPI \times \text{Fabric length in m} \times (\text{Fabric width in inch} + \text{Fabric width in inch} \times \text{crimp\%})}{Ne_{weft}} \times 0.0005905512$$

+ Wastage % of total weight of the weft (about 15%, although it depends on selvedge, loom type)

Similarly weight of the warp and weft yarn in pound (lb) can be calculated by the following formula:

Weight of warp yarn in lb. =

$$\frac{EPI \times \text{Fabric width in inch} \times (\text{Fabric length in yds} + \text{Fabric length in yds} \times \text{crimp\%})}{Ne_{warp} \times 840}$$ + Wastage % of total weight of the warp (about 20%).

Weight of weft yarn in lb. =

$$\frac{PPI \times \text{Fabric length in yds} \times (\text{Fabric width in inch} + \text{Fabric width in inch} \times \text{crimp\%})}{Ne_{weft} \times 840}$$ **+ Wastage** % of total weight of the weft (about 15%).

Problem:

Calculate the weight of warp and weft yarn in lb to produce 2500 yds. of the following fabric

$$\frac{120 \times 90}{16 \times 14} \times 58"$$

The weight of warp and weft yarn in lb. can be calculated directly from the fabric specification by using the above formula. It will be very easy and it safe lot of times.

Solution:

Weight of warp yarn in lb. =

$$\frac{\text{EPI} \times \text{Fabric width in inch} \times (\text{Fabric length in yds} + \text{Fabric length in yds} \times \text{crimp}\%)}{\text{Ne}_{warp} \times 840} + \text{Wastage \% of total weight of the warp.}$$

$$= \frac{120 \times 58 \times (2500 + 2500 \times 0.03)}{16 \times 840} + 20\ \%$$

$$= 1333.48 + 1333.48 \times 0.2$$

$$= 1333.48 + 266.696$$

$$= 1600.176 \text{lbs. Or } 725.84 \text{ kg } (1600.176 \times 0.4536)$$

Weight of weft yarn in lb. =

$$\frac{\text{PPI} \times \text{Fabric length in yds} \times (\text{Fabric width in inch} + \text{Fabric width in inch} \times \text{crimp}\%)}{\text{Ne}_{weft} \times 840} + \text{Wastage \% of total weight of the weft.}$$

$$= \frac{90 \times 2500 \times (58 + 58 \times 0.05)}{14 \times 840} + 15\ \%$$

$$= 1165.18 + 1165.18 \times 0.15$$

$$= 1339.96 \text{lbs. Or } 607.804 \text{ kg } (1339.96 \times 0.4536)$$

Foundation of woven cloth structure:

Variation of woven cloth structure depends on following foundational factors:

- The nature of yarns used
- The count or relative thickness of the yarns used as warp and weft
- The relative setting, or the number of ends or picks, which are placed side by side in a given width and length of the cloth
- The order of interlacing the ends and picks
- Modifications produced by finishing

Classification or parts of a complete design for a woven fabric:

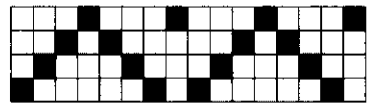
A complete design for a woven fabric consists of three parts as follows:

- **The weave plan:**

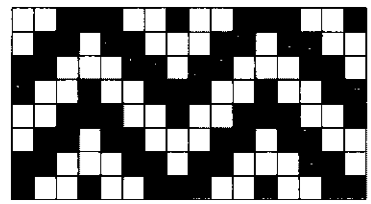
  It illustrates the interlacing of ends and picks in the fabric under consideration. In the weave plan, space between two vertical lines indicates as warp yarn and space between two horizontal lines indicates as weft yarn.

- **The drafting or looming plan:**

  A draft indicates the number of heald, used to produce a given design and the order in which the warp threads or ends are threaded through the mail eyes of the healds. In the drafting plan, space between two vertical lines indicates as warp yarn and space between two horizontal lines indicates as heald shaft.



Drafting plan



Weave plan

Lifting plan

- **The lifting or peg plan:**

  Lifting plan defines the selection of healds to be raised or lowered on each successive insertion of the pick of weft to produce the pattern.

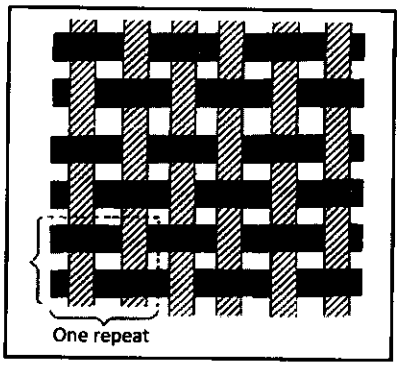
- **Denting plan:**

  This indicates the order of drawing-in the warp threads or ends through the dents of reed.

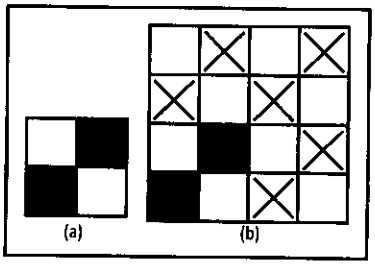
Point paper diagram in textile design:

To illustrate a weave either in plan view and/or in cross-section, as the following figure, takes a lot of time, especially for more complicated weaves. A type of shorthand for depicting weave structures has therefore been evolved and the paper used for producing designs is referred to as squared paper, design paper or point paper. Generally the spaces between two vertical lines of graph or design paper represent one warp thread or end and the spaces between two horizontal lines of graph or design paper indicates one weft thread or pick. If a square is filled in it represents an end passing over a pick whilst a blank square represents a pick passing over an end. If ends and picks have to be numbered to make it easier to describe the weave, ends are counted from left to right and picks from the bottom of the point paper design to the top. The point paper design shown in the following figure (a) is the design for a plain weave fabric . To get a better impression of how a number of repeats would look, four repeats of a design (two vertically and two horizontally) are sometimes shown. When four repeats are shown the first repeat is drawn in the standard way but

for the remaining three repeats crossing diagonal lines may be placed into the squares, which in the first repeat, are filled in. This method is shown for a plain weave in following figure (b).



Plan view - 3×3 repeats

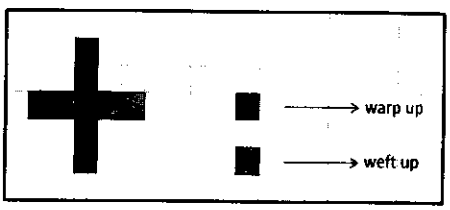


Point paper diagram (a) 1- repeat (b) 4- repeat

Methods of fabric representation:

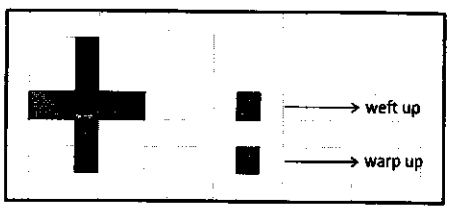
Interlacing type 'a':

In this type the warp yarn is up over the weft yarn. In the graph or design paper, it is represented by putting any type of sign such as cross, circle, or colour shade in the square space of the design paper.



Interlacing type 'b':

In this type the weft yarn is up over the warp yarn. In the graph or design paper, it is normally represented as empty square space of the design paper.

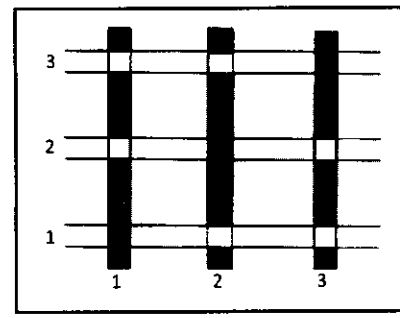


One repeat of weave:

A number of interlacings combined together in both directions produce a unit of design, or one repeat of the weave. In the above figure (a) represents one repeat of the design.

Some important factors or terms:

The weave shows the interlacing pattern of warp and weft. Each weave consists of the following parts or fields



- **Contact fields:**

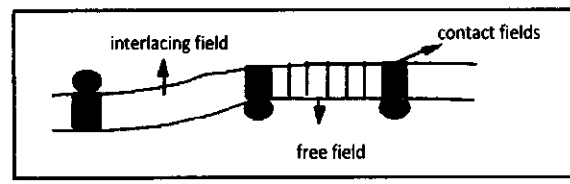
  These are the contact points between warp and weft crossing at right angle. The number of contact fields always equals the product of the number of warp and weft threads. Contact field = $RN_{wa} \times RN_{we} = 3 \times 3 = 9$

- **Interlacing field:**

  These are the points where a yarn of one system of threads changes its position in relation to the other system. A distinction is made between single and double interlacing fields.

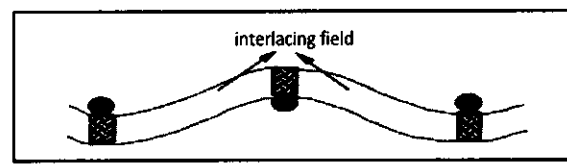
- **Single interlacing field:**

  The yarn bends from the top of the fabric to the bottom and covers two or more yarns.



- **Double interlacing field:**

  The yarn bends, cover a following yarn, bends again and reappears at the same fabric side.



Interlacing fields are active fields since they provide the fabric cohesion.

- **Free field:**

  These are the zones where the warp and weft yarns do not touch and do not change fabric side. Because of the free field floats are formed and the yarns in the weave may shift.

- **Open field:**

These are zones where neither warp nor weft threads occurs. The number of open field is important, for example for air and water permeability.

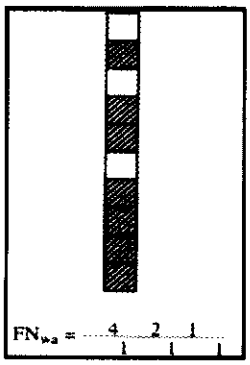
Open field = $RN_{wa} \times RN_{we} = 3 \times 3 = 9$, same as contact field

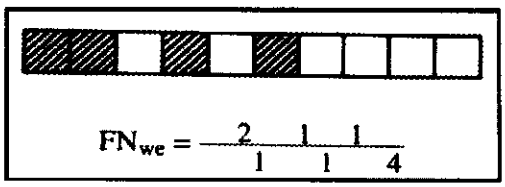
Where, RN = Repeat number

W_a = warp and W_e = weft

- **Formula number:**

It is a kind of short-hand system representing the waving of warp or weft yarn. It gives the successive floats. The number of floats always equals the number of figures in the formula number. The warp floats coming up are put above the fraction line, the warp floats going down are put under the fraction line.





Where, FN_{wa} = formula number for the warp & FN_{we} = formula number for the weft.

- **Repeat number:**

It indicates the number of warp and weft yarns in the repeat. The repeat number for the warp equals the sum of the figures in the formula number for the weft and vice versa.

- **Interlacing ratio:**

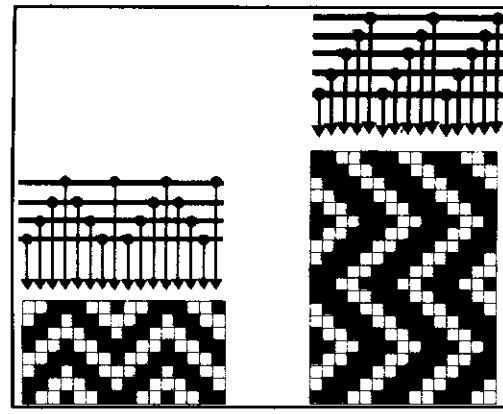
The interlacing ratio of a fabric is the ratio between the actual number of interlacing fields and the maximum number of interlacing fields. The degree of interlacing is the interlacing ratio expressed in percentage.

Drafting:

Various **methods of indicating** drafts may be employed as for instance –

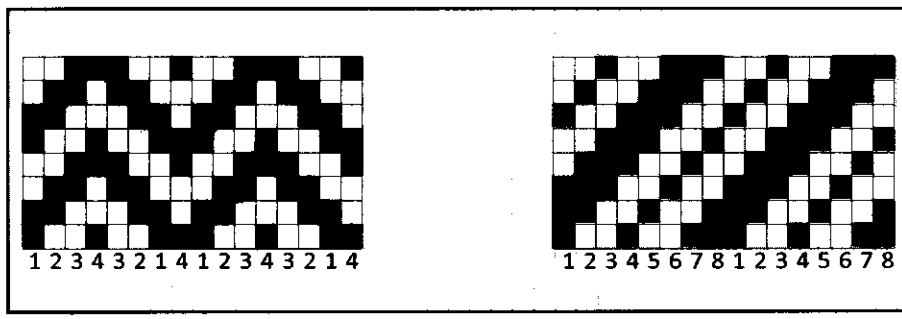
a) By ruling lines:

In which the horizontal lines represent the healds and the vertical lines the warp threads, while the marks placed where the lines intersect indicate the healds upon which the respective threads are drawn.



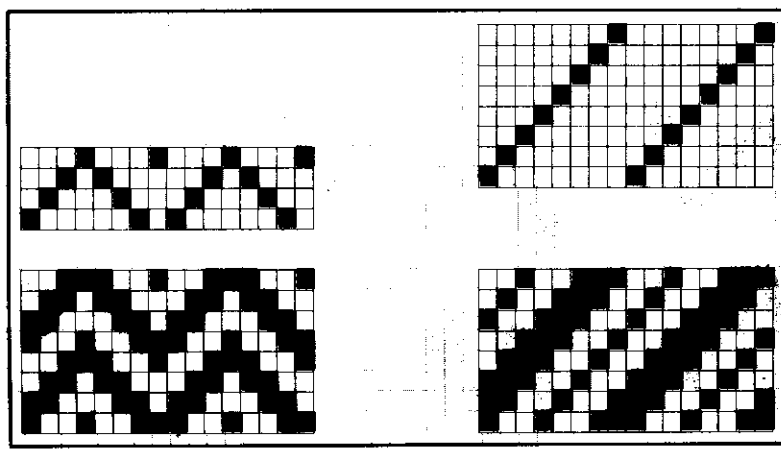
b) By numbering:

As shown by the numbers below the designs, which refer to the number of the healds (the front heald is number one). In this case the threads are successively drawn on the healds in the order indicated by the numbers.



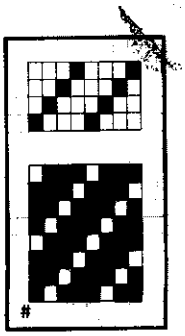
c) By the use of design paper:

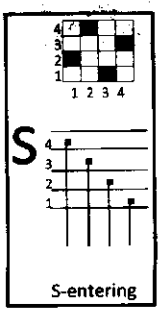
In which the horizontal spaces are taken to represent the healds, and the vertical spaces the warp threads. Marks are inserted upon the small squares to indicate the healds upon which the respective threads are drawn. This method is usually the most convenient.

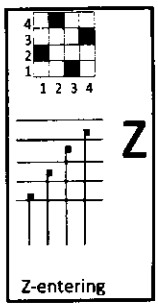


Systems of drafting / Classification of drafting:

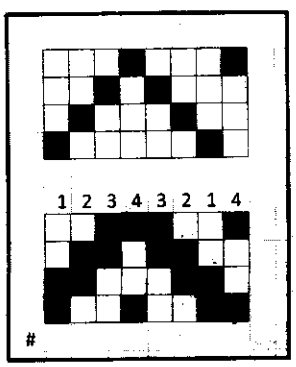
1. **Straight draft (or entering):**
The warp ends are threaded through the heddles according to their numerical order. A distinction is made between S- and Z- entering. Straight draft is the most common and can be used with any number of shafts. Each successive thread is drawn on successive shafts, the first thread on the first shaft, the second thread on the second shaft, and so on. The last thread of the warp repeat is drawn on the last shaft. Thus the number of shafts equals the warp repeat and the repeat of draft equals the warp repeat.

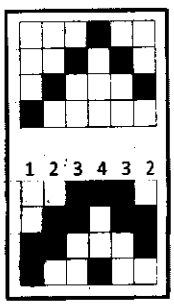


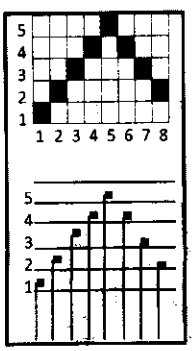


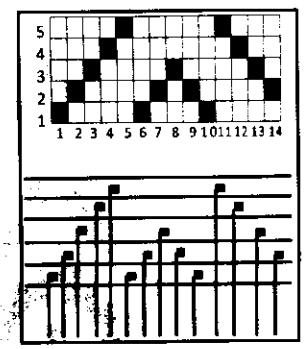


2. **Point draft:**
Point entering is obtained by straight entering of a number of yarns followed by reverse entering of the same or a different number of yarns. Point drafts are used for weaves, which are symmetrical about the center, and they are frequently employed to produce waved or diamond effects. The main advantage of this system is that it allows the production of quite large effects economically, which if attempted on the straight drafts would require almost twice the number of healds. The method used to construct these drafts and it will be seen that to achieve a well defined point in the design the ends are drawn in straight order starting with heald 1 and finishing with the last heald in the number employed, where upon the order of drawing-in of the consecutive ends is reversed. The first and the last healds carry only one end each, whilst all the healds in the middle carry two ends each per repeat of the draft. As a result, using this system of drafting the number of ends per repeat of the design is : **2 x number of healds – 2.**



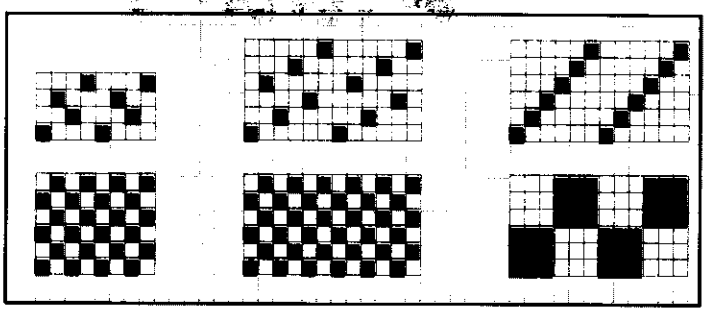






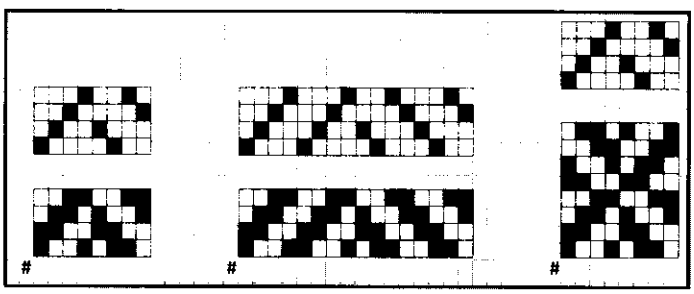
3. Skip drafts:

The warp ends are threaded in an irregular way. Warp ends with the same action are threaded through the same shaft. This system is particularly useful in weaving very densely set fabrics where normally a small number of healds is required. In order that the mails will not be too crowded on the shaft and to reduce friction and rubbing between the ends it is customary to use more healds than the minimum necessary for the weave. For example, in case of the plain weave, may be drawn on two healds, if the cloth is coarse; or on four healds, if the cloth is of medium fineness; or on six healds, if the cloth is very fine.



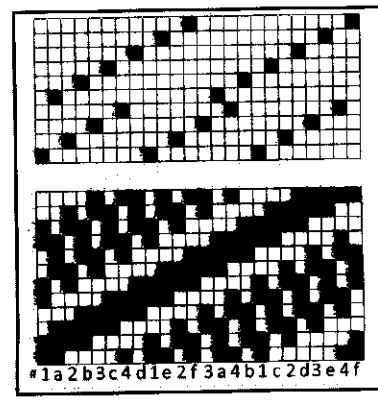
4. Broken draft:

It can be considered as a modified pointed draft. Again it is a combination of straight drafts with different directions of constructing. But the direction is reversed not on the last or the first shaft. When the direction is reversed the first thread of the next group is started higher or lower than the last thread of the preceding group. This small modification changes considerably the design by breaking the axis of symmetry. The order of interlacing of the last thread of the first group is opposite to that of the first thread of the preceding group. This draft is applied for producing herringbone twills, diaper design and etc.



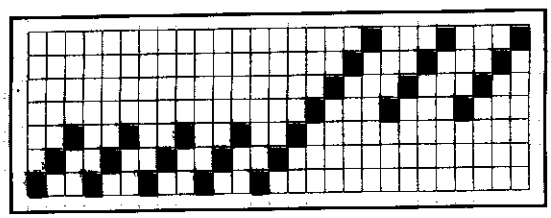
5. Divided draft:

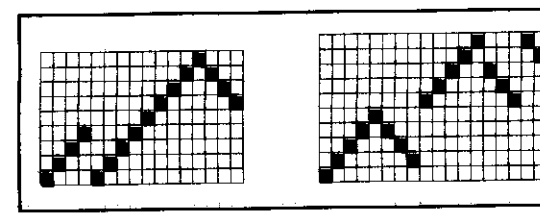
This draft is employed for derived weaves, double warp weaves, two ply weaves, pile weaves, and some others. The shafts are divided into two or more groups. A suitable type of draft is chosen for each group. The divided draft is employed for double-warp fabric. There are two systems of warp threads: the face and back ones.



6. Grouped drafts:

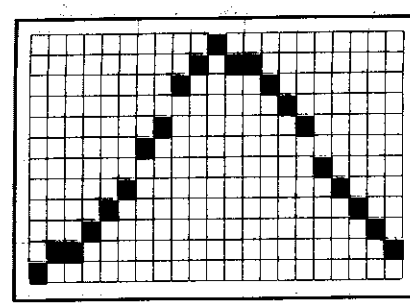
These drafts are employed for production of check and stripe designs, in which the stripes have different weaves or their combinations. A typical draft is used for producing the fabric with two different stripes containing 15 and 12 threads, respectively. The warp repeat of the first stripe equals 3 and the second 4. The weave of the first stripe requires 3 shafts, and that of the second stripe 4 shafts. All the threads of the first stripe are drawn on 3 first shafts with straight draft, and the threads of the second stripe are drawn on shafts 4, 5, 6, 7 of the second group. The repeat of the draft is 27.



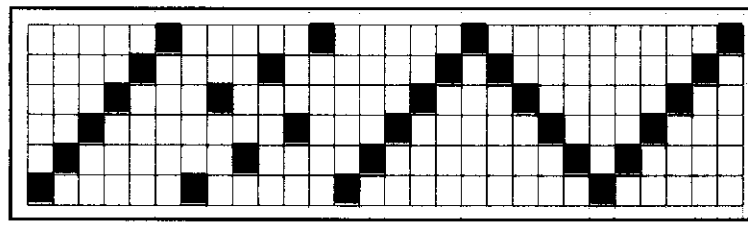


7. Curved drafts:

These drafts are applied for fancy weaves having a large warp repeat with the purpose of reducing the number of shafts. Note, that the minimal number of shafts equals the number of threads in warp repeat with different order of interlacing. The drawing-in is done applying the rule: all warp threads which works alike are drawn on the same shaft. Curved drafts are irregular and cannot be classified.



8. **Combined draft:**
   Various methods of drawing-in can be combined in one draft for producing a certain type of fabric. Two or more drafts described above can be applied simultaneously, for example, straight and skip or sateen, grouped and curved, and so on. Combined draft is the most complicated and can be chosen only if there are some technological or economical reasons.

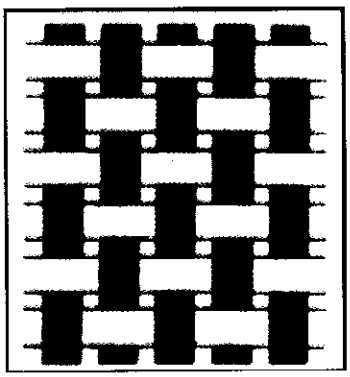


The basic weaves or structures of woven fabric:

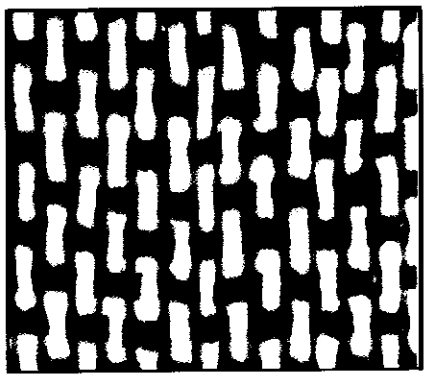
Woven fabric Structure is defined as the interlacement of warp and weft yarn at 90^0 angles to each other. It is also called weave structure. The number of weave structures that can be produced is practically unlimited. Three types of weave structure form the basis of even the most complex weaves. Known as basic weaves, these are the plain weave, the twill weave, and the satin weave. In the following section basic structures, from which all other weave structures are developed, are discussed. All structures can be derived from the **three basic weaves: Plain, Twill and Satin / Sateen**. Most two-dimensional woven fabrics are constructed from simple weaves and of these at least 90 % use plain weave.

PLAIN WEAVE

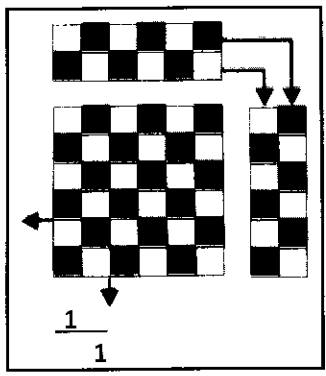
The plain weave is the simplest of the weaves and the most common. It consists of interlacing warp and weft yarns in a pattern of over one and under one. Imagine a small hand loom with the warp yarns held firmly in place. The weft yarn moves over the first warp yarn, under the second, over the third, under the fourth, and so on. In the next row, the weft yarn goes under the first warp yarn, over the second, under the third, and so on. In the third row, the weft moves over the first warp, under the second, and so on, just as it did in the first row. Plain weave is obtained by raising all even-numbered warp ends at one pick and raising all the odd numbered ones at the other pick. It means threads interlacing in alternate order.



Plain weave



Close-up photograph of plain weave



Graph paper example with drafting and lifting plan

Main features of plain weave:

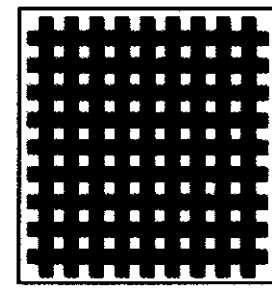
- Threads interlacing in alternate order.
- The repeat contains two ends and two picks.
- Both sides of the weave are identical.
- Each thread gives maximum amount of support to the adjacent threads.
- Texture is stronger and firmer than any other ordinary cloth.
- Made from all kind of textile raw materials and yarns i.e. cotton, linen, jute, man-made fibres, both spun and continuous filament yarns.
- It comprise a high production of the total output of woven fabrics.
- Two heald shafts are sufficient to produce plain weave, when the number of ends/inch is large (more than 50), four or six heald shafts are used with skip draft.

Classification of plain cloth:

There are at least two ways of approaching such a classification. The simplest is in terms of warp and weft cover factors.

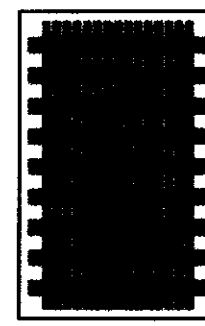
a. **Approximately square cloths:**
The cloths in which the warp and weft counts, the ends and picks per inch, and therefore the warp and weft cover factors are approximately equal, so that warp and weft are equally prominent, or nearly so, on both sides of the cloth. The crimps are also usually approximately equal.

$$\frac{150 \times 150}{40 \times 40} \times 58"$$



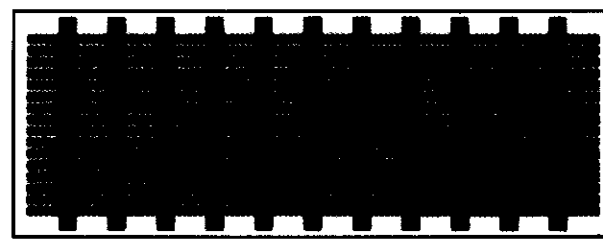
b. **Warp faced cloths:**
The cloths in which the warp cover factor substantially exceeds that of the weft, and in which the warp predominates on both sides of the cloth. A warp faced effect is obtained by increasing the warp count i.e. warp yarn is finer than the weft yarn.

$$\frac{150 \times 30}{50 \times 8} \times 56"$$



c. **Weft faced cloths:**
The cloths in which the weft cover factor substantially exceeds that of the warp, and in which the weft predominates on both sides of the cloth. A weft faced effect is obtained if the weft yarn is finer than the warp yarn.

$$\frac{32 \times 148}{7 \times 60} \times 57"$$



Another method of classification, more logical in some respects, distinguishes between balanced and unbalanced structures:

a. Balanced cloths:

The cloths in which the warp and weft counts are similar, and likewise the ends and picks per inch. The yarn crimps are usually equal.

$$\frac{140 \text{ X } 140}{45 \text{ X } 45} \text{ X } 59"$$

b. Unbalanced cloths:

The cloths include all those which do not conform to the requirements of balanced cloths. They are grouped under three headings:

I. The ends and picks per inch are similar (square sett), but the warp and weft counts are different, so the warp and weft cover factors are also different.

$$\frac{150 \text{ X } 150}{50 \text{ X } 42} \text{ X } 58"$$

II. The warp and weft counts are similar, but the ends and picks per inch are different, so again the warp and weft cover factors are different.

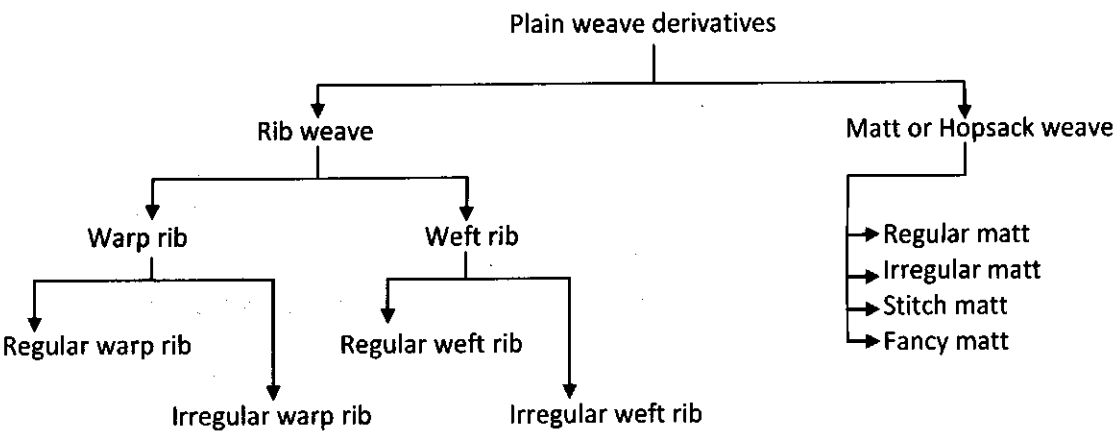
$$\frac{150 \text{ X } 140}{42 \text{ X } 42} \text{ X } 57"$$

III. The ends and picks per inch are different, and so are the warp and weft counts. The warp and weft cover factors will usually be different, but in a special case they may be similar.

$$\frac{120\text{X } 90}{20 \text{ X } 16} \text{ X } 58"$$

Derivatives of Plain weave:

Weaves developed on the basis of plain weave principle is called derivatives of plain weave. All the weaves those are based on plain weave principle are classified as follows:



Rib Weave:

Ribbed or corded effects are variations of the plain weave. Interesting and attractive fabrics can be obtained with the rib variation of the plain weave or by making a rib-weave construction. The rib may be produced in the warp or in the weft by alternating fine yarns with coarse yarns, or single yarns with doubled yarns. There are two types of rib weave, such as warp rib and weft rib.

Warp Rib weave:

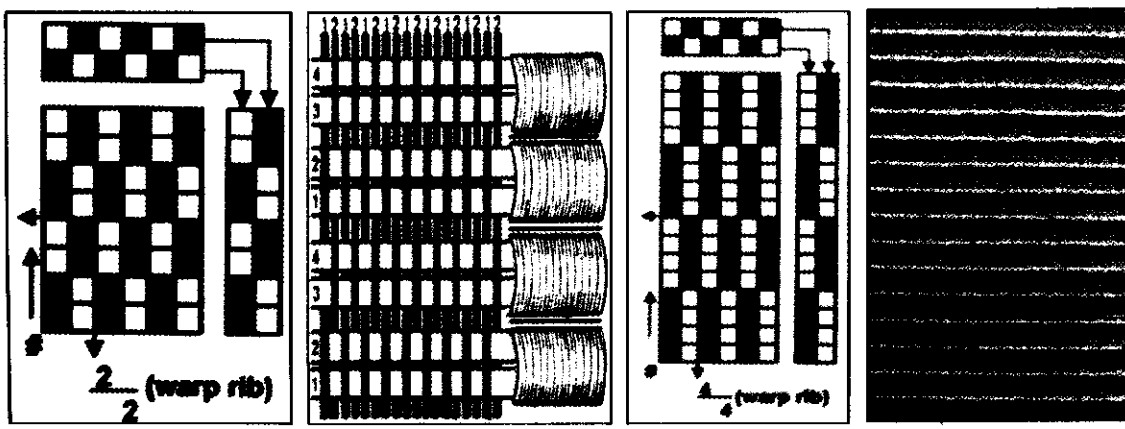
In the warp rib, the warp ends float over two or more picks. At the change of shed which occurs simultaneously across the whole warp, the picks in the same shed are bunched together and form the rib effect which characterizes this weave. Usually, only the warp ends can be seen on the both face and back surfaces because they are very closely set and tend to cover the weft which only acts as a weft material. Thus, while one uses good quality, fine yarn for the warp, the weft can be a cheap, coarse material. So the main features of warp rib fabrics are as follows:

- Warp yarns are used as a single yarn and weft yarns are used as group or bundle yarns.
- Rib or cord effects are shown horizontally i.e. weft-way rib effects.
- The formula number of a typical warp rib weave is $\frac{2}{2}$ warp rib, $\frac{4}{1}$ warp rib etc.
- In the repeat size, the number of warp yarn is always two and the number of weft yarn is depends on the formula number, it is the sum of warp and weft floats.

There are two types of warp rib weave, such as regular warp rib and irregular warp rib.

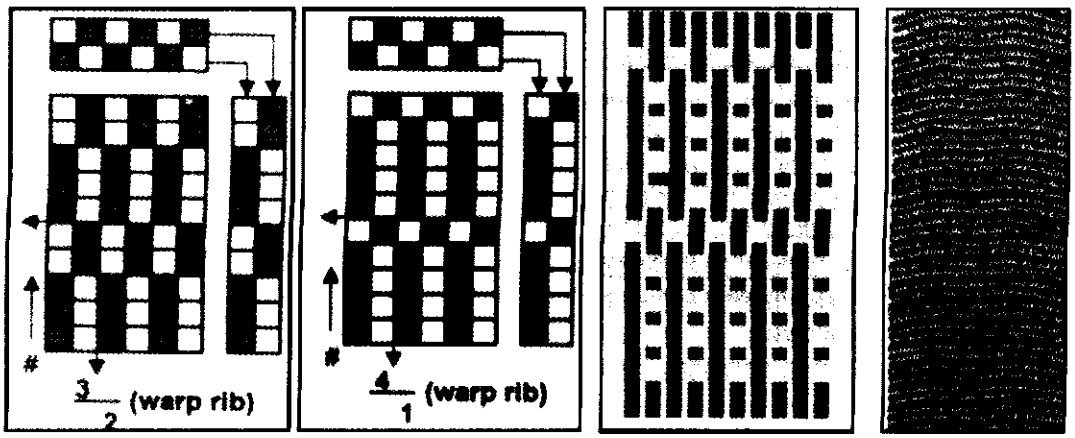
Regular Warp rib weave:

In this weave the number of picks in the bundle should be same, i.e. in the formula number, the number above the fraction line and below the fraction line are same. The thickness of all ribs are same. So the same size of ribs are produced on the surface of the fabric. The regular warp rib weaves are shown in the following figure.



Irregular Warp rib weave:

In this case the number of weft yarns in the bundle are different, i.e. in the formula number, the number above the fraction line and below the fraction line are not same. The thickness of all ribs are not same. So the different size of ribs i.e. thick and thin ribs are produced on the surface of the fabric. The irregular warp rib weaves are shown in the following figure.



Close-up view of $\frac{4}{1}$ warp rib fabric with weave, drafting and lifting plan

Weft Rib weave:

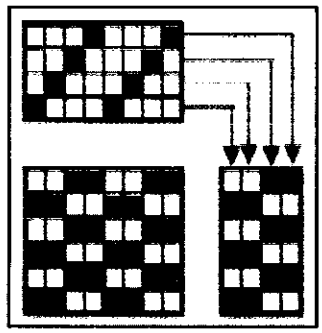
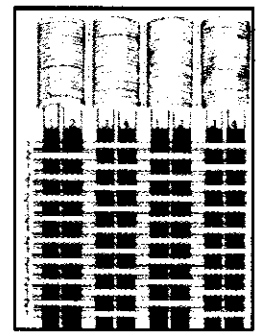
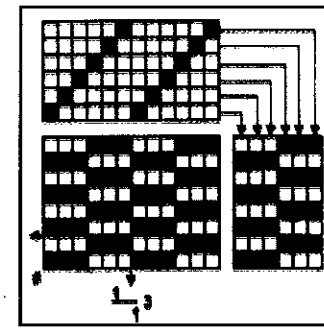
These are opposite to warp rib weaves, and result from extending the plain weave horizontally. This weave may be described as plain weave in which two or more ends weave together as one. In the weft rib which is frequently called cord, the picks float over several warp ends which are bunched together to form a rib in the warp direction. With these fabrics, the pick spacing is usually so close that the weft completely covers the warp. Here, one uses a fine, high-quality yarn as weft and a cheaper, coarser yarn as warp. The first following figure shows a two-end weft rib (cord). The draft is shown for four heald shafts. The short-hand or formula number used for the warp rib is inadequate for the weft rib because it only indicates the length of the warp floats. For characterizing the weft rib, the length of the float must be added. Thus, the weave shown in the first following figure is described by: $\frac{1}{1}2$. So the main features of weft rib fabrics are as follows:

- Weft yarns are used as a single yarn and warp yarns are used as group or bundle yarns.
- Rib or cord effects are formed warp-wise i.e. in the direction of warp.
- The formula number of a typical weft rib weave is $\frac{1}{1}3, \frac{1}{1}(4+2)$ etc.
- In the repeat size, the number of weft yarn is always two and the number of warp yarn is depends on the formula number, it is the sum of group yarns.
- The prominence of the ribs can be increased by suitable use of coarse and fine yarns.

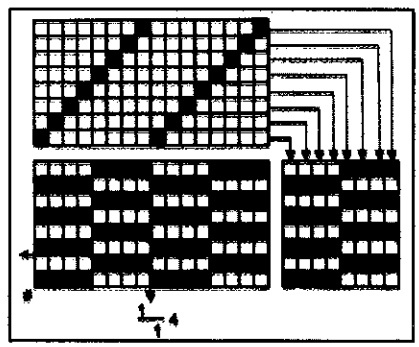
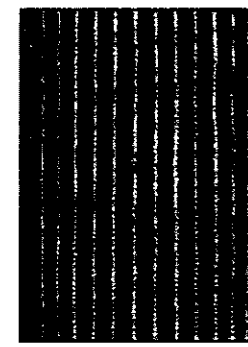
There are two types of weft rib weave, such as regular weft rib and irregular weft rib.

Regular Weft rib weave:

In this weave the number of warp ends in the bundle should be same, i.e. in the formula number, there is single number at the right side of the fraction line. The thickness of all ribs is same. So the same size of ribs is produced on the surface of the fabric. The regular weft rib weaves are shown in the following figure.

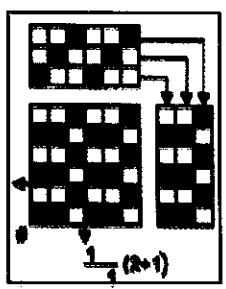
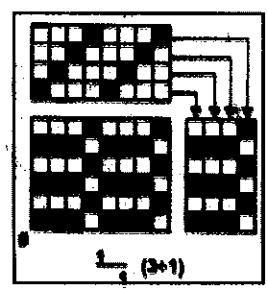
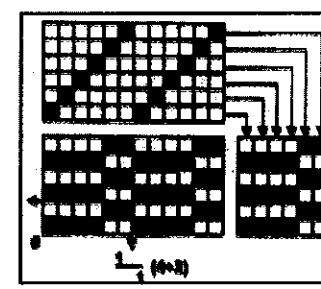
$\frac{1}{1}$ 2 weft rib fabric

Close-up view of $\frac{1}{1}$ 4 weft rib fabric with weave, drafting and lifting plan

Irregular Weft rib weave:

In this case the number of warp yarns in the bundle is different, i.e. in the formula number, there is two different numbers at the right side of the fraction line. The thickness of all ribs is not same. So the different size of ribs i.e. thick and thin ribs are produced on the surface of the fabric. The irregular weft rib weaves are shown in the following figure.

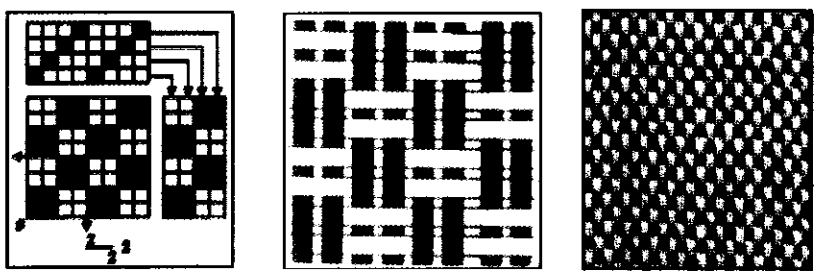




Hopsack, Basket or Matt Weave:

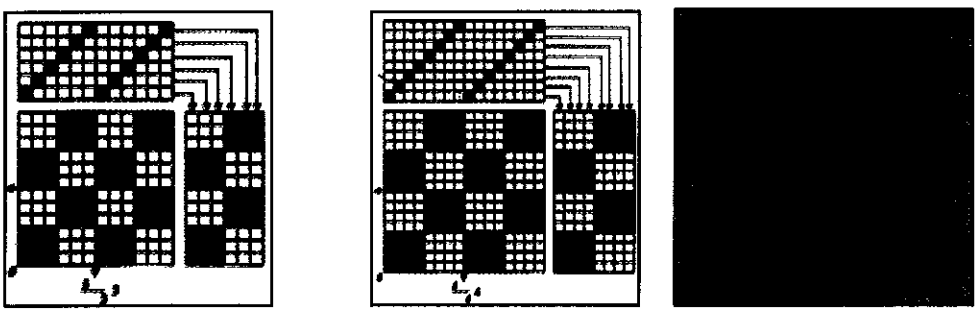
The hopsack weave, a variation of the plain weave, uses two or more warp and / or two or more weft yarns side by side as one yarn. The resultant cloth is fairly loose in weave. The hopsack weave is obtained by doubling or otherwise multiplying the interlacing points of the plain weave in both the warp and weft direction. Basket weaves are made with two or more adjacent warps controlled by the same harness, and with two or more weft yarns placed in the same shed. The interlacing pattern is similar to a plain weave, but two or more yarns follow the same parallel path. Basket weave fabrics are more flexible and wrinkle resistant because there are fewer interlacings per square inch. The fabrics look flatter than comparable regular plain weave fabrics. However, long floats snag easily. The matt weave cloth has a greater resistance to tearing. Matt weaves tend to give smooth-surfaced fabrics. In the repeat size of the matt weave the numbers of warp and weft yarns are equal. There are four types of hopsack or matt weave such as regular matt, irregular matt, stitch matt and fancy matt.

Regular Matt weave:

Most regular matts are woven with the same number of ends and picks and the same yarn coun. Equal warp floats exchange with equal weft floats. So the regular matt weave is produced by the combination of regular warp and weft rib weave. The regular matt weave is represented by the formula number of "$\frac{A}{A}$A ", where 'A' indicates the warp or weft floats. Denting plays an important part in achieving a correct matt weave. Ends that work alike should be separated by the reed as the ends tend to roll or twist round each other when weaving. The following figures show close-up view of some regular matt weave with drafting and lifting plan.



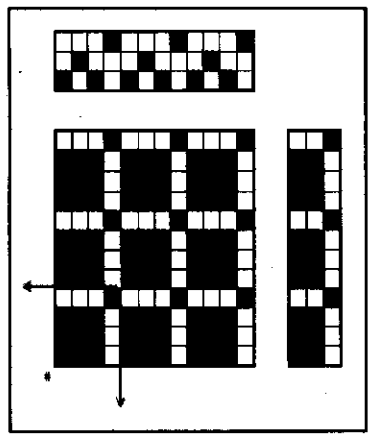
Close-up view of $\frac{2}{2}$2 matt fabric with weave, drafting and lifting plan

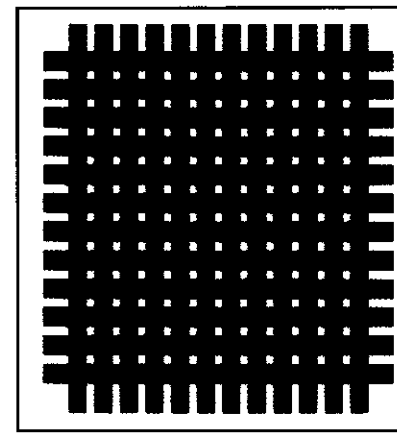


Close-up view of $\frac{4}{4}$4 matt fabric with weave, drafting and lifting plan

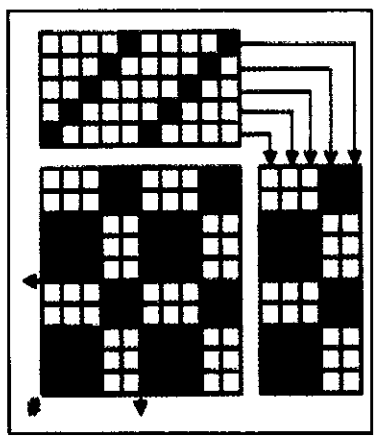
Irregular Matt weave:

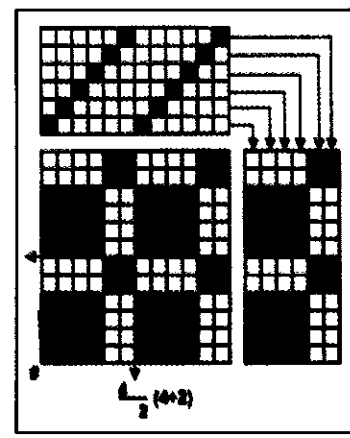
Warp and weft floats are different in one repeat of irregular matt weave. So the irregular matt weave is produced by the combination of irregular warp and weft rib weave. The irregular matt weave is represented by the formula number of "$\frac{A}{B}(A + B)$" , where 'A' indicates the warp floats and 'B' indicates the weft floats. The following figures show close-up view and interlacing diagram of some irregular matt weaves with drafting and lifting plan.

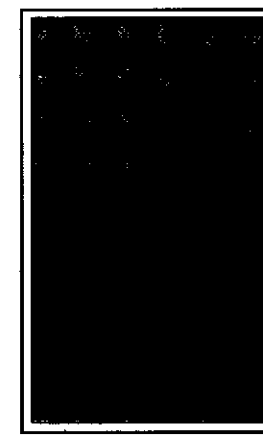




Interlacing diagram of $\frac{3}{1}$ (3 + 1) matt fabric with weave, drafting and lifting plan



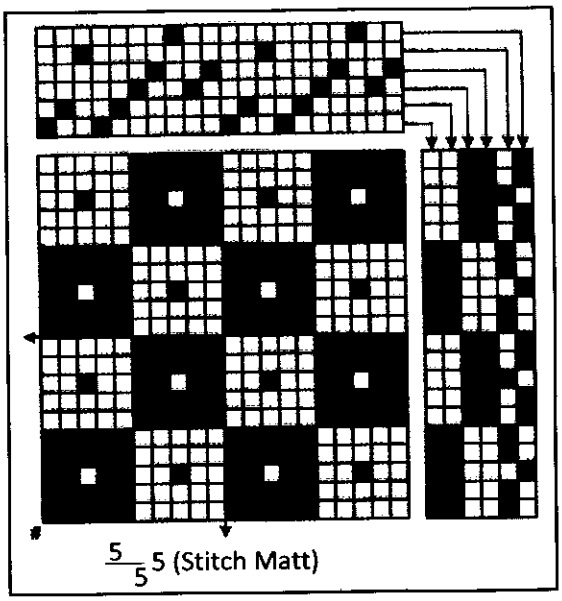




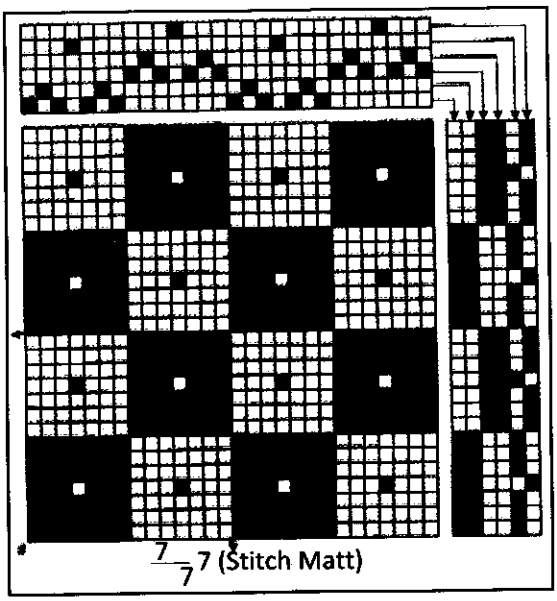
$\frac{3}{2}(3 + 2)$ Weave, drafting and lifting plan of $\frac{4}{2}(4 + 2)$ with close-up view

Stitch Matt weave:

Matt or basket structures are liable to slippage, especially in coarser weaves or when woven with worsted yarns. To produce a firm cloth with lower setting, the centre ends in each square can be stitched. In case of warp float area the central warp yarn goes down and of weft float area the central warp yarn comes up. The following figures show the weave plan of some stitch matt fabric with drafting and lifting plan.



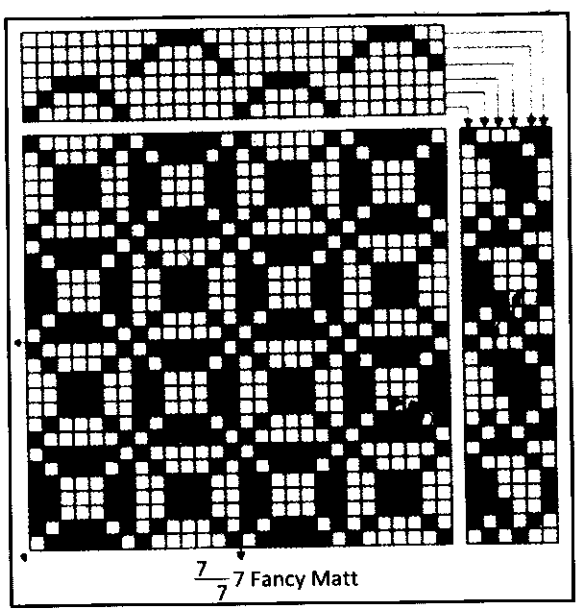
$\frac{5}{5}$ 5 (Stitch Matt)



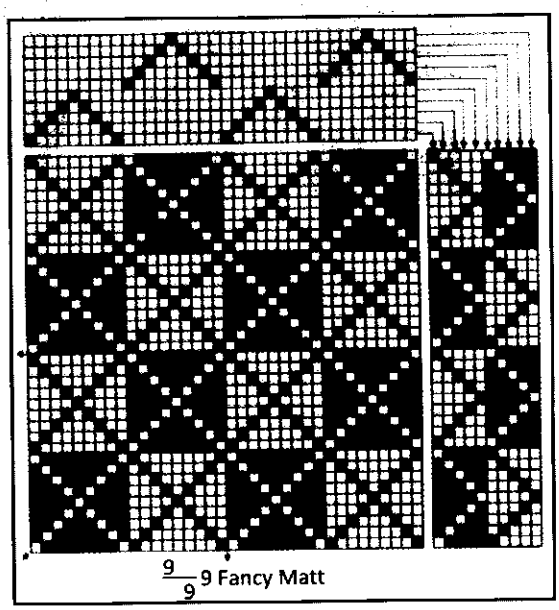
$\frac{7}{7}$ 7 (Stitch Matt)

Fancy Matt weave:

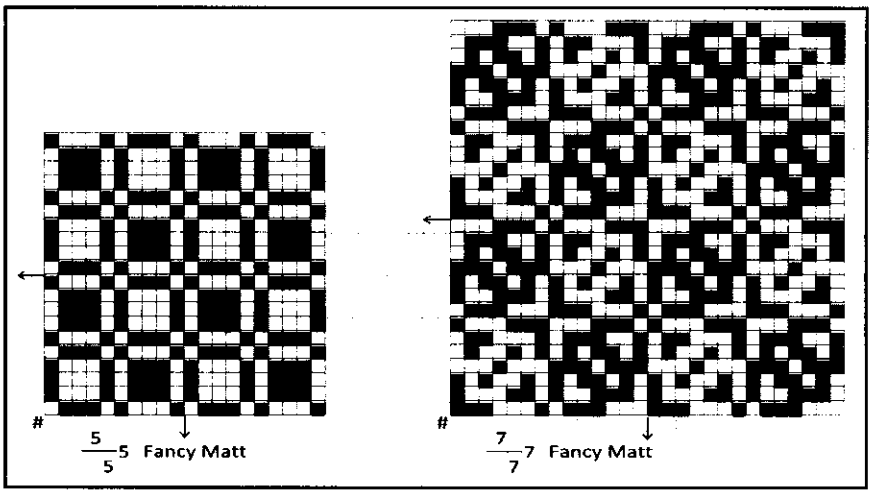
Fancy matt is one kind of stitch matt. In case of stitch matt, the stitch or stitching thread is does not affect the prominence of actual regular matt effect. The stitching thread is hidden by the neighbouring threads, so it does not visible on the fabric surface. But in the fancy matt the stitching threads are not hidden, they are visible. The stitching system affects the design of the regular matt weave. They produce decorative appearance on the fabric surface. It can be compared with "katha" and "nokshi-katha".



$\frac{7}{7}$ 7 Fancy Matt



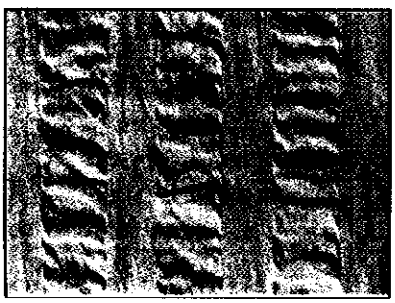
$\frac{9}{9}$ 9 Fancy Matt



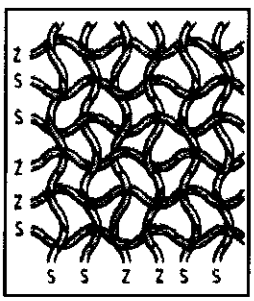
Ornamentation of plain cloth:

A plain weave is ornamented without deviating from the true principles of plain weave as follows:

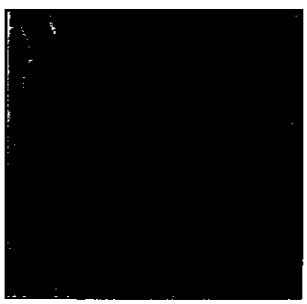
- The threads in both warp and weft vary in colour, raw material, types of construction and in thickness.
- Threads of different colours are combined in check form.
- By using fancy slub yarns.
- By combining different orders of denting.
- By using two warp beams, which are differently tensioned, is produced seer-sucker stripe.



Seer-sucker stripe



Crepon effect



Crepe fabric

- By using different twisted yarns (such as hard twisted weft yarn is produced crepon effect).
- By using different Textile materials, such as wool and cotton is produced union fabric.
- By using a specially shaped reed, which rises and falls the threads are caused to form zig-zag lines in the cloth.
- By using extremely fine or coarse yarn.

End uses:

It is used for structures, which range from very heavy and coarse canvas and blankets made of thick yarns to the lightest and finest cambries and muslins made in extremely fine yarns.

Advantages and disadvantages of plain weave fabric:

Advantages:

- Wears well
- Offers appropriate background for printing, special finishes, and applied surface designs.
- Is snag-resistant
- Has good dimensional stability if of high fabric count, i.e. high thread density.
- Is reversible if not printed or finished with special effects.

Disadvantages:

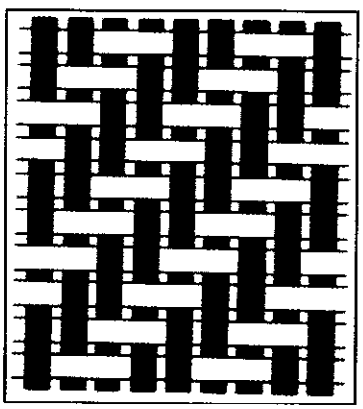
- Ravels
- Appears uninteresting
- Shows wrinkling
- Has lower tear strength than some other weaves
- Shows soil readily.

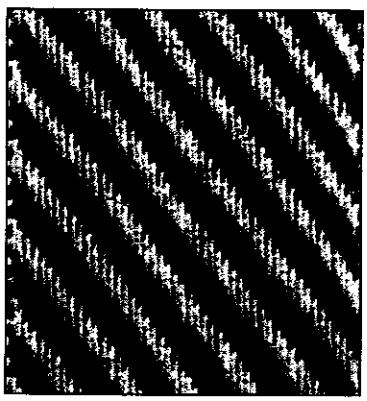
TWILL WEAVE

The second basic weave pattern used in manufacturing fabrics is the twill weave. This weave is characterized by diagonal lines or ribs (twill lines) on the face, and often on the back, of the fabric. The face diagonal can vary from reclining twill, with a low 14-degree angle, to steep twill, with a 75-degree angle. A twill angle of 45-derees is considered to be a medium diagonal or a regular twill; it is the most common.

The angle of the twill line is determined by the closeness of the warp ends, the number of yarns per inch, the diameters of the yarns used, and the actual progression forming the repeat. These twill lines are produced by letting all warp ends interlace in the same way but displacing the interlacing points of each end by one pick relative to that of the previous end. While the plain weave can only be woven in one form, there exist several options with regard to twills.

Twill lines are formed on both sides of cloth. The direction of diagonal lines on the face side of cloth is opposite to that on the wrong side coinciding respectively with the weft and warp floats on the other side. Thus, if warp floats predominate on one side of the cloth, weft floats will predominate in the same proportion on the other side.





Twills differ from plain weaves in the increased number of picks and ends needed to complete a repeat pattern. Whereas a plain weave requires two ends and two picks for a repeat, the simplest twill requires three picks and three ends. At least three heald-shafts are needed to make a twill weave. Normally straight drafting system is used to produce regular twill fabric. The smallest possible repeat for a twill weave is 3 ends × 3 picks, and there is no theoretical upper limit to the size of the repeat.

The designation of the design of a twill fabric describes the placement of the warp yarns over and under the weft yarns. In a fabric described as a $\frac{2}{2}$ twill, four warp and four weft yarns are used to form the design repeat.

Classification of Twill weave:

Twill weaves can be classified from four points of view:

a) According to the way of construction
   - Warp-way twill weave: $\frac{3}{1}$ warp-way twill, etc.
   - Weft-way twill weave: $\frac{2}{3}$ weft-way twill, etc.

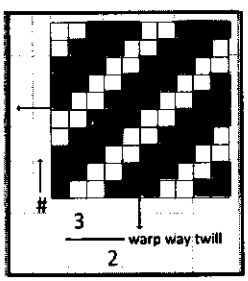
b) According to the direction of twill lines on the face of the fabric
   - S – Twill or Left-hand twill weave: $\frac{2}{1}$ S, etc.
   - Z – Twill or Right-hand twill weave: $\frac{3}{2}$ Z, etc.

c) According to the face yarn (warp or weft)
   - Warp face twill weave: $\frac{4}{2}$ S, etc.
   - Weft face twill weave: $\frac{1}{3}$ Z, etc.
   - Double face twill weave: $\frac{3}{3}$ Z, etc.

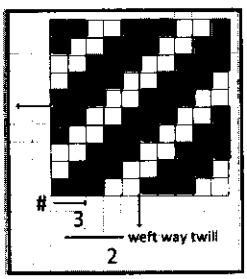
d) According to the nature of the produced twill line
   - Simple twill weave: $\frac{1}{2}$ S, $\frac{3}{1}$ Z, etc.
   - Expanded twill weave: $\frac{4}{3}$ S, $\frac{3}{2}$ Z, etc.
   - Multiple twill weave: $\frac{2\ 3}{3\ 1}$ S, $\frac{3\ 2\ 1}{1\ 2\ 3}$ Z, etc.

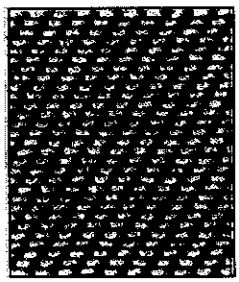
a) According to the way of construction:

Warp-way Twill weave: In warp way twill weave warp float run in the warp direction.



Warp way twill





Weft way twill

Formula number of every yarn is same i.e. all warp ends interlace in the same way but displacing the interlacing points of each end by one pick relative to that of the previous end. In this case any sign or colour in the square of graph or design paper represent warp up and empty square represent weft up.

Weft-way Twill:

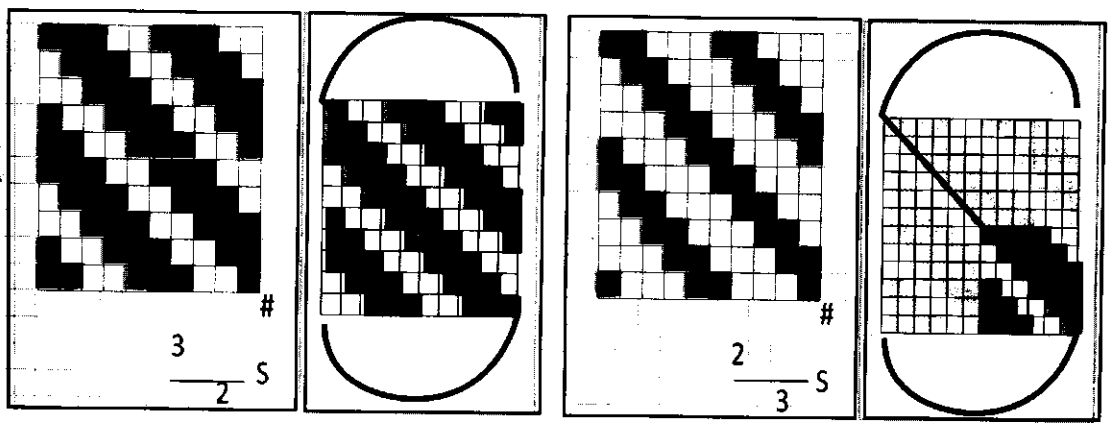
In weft way twill weave weft float run in the weft direction. Formula number of every yarn is same i.e. all weft yarn interlace in the same way but displacing the interlacing points of each pick by one end relative to that of the previous pick. In this case any sign or colour in the square of graph or design paper represent weft up and empty square represent warp up. This is exceptional than other normal system.

According to the direction of twill lines on the face of the fabric:

The lines created by this pattern are called twill lines or diagonal lines or wales. When the cloth is held in the position in which it was woven, the diagonal lines will be seen to run either from the lower left corner to the upper right corner or from the lower right to the upper left corner.

S – Twill or Left-hand Twill:

When the twill runs from the lower right to the upper left corner, the twill is known as a left-hand twill. It is produced by downward displacement of the interlacing points, if the starting point is bottom left corner or upward displacement of the interlacing points, if the starting point is bottom right corner. For example it is expressed by the formula number " $\frac{3}{2}$ S", where S – indicate the direction of twill line. The following figures show the weave plan of different left hand twill fabric. The alignment of twill line is parallel to the middle portion of 'S', so it is called S – twill.

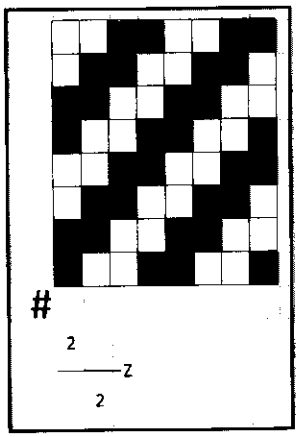


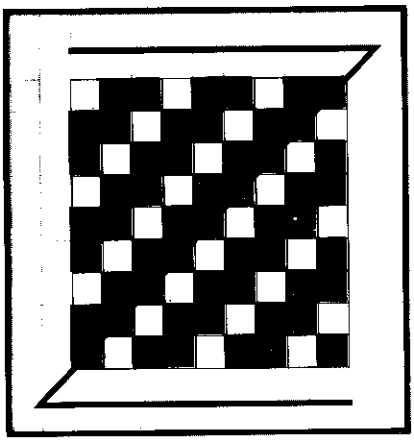
Z – Twill or Right-hand Twill:

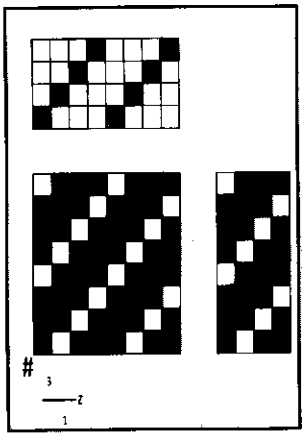
When the diagonal line runs from the lower left corner to the upper right corner, the twill is known as a right-hand twill. About 85% of all twill-woven fabrics are right-hand twills. It is produced by upward displacement of the interlacing points. For example it is

expressed by the formula number " $\frac{2}{2}$ Z", where, Z– indicate the direction of twill line.

The following figures show the weave plan, with drafting and lifting plan of different right-hand twill fabric. The alignment of twill line is parallel to the middle portion of 'Z', so it is called Z – twill.





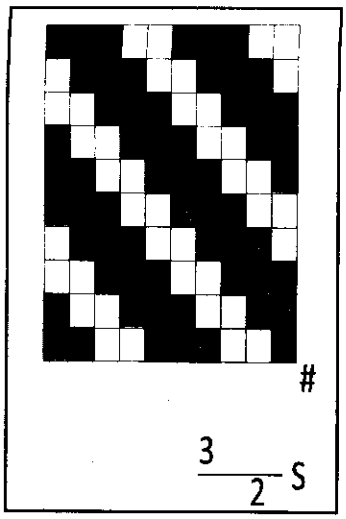


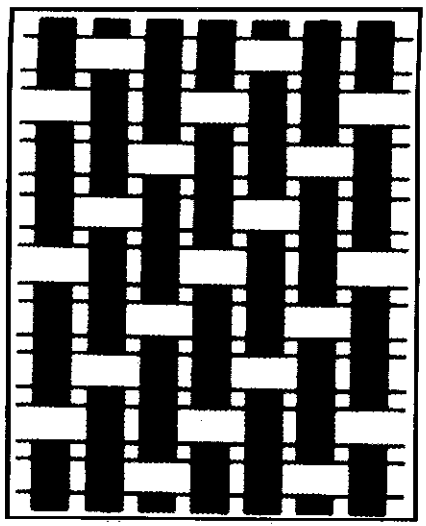
c) According to the face yarn (warp or weft):

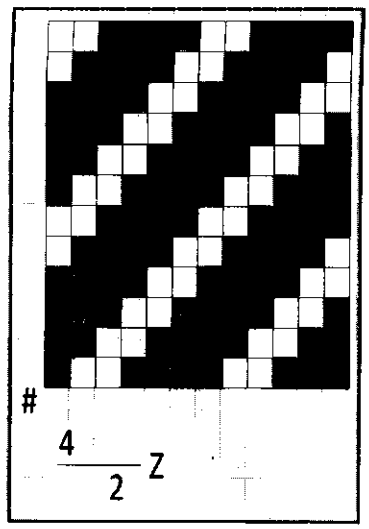
The description of twill weaves is notated as $\frac{4}{}$, $\frac{2}{2}$, $\frac{2}{3}$, and so on. The top digit of the fraction line refers to the number of weft yarns crossed over by the warp and the bottom digit to the number of weft yarns the warp passes under before returning to cross the filling again. When the crossing is over and under the same number of yarns, the fabric is called a double-face or even or even-sided twill. When warps pass over a larger or smaller number of weft yarns than they pass under, the fabric is called an uneven twill. Uneven twill fabrics have a right and a wrong side and therefore are not considered reversible. The traditional denim fabric used in blue jeans is an uneven warp-faced twill; the warp yarns are dyed blue and the weft yarns are undyed, so the fabric appears blue on the face and white on the back. There are two types of uneven twill, such as warp-face twill and weft-face twill.

Warp-face Twill:

Warp-faced twills have a predominance of warp yarns on the face of the fabric, with patterns of $\frac{2}{1}$, $\frac{3}{1}$, $\frac{3}{2}$, $\frac{4}{2}$, and so on.The top digit of the fraction line is higher than the bottom one, so it is called warp-face twill. Since warp yarns are made with higher twist, these fabrics are stronger and more resistant to abrasion and pilling. The following figures show the weave plan and interlacing diagram of warp-face twill.

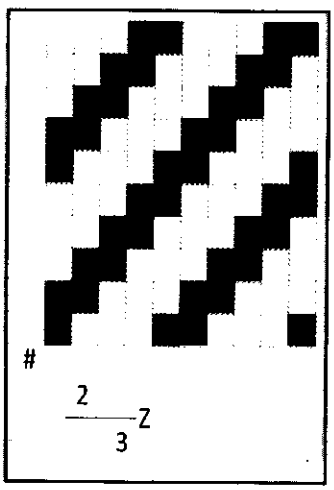


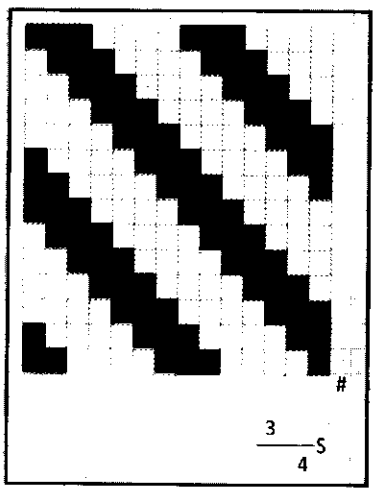


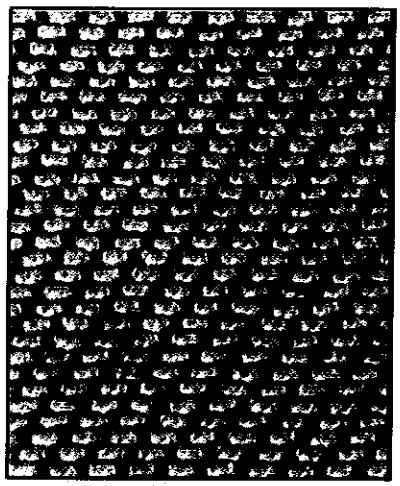


Weft-face Twill:

Weft-faced twills have a predominance of weft yarns on the surface of the fabric, with patterns of $\frac{2}{3}$, $\frac{3}{4}$, $\frac{1}{2}$, $\frac{2}{4}$, and so on. The top digit of the fraction line is smaller than the bottom one, so it is called weft-face twill. Weft yarns are generally weaker than are warp yarns, so that relatively few weft-faced twills are made. The following figures show the weave plan of weft-face twill.



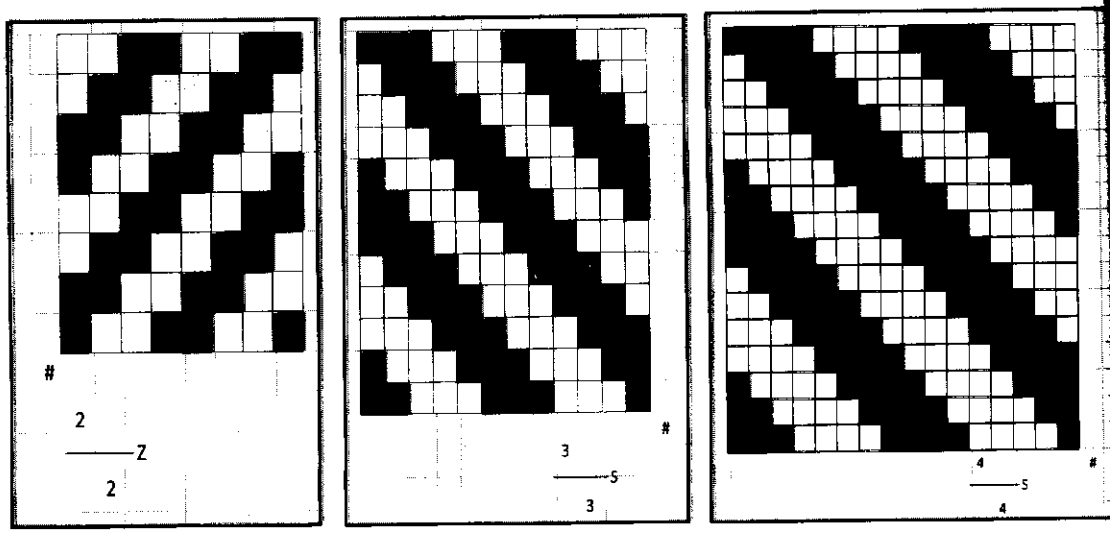




Double face Twill or Even-sided twill:

Even-sided twills expose an equal amount of warp and weft yarn on each side of a fabric. They are also known as reversible twills because they look alike on both sides, although the direction of the twill line differs. Better quality weft yarns are used in these fabrics as compared with warp-faced twills because both sets of yarn are exposed to wear. They are most often $\frac{2}{2}$ twills and have the best balance of all the twill weaves.

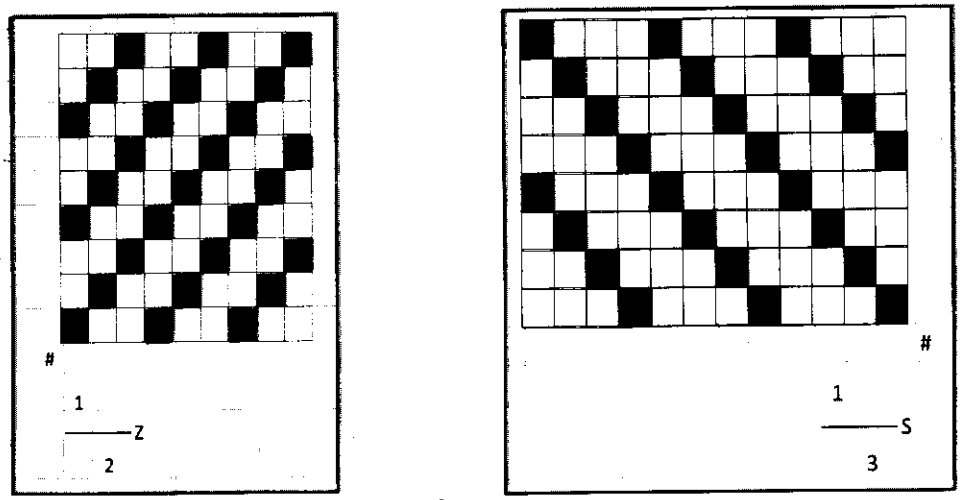
$\frac{3}{3}$, $\frac{4}{4}$, etc. are also the double-face twill. In this case the top and bottom both digi of the fraction line are same, so it is called double-face twill. The following figures sho the weave plan of some double-face twill.

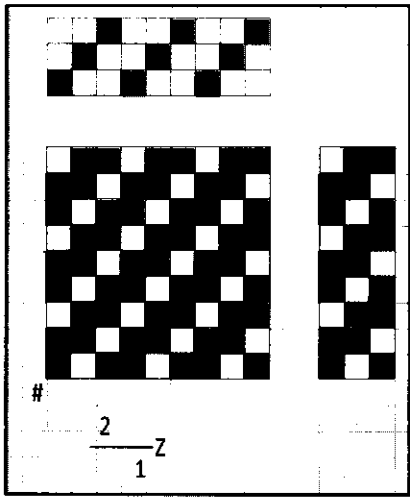


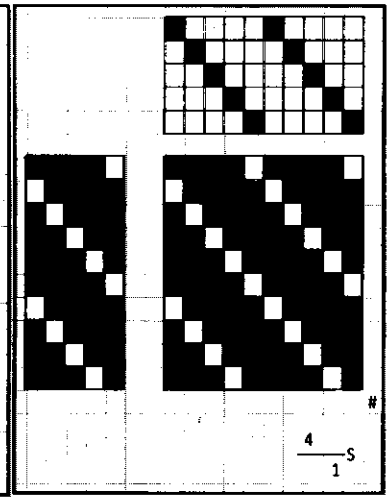
d) According to the nature of the produced twill line:

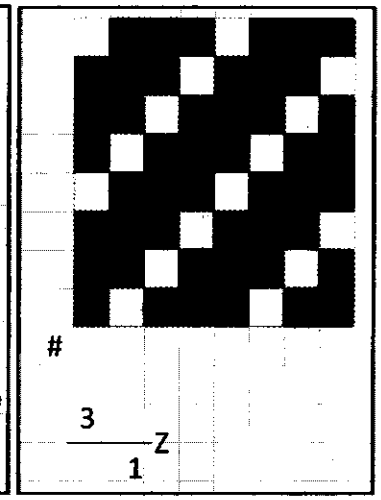
Simple Twill:

There are two types of simple twill, such as simple warp twill and simple weft twills Each warp end is raised over or lowered under only one pick in the repeat, with pattern of $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{2}{1}$, $\frac{3}{1}$, $\frac{4}{1}$, and so on. $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, etc. are the simple wef twill and $\frac{2}{1}$, $\frac{3}{1}$, $\frac{4}{1}$, etc. are the simple warp twill. The following figures show th weave plan with drafting and lifting plan of some simple warp and simple weft twi fabrics.



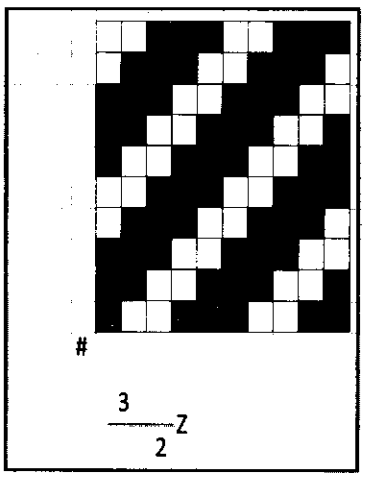


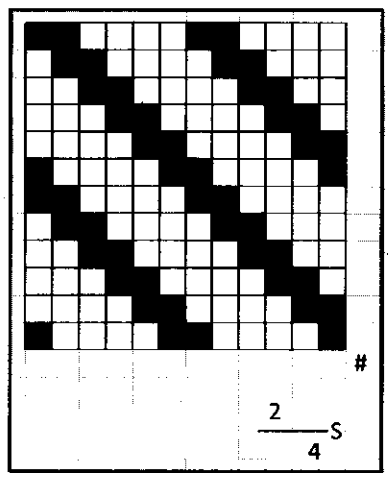


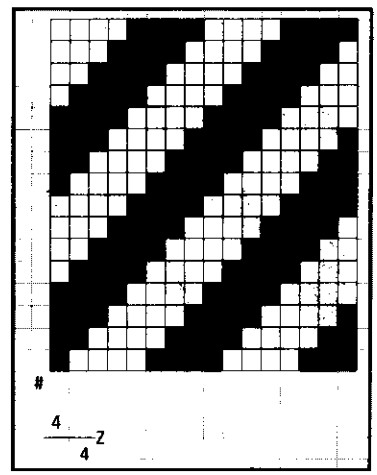


Expanded Twill:

Each warp end is raised over or lowered under more than one adjacent pick in the repeat. If the warp and weft twill lines are of equal width, the fabric is double-faced. It is represented by the formula number of $\frac{2}{3}, \frac{3}{2}, \frac{4}{4}, \frac{2}{4}$, and so on. The following figures show the weave plan of some expanded twill weaves.



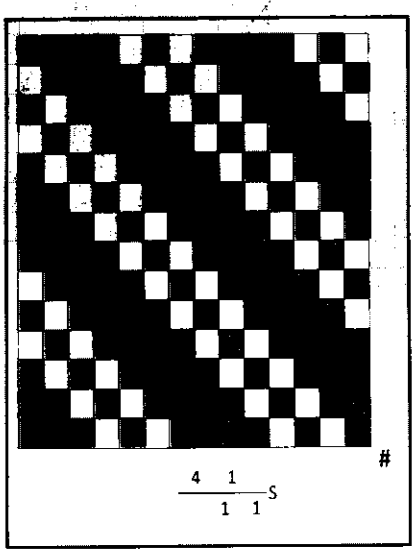




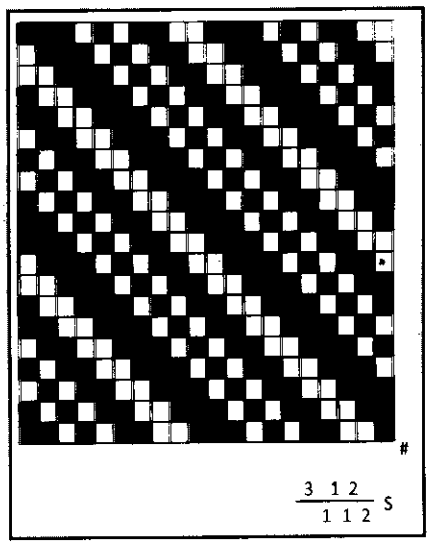
Multiple Twill:

In each repeat, there are at least two warp twill lines or two weft twill lines of different width. If the prominency of warp yarn is more than it is called warp-face multiple twill and the prominency of weft yarn is more than it is called weft-face multiple twill. If the prominency of both warp and weft yarns are same than it is called double-face multiple twill.It is represented by the formula number of $\frac{4\ 1}{1\ 1}, \frac{3\ 1\ 2}{1\ 1\ 2}, \frac{1\ 3\ 1}{1\ 1\ 5}$ and

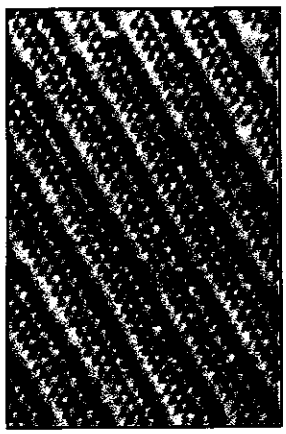
so on. The following figures show the weave plan with close-up view of some multiple twill weaves.



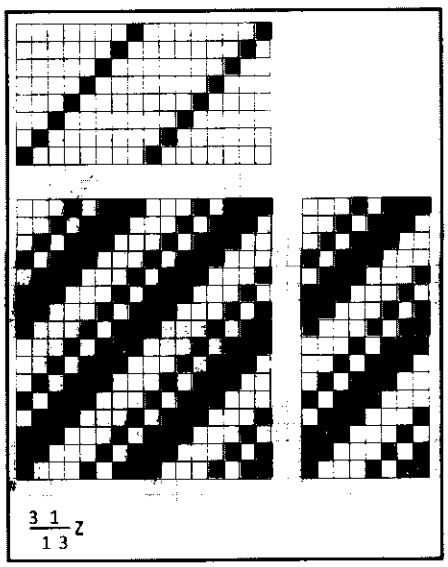
$\frac{4\ 1}{1\ 1}$ S



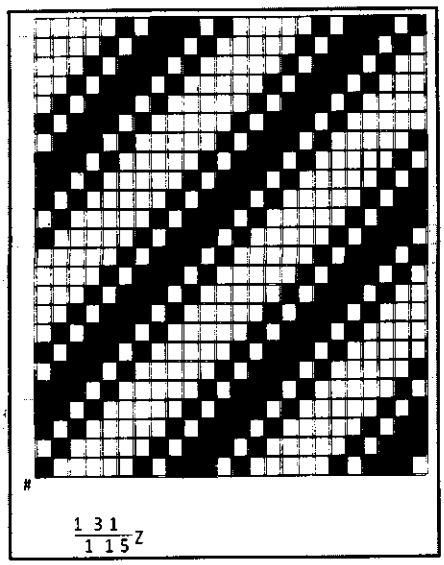
$\frac{3\ 1\ 2}{1\ 1\ 2}$ S



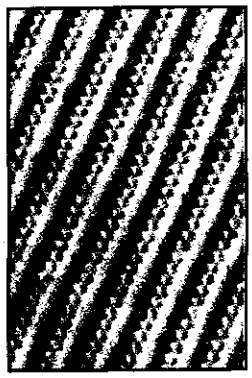
$\frac{3\ 1\ 2}{1\ 1\ 2}$ S



$\frac{3\ 1}{1\ 3}$ Z



$\frac{1\ 3\ 1}{1\ 1\ 5}$ Z



$\frac{1\ 3\ 1}{1\ 1\ 5}$ Z

Derivatives of Twill weave:

Weaves are developed on the basis of principle of twill weave or from a regular twill, these are called derivatives of twill weave. The common twill derivatives are listed below:

1. Zig-zag or waved or pointed Twill weave
2. Herringbone Twill weave
3. Diamond design

4. Diaper design
5. Broken Twill weave
6. Re-arranged Twill weave or Transposed Twill weave
7. Stepped Twill weave
8. Elongated Twill weave
9. Combined Twill weave or combination of twill weave
10. Shaded Twill weave or shaded design
11. Curved Twill weave

1. Zig-zag or Pointed or Waved Twill weave:

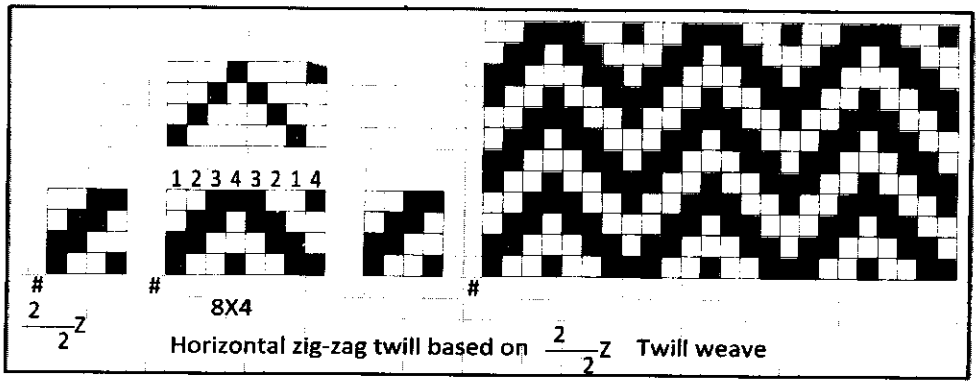
In zig-zag twills the diagonal line proceeds either to the left or right. Where two lines meet they create a point, forming a continuous zig-zag effect in the fabric. If one takes a twill weave and reverses the drafting order in the heald shafts regularly after a certain number of ends, the twill lines will run across the width of the fabric in a zig-zag configuration. The reversing of the draft can occur after a repeat or after any number of warp ends. Each reversal produces a point.

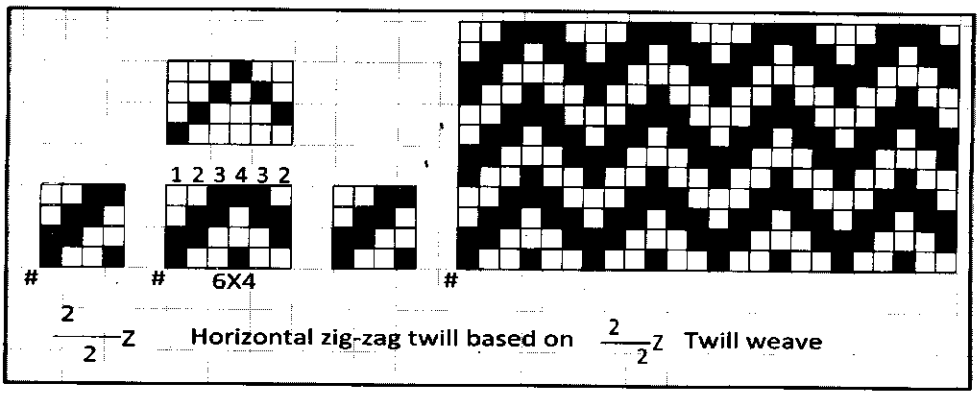
Selecting the right twill weave when constructing zig-zag or waved effects is of great importance. Short warp or weft floats should be used so as to avoid long floats when the weave is reversed. So zig-zag weave is produced by the combination of S-twill and Z-twill weave. According to the change of twill direction there are two types of zig-zag weave, such as:

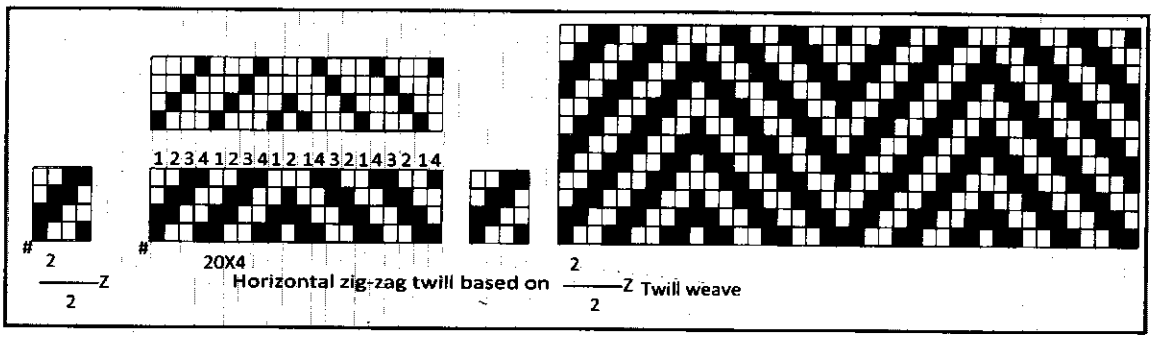
- Horizontal zig-zag, and
- Vertical zig-zag weave.

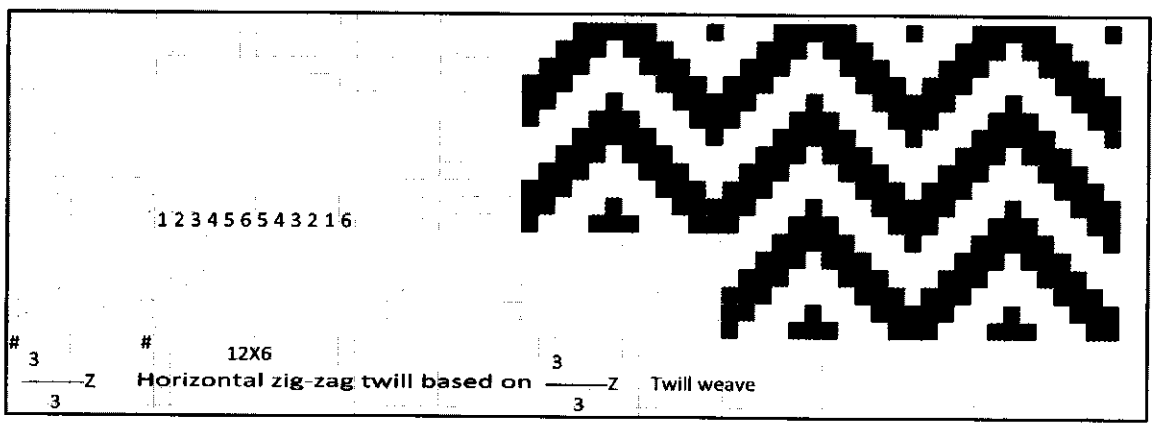
Horizontal Zig-zag weave:

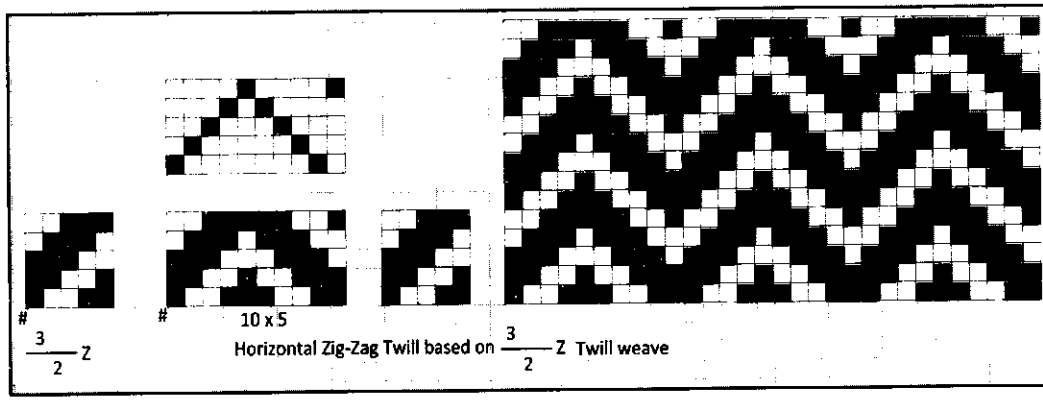
If the direction of twill line is change depends on the warp yarn than horizontal zig-zag twill weave is produced. The repeat size of horizontal zig-zag is calculated from the regular or base twill weave. In one system, the number of warp yarn in zig-zag weave is double of the number of warp yarn of base twill and the number of weft yarn is same as base twill weave. For example, if the repeat size of basic regular twill is 4 × 4, than the repeat size of horizontal zig-zag is 8 × 4. In other system, the number of warp yarn in zig-zag weave is two less from double of the number of warp yarn of base twill and the number of weft yarn is same as base twill weave. For example, if the repeat size of basic regular twill is 4 × 4, than the repeat size of horizontal zig-zag is 6 × 4. In general, the direction of twill line is changed after the completion of repeat of regular twill weave and the point is created at the changing time. Normally warp-way twill is used as regular basic twill. Returning a straight draft in the opposite direction will create a pointed draft and does result in a horizontal waved effect if programmed with a peg plan of the twill weave. So pointed or V – draft is used to produce horizontal zig-zag weave. It is possible to produce this weave from any type of regular basic twill weave. The following figures show the weave plan with drafting and lifting plan of some horizontal zig-zag weaves.

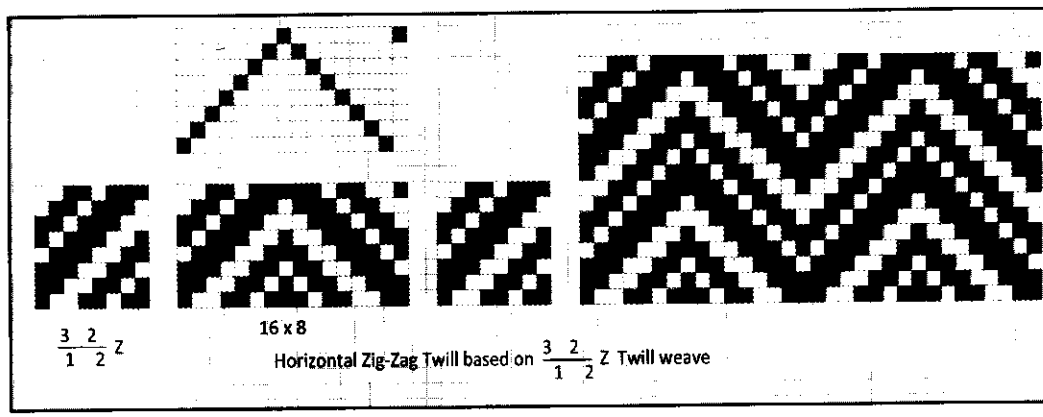

1 2 3 4 3 2 1 4
8X4
Horizontal zig-zag twill based on 2/2 Z Twill weave


1 2 3 4 3 2
6X4
Horizontal zig-zag twill based on 2/2 Z Twill weave

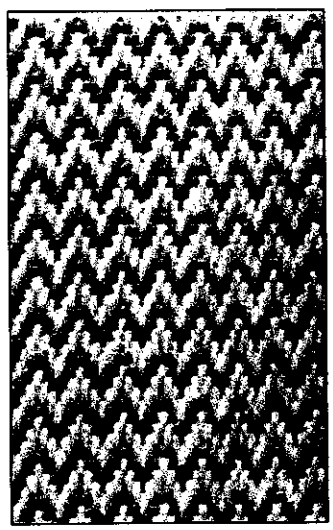

1 2 3 4 1 2 3 4 1 2 14 3 2 14 3 2 14
20X4
Horizontal zig-zag twill based on 2/2 Z Twill weave


1 2 3 4 5 6 5 4 3 2 1 6
12X6
Horizontal zig-zag twill based on 3/3 Z Twill weave

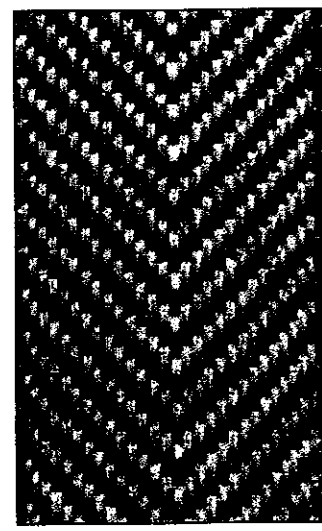




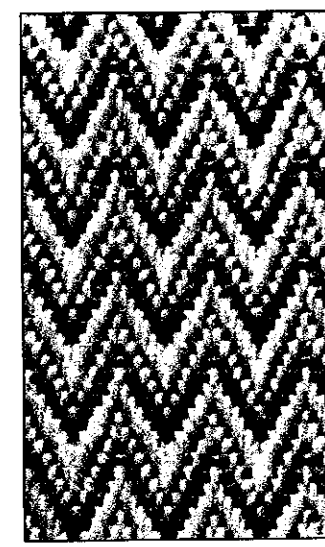
The following figures show the close-up view of some horizontal zig-zag fabric.



Zig-zag twill based on $\frac{2}{2}$, reversing after each repeat.



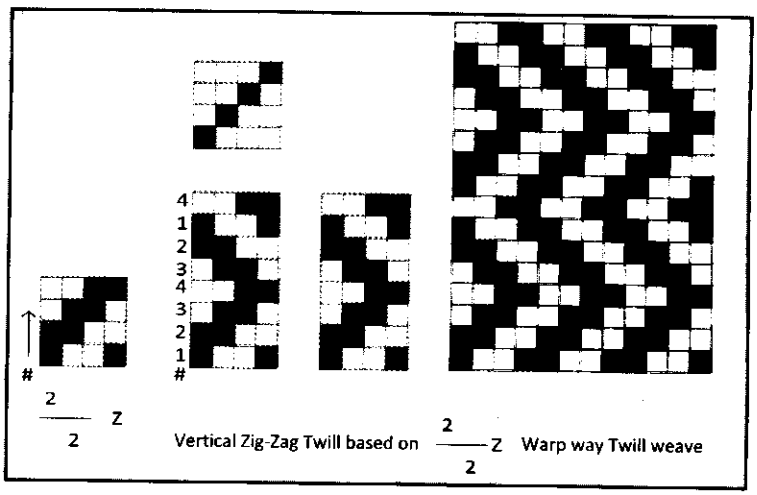
Zig-zag twill based on $\frac{2}{2}$, reversing after every 10 picks.

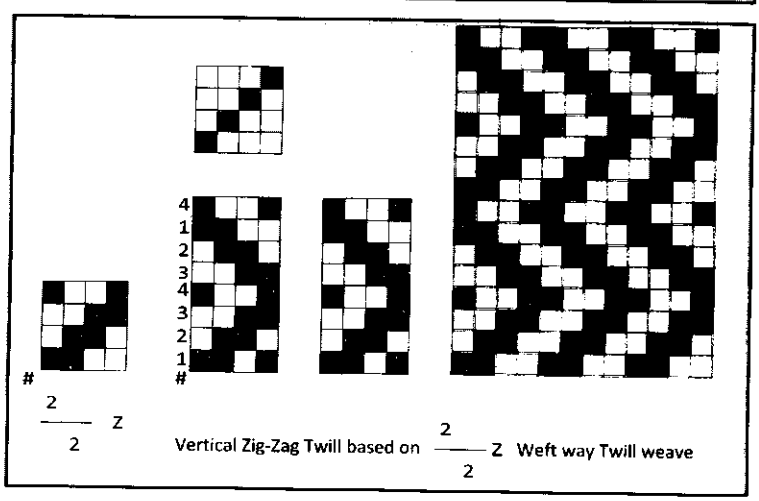


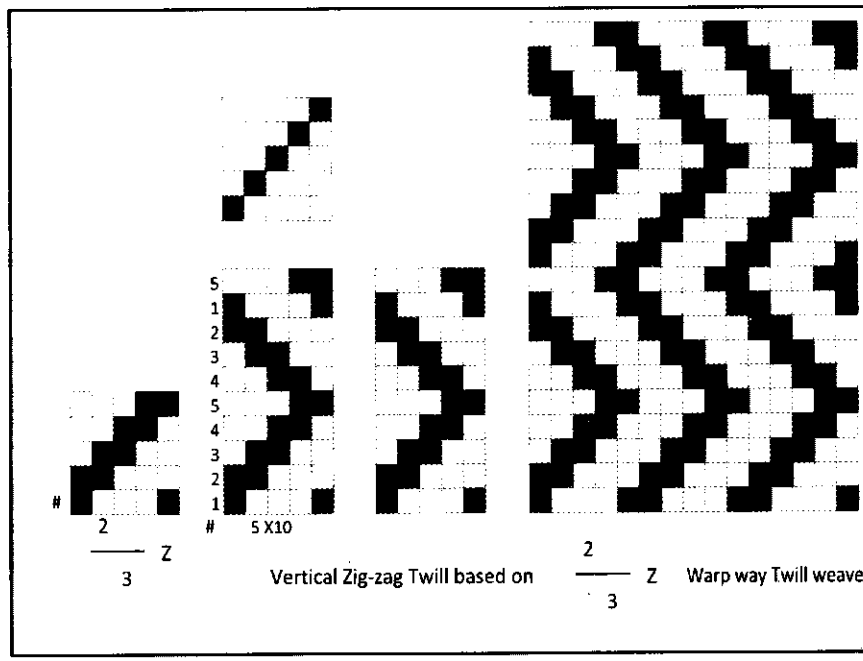
Zig-zag twill based on $\frac{3\ 1}{1\ 3}$

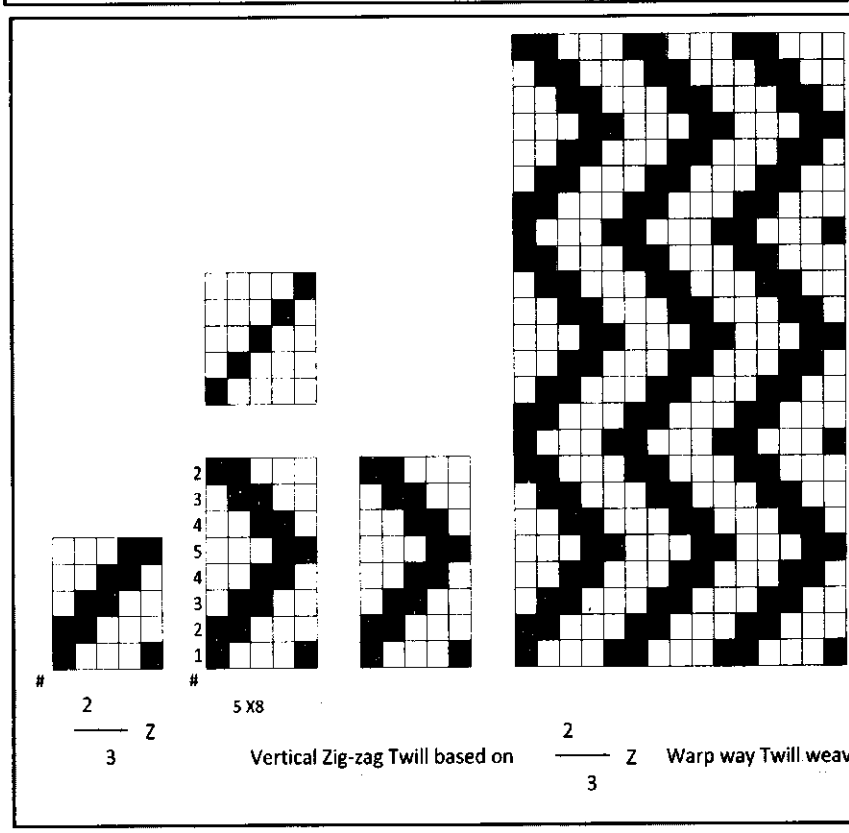
Vertical Zig-zag weave:

If the direction of twill line is change depends on the weft yarn than vertical zig-zag twill weave is produced. The repeat size of vertical zig-zag is calculated from the regular or base twill weave. In one system, the number of weft yarn in zig-zag weave is double of the number of weft yarn of base twill and the number of warp yarn is same as base twill weave. For example, if the repeat size of basic regular twill is 5 × 5, than the repeat size of vertical zig-zag is 5 × 10. In other system, the number of weft yarn in zig-zag weave is two less from double of the number of weft yarn of base twill and the number of warp yarn is same as base twill weave. For example, if the repeat size of basic regular twill is 5 × 5, than the repeat size of horizontal zig-zag is 5 × 8. In general, the direction of twill line is changed after the completion of repeat of regular twill weave and the point is created at the changing time. Both weft-way and warp-way twills are used as regular basic twill. Straight draft is used to produce vertical zig-zag weave. It is possible to produce this weave from any type of regular basic twill weave. The following figures show the weave plan with drafting and lifting plan of some vertical zig-zag weaves.

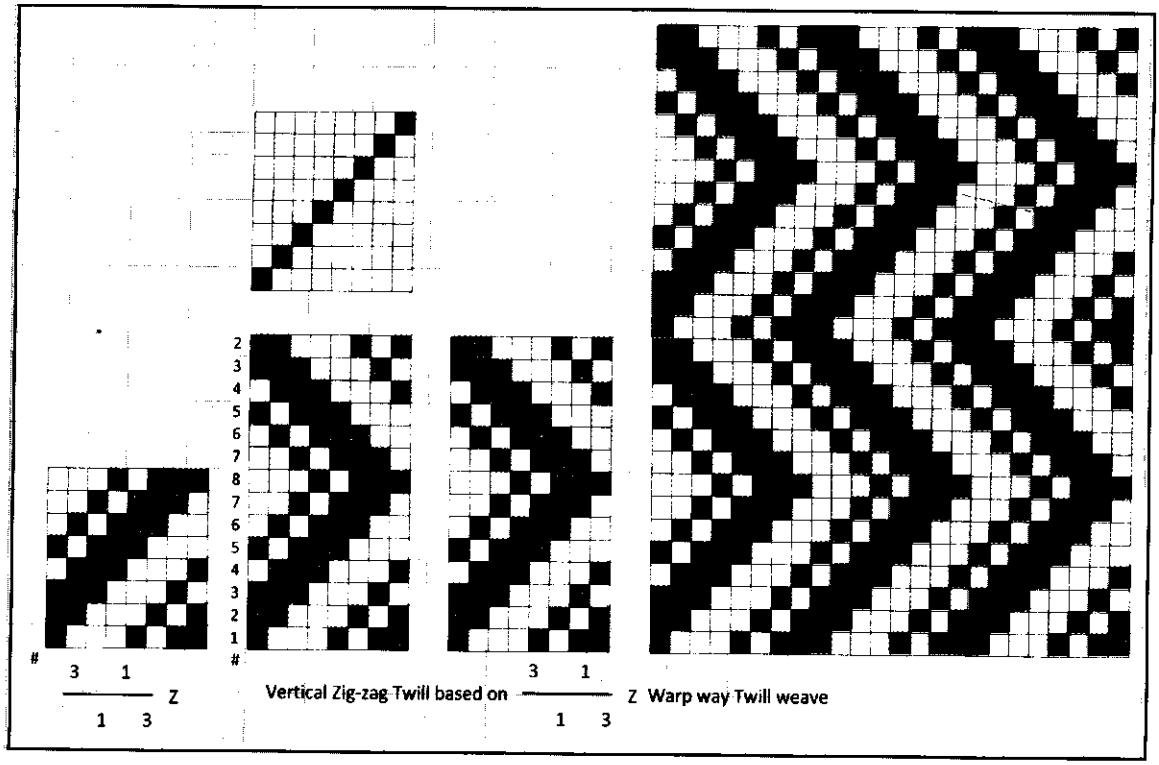








Zig-zag twill is used for figured or ornamented design, upholstery, wall-covering, screen, curtain, various house hold items.



2. Herringbone Twill weave:

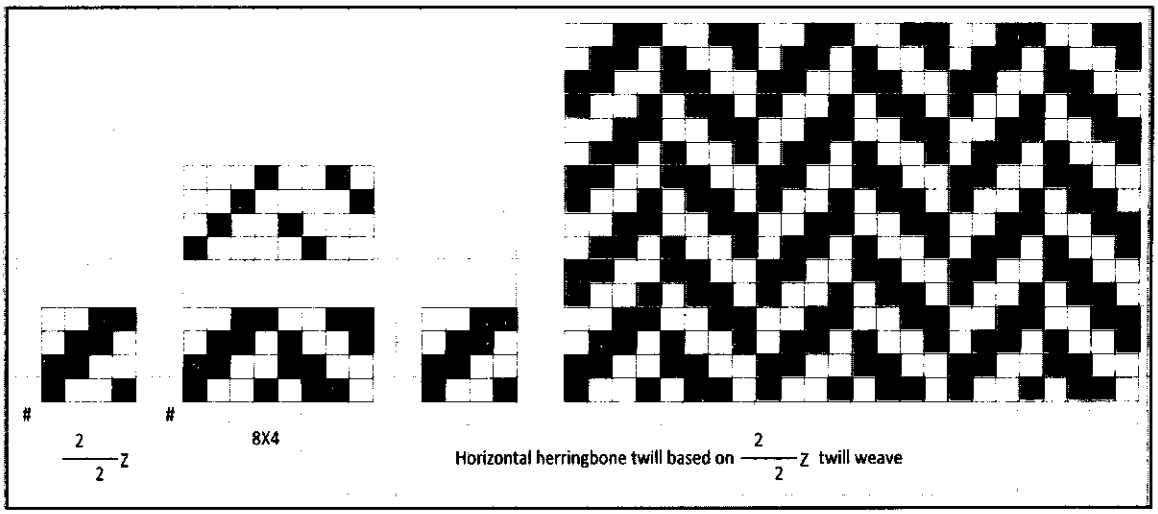
These weaves are generated by introducing a step into the design after a certain number of ends or picks. At the step, every thread changes from up to down or vice versa. If the original weave is not double-faced, this means that, at every step, a warp twill changes into a weft twill or vice versa. It is also produced by the combination of S – twill and Z – twill like zig-zag weave but it is not create a point. It is also divided into two groups depending on the change of the direction of twill line, such as:

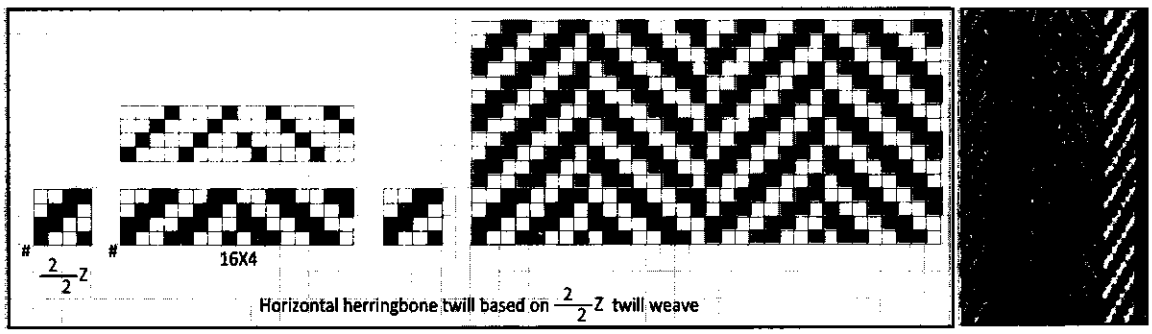
- Horizontal herringbone twill weave, and
- Vertical herringbone twill weave.

Horizontal Herringbone Twill weave:

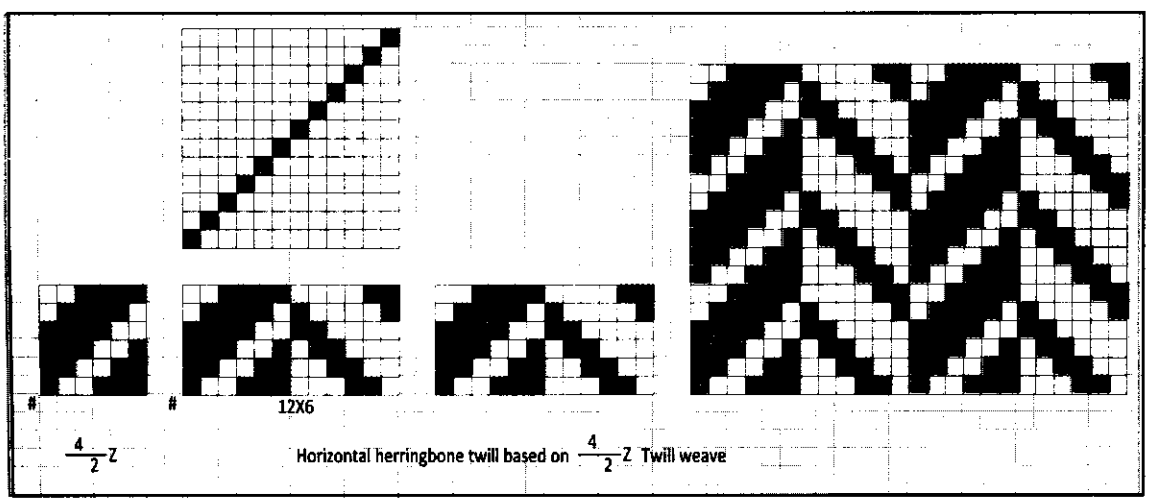
If the direction of twill line is change according to the herringbone principle depends on the warp yarn than horizontal herringbone twill weave is produced. The repeat size of horizontal herringbone is calculated from the regular or base twill weave like as horizontal zig-zag weave. In this case the number of warp yarn in herringbone weave is double of the number of warp yarn of base twill and the number of weft yarn is same as base twill weave. For example, if the repeat size of basic regular twill is 4 × 4, than the repeat size of horizontal herringbone is 8 × 4. In general, the direction of twill line is changed after the completion of repeat of regular twill weave. Normally warp-way twill is used as regular basic twill. Broken draft is used to produce horizontal herringbone weave, if double-face twill weave is used as base twill. When uneven

twill such as warp-face or weft-face twill is used as base twill then straight draft is used to produce horizontal herringbone weave.





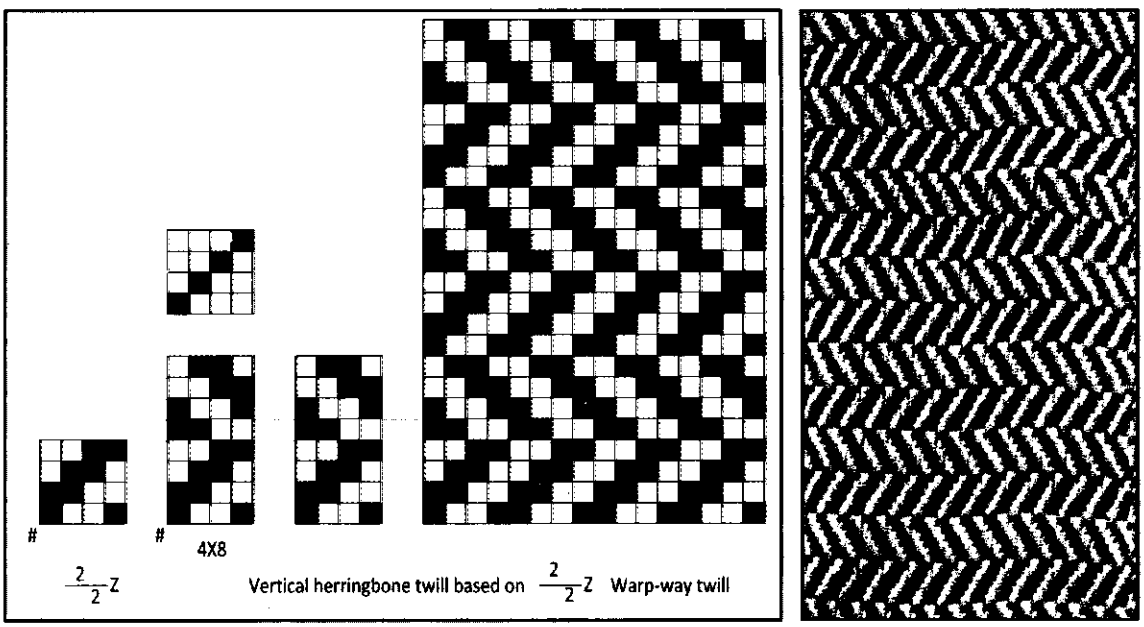
Horizontal herringbone twill based on $\frac{2}{2}$, reversal of twill after every eight ends



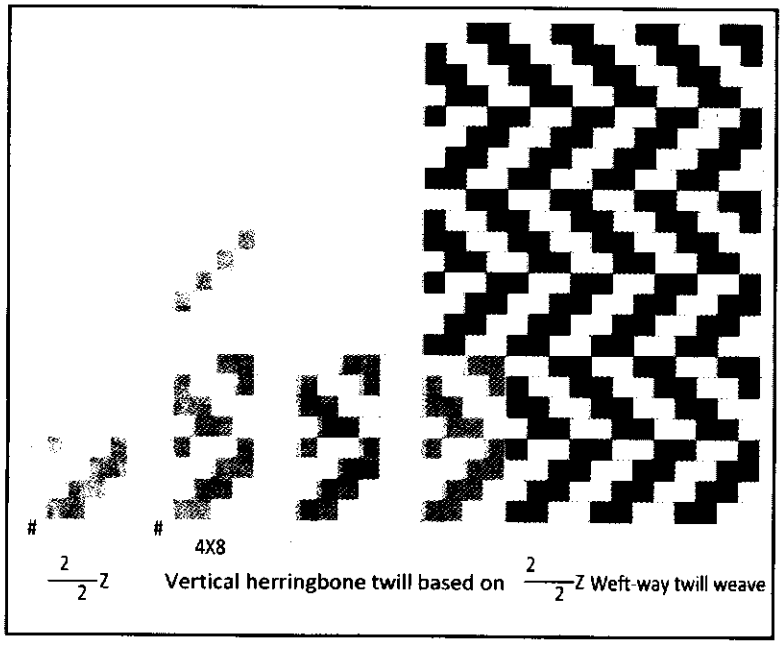
It is possible to produce this weave from any type of regular basic twill weave. The vertical stripe effect is produced on the surface of this fabric. The just previous figures show the weave plan with drafting and lifting plan of some horizontal herringbone weaves.

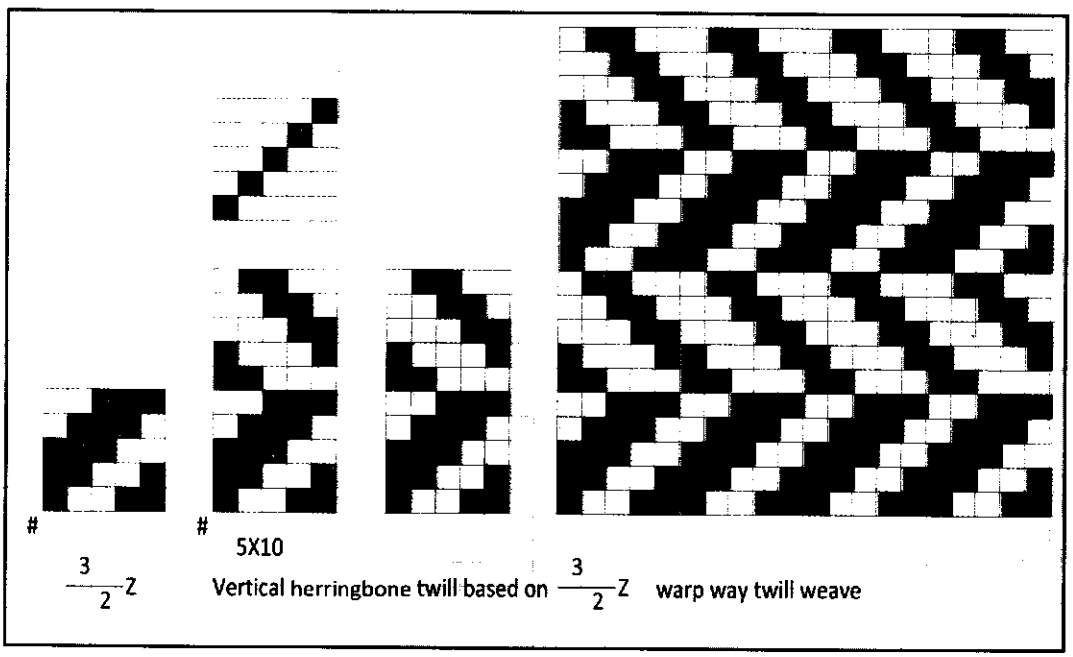
Vertical Herringbone Twill weave:

If the direction of twill line is change according to the herringbone principle depends on the weft yarn than vertical herringbone twill weave is produced. The repeat size of vertical herringbone is calculated from the regular or base twill weave like as vertical zig-zag weave. In this case the number of weft yarn in herringbone weave is double of the number of weft yarn of base twill and the number of warp yarn is same as base twill weave. For example, if the repeat size of basic regular twill is 4 × 4, than the repeat size of vertical herringbone is 4 × 8. In general, the direction of twill line is changed after the completion of repeat of regular twill weave. Normally weft-way twill is used as regular basic twill. Straight draft is used to produce vertical herringbone weave from all type of base twill. It is possible to produce this weave from any type of regular basic twill weave. The horizontal stripe effect is produced on the surface of this fabric. The following figures show the weave plan with drafting and lifting plan of some vertical herringbone weaves.



The weave, drafting and lifting plan with Close-up view of vertical herringbone twill based on $\frac{2}{2}$ warp-way twill.

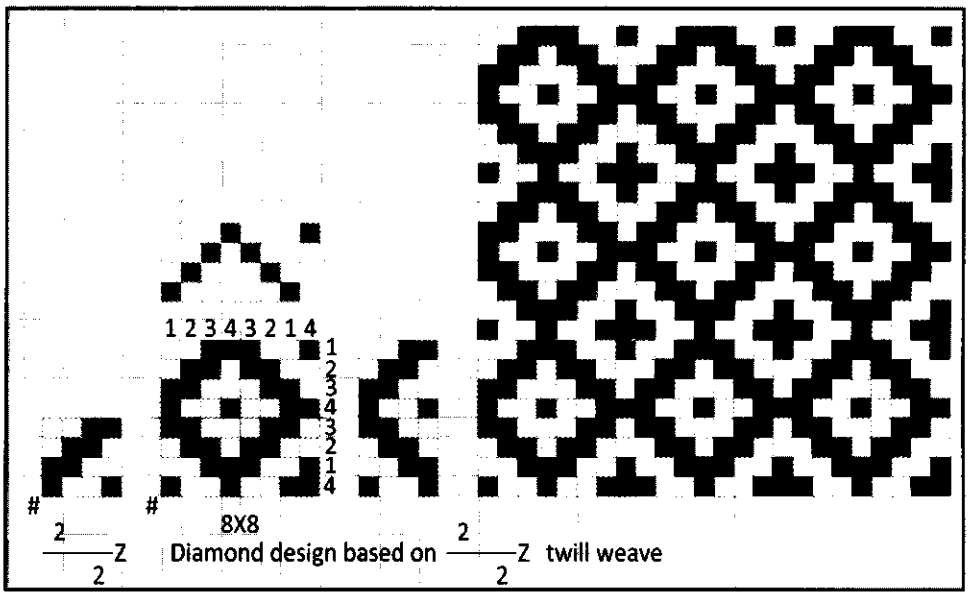


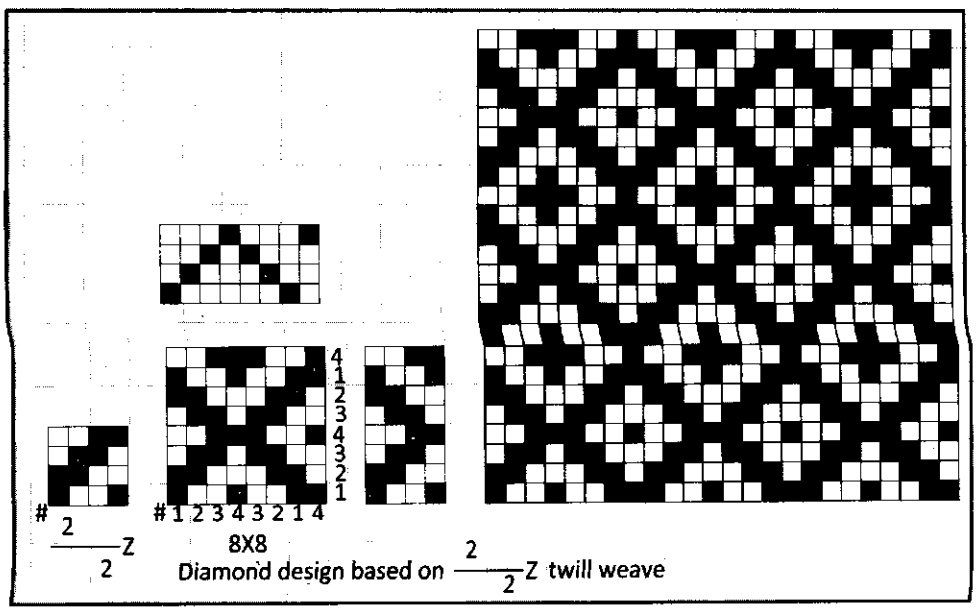


3. Diamond design:

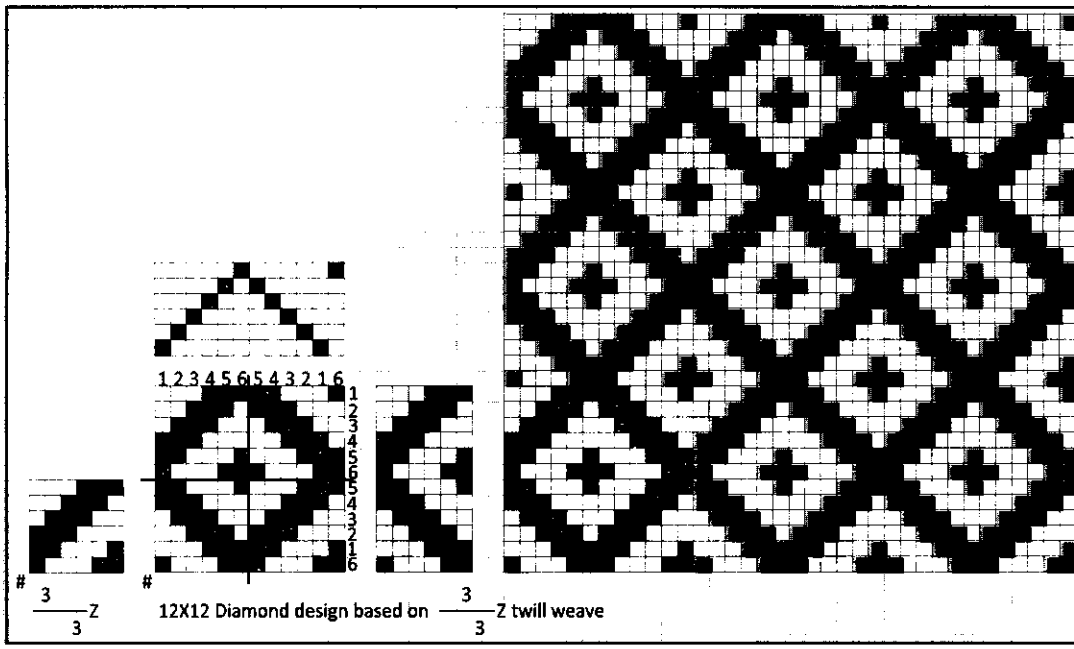
This is a derivative of twill weave. Diamond design is developed on the basis of pointed principle. It is build-up by the combination of vertical and horizontal zig-zag weave. The repeat size of diamond design is also calculated from the regular or base twill weave. In

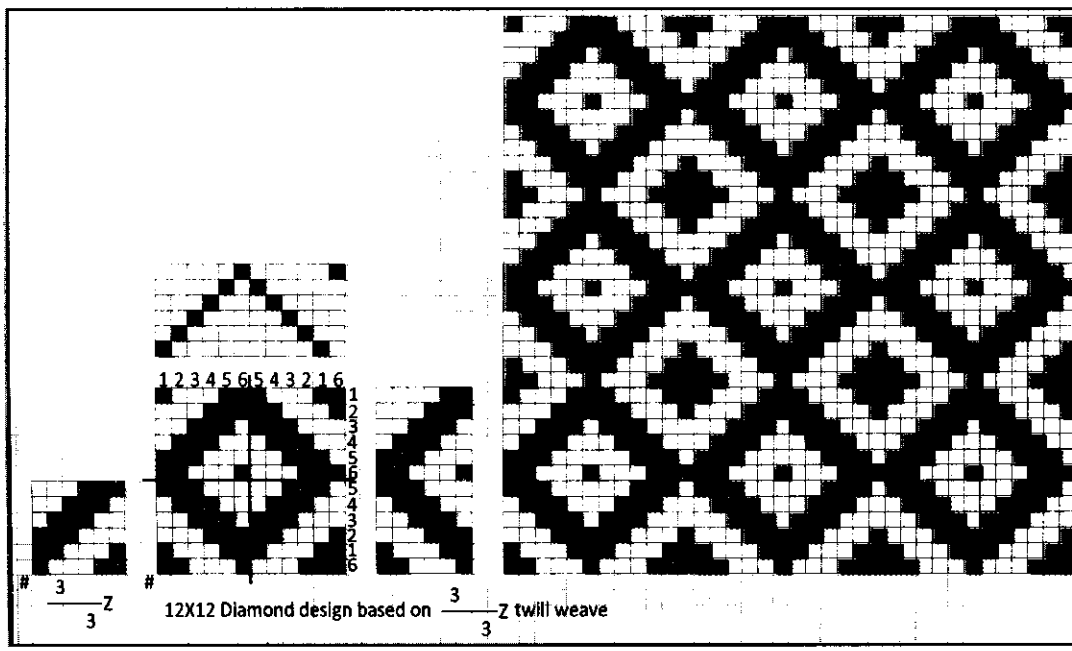
this case the number of both warp and weft yarns in diamond weave are double of the number of warp and weft yarn of base twill respectively. For example, if the repeat size of basic regular twill is 4 × 4, than the repeat size of diamond design is 8 × 8. Diamond is a reversible design. So it may be divided into two equal parts in both vertical and horizontal axis. Pointed or V – drafting system is used to produce diamond design.





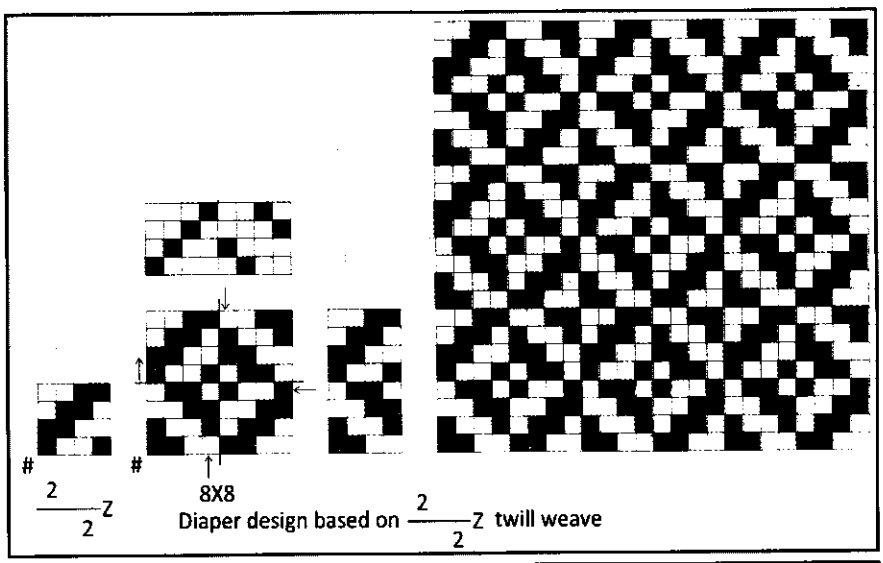
The construction principle of diamond as follows: there is several system to build up diamond design. At first select the repeat size according to the basic twill. Then repeat size is divided into four quadrants. Now the basic twill is put in every quadrant by the change of direction of twill line in this way that the opposite twill line of every twill should be parallel and they produce an angle at the changing point. Both sides of some diamond design are equal but some diamond designs are not equal although they are developed on the same basic twill. It depends on the construction principle, which is shown in the following figures.

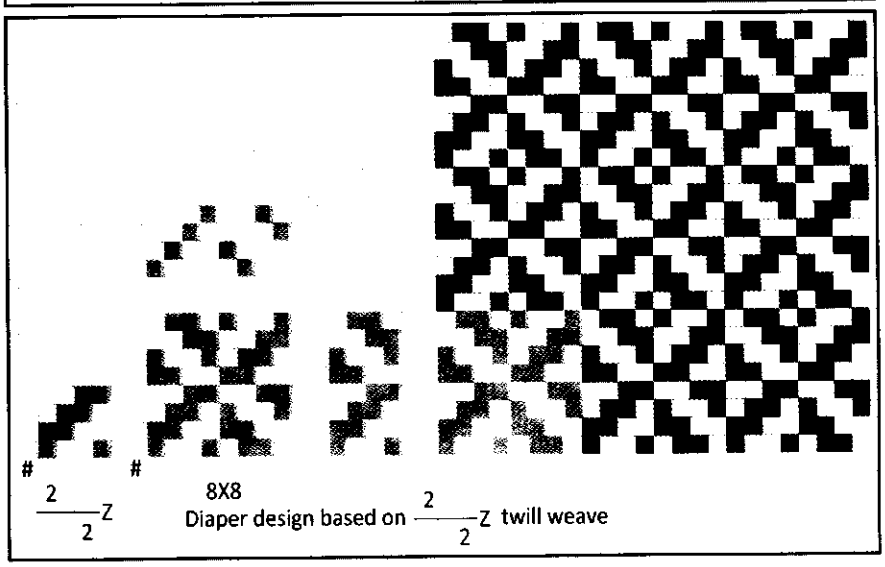




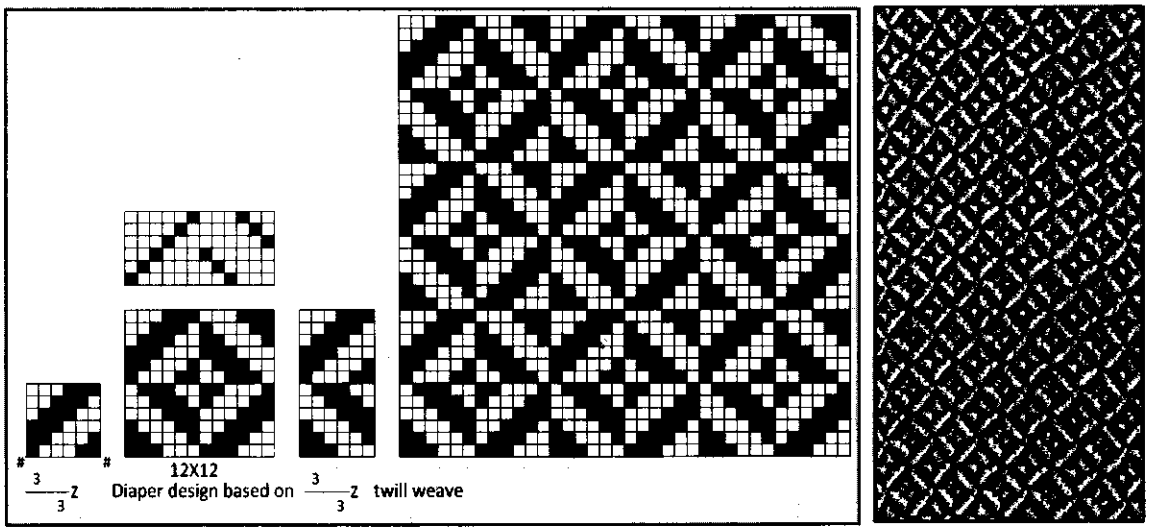
4. Diaper design:

This derivative of twill weave is developed on the basis of herringbone principle. It is build-up by the combination of vertical and horizontal herringbone weave. The repeat size of diaper design is also calculated from the regular or base twill weave like as diamond design. In this case the number of both warp and weft yarns in diaper weave are double of the number of warp and weft yarn of base twill respectively. For example, if the repeat size of basic regular twill is 4 × 4, than the repeat size of diaper design is 8 × 8. Diaper is not a reversible design like diamond. It may be divided into two parts in diagonal axis. Broken draft is used to produce diaper design, if double-face twill weave is used as base twill. When uneven twill such as warp-face or weft-face twill is used as base twill then straight draft is used to produce this design.

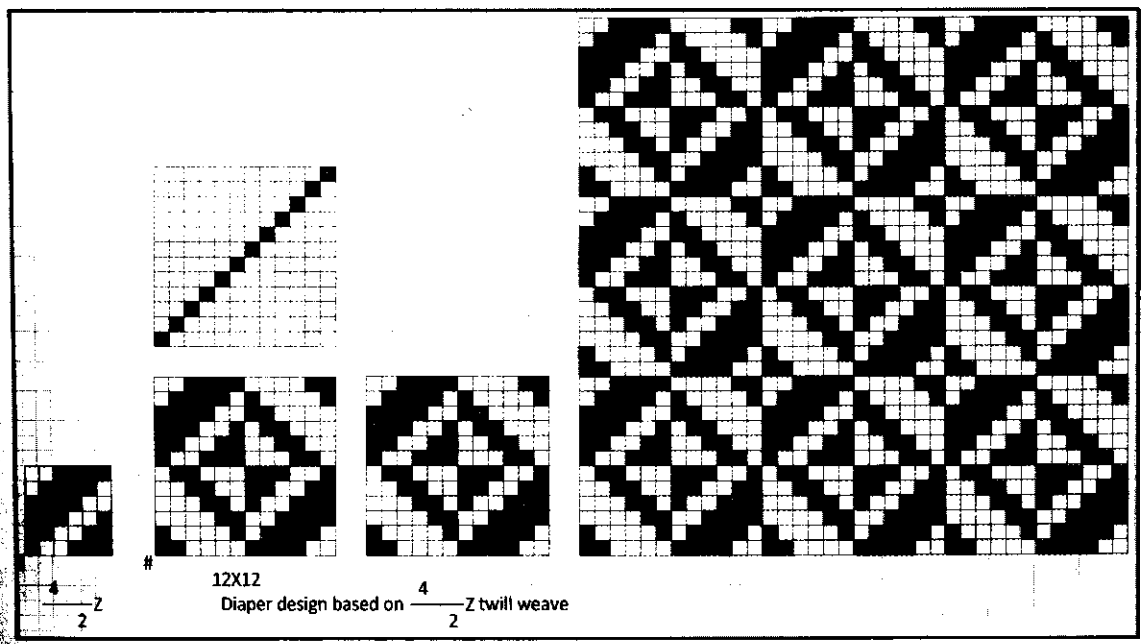




The construction principle of diaper design as follows: there is several systems to build up diaper design. At first select the repeat size according to the basic twill. Then repeat size is divided into four quadrants. Now the basic twill is put in every quadrant by changing direction of twill line on the basis of herringbone principle in this way that they do not produce point like as diamond. For every change of twill direction a warp twill changes into a weft twill or vice versa like as herringbone principle.



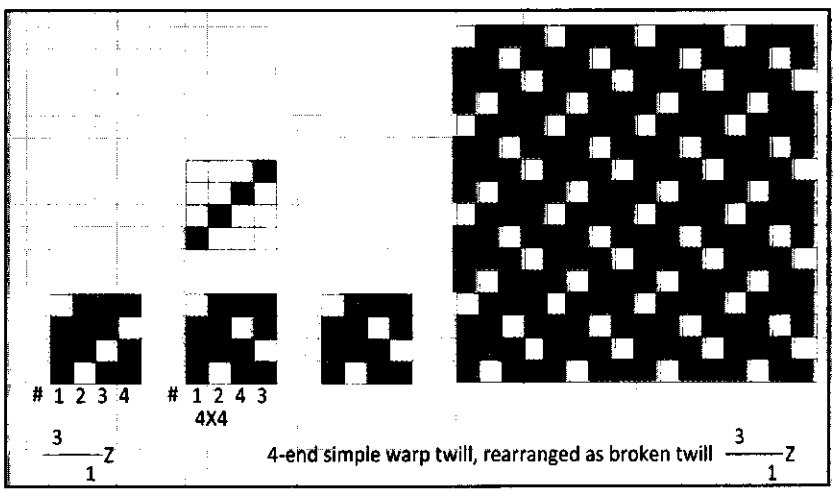
Close-up view of diaper design based on $\frac{3}{3}$ twill with weave, drafting and lifting plan

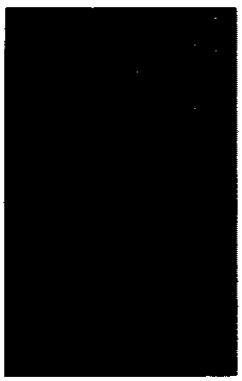


Towel, bedsheet, wrappers, pelow covers, table cloth, curtain, sopa cover and many other house hold fabrics can be made by this weave.

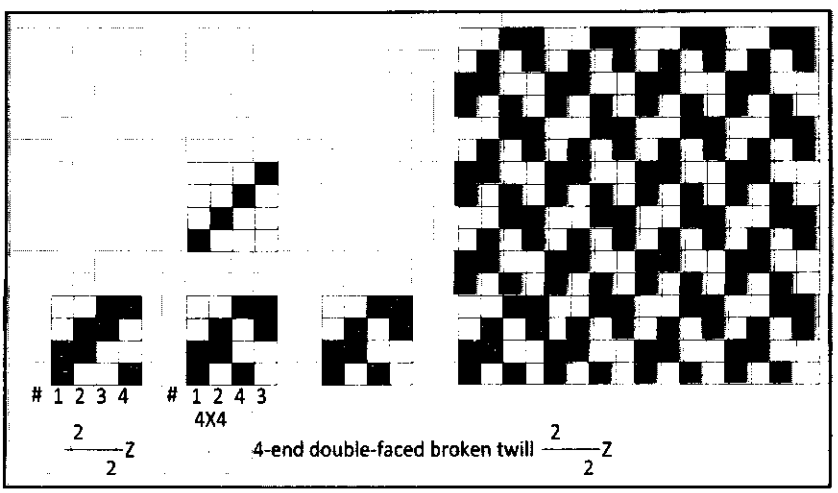
5. Broken or reversed Twill weave:

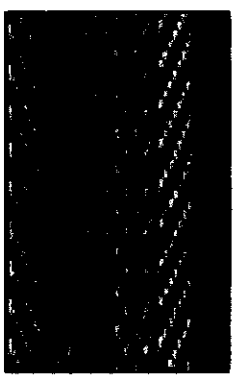
A broken twill is formed by a break in the continuation of the twill line at predetermined intervals. There is several systems to produce broken twill. Usually the break will be at the centre of the repeat, with only one reversal, but more complicated breaks can be made. One divides the original weave into two halves and copies the first half unchanged, starting from the first warp end. The second half is copied in reverse order, starting from the last end. Broken twills are also produced by dividing three or more parts. Normally straight draft is used to produce this weave. The pattern can be broken either in the warp or in the weft direction and no twill line will be generated. The following figures show the close-up view with weave, drafting and lifting plan of different types of broken twill weaves.



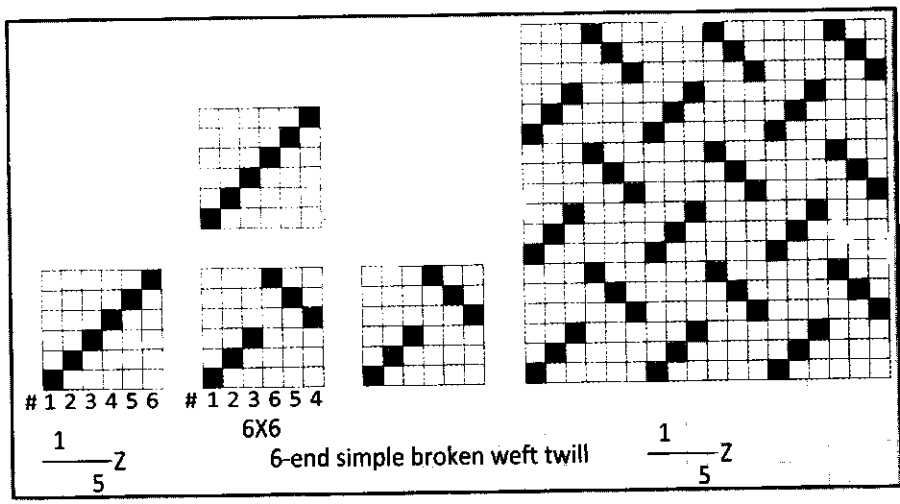


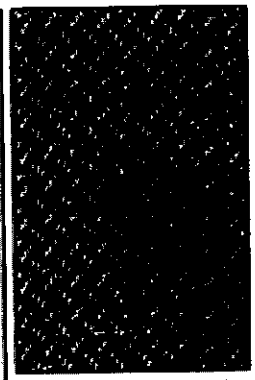
Close-up view of broken twill based on $\frac{3}{1}$ twill weave



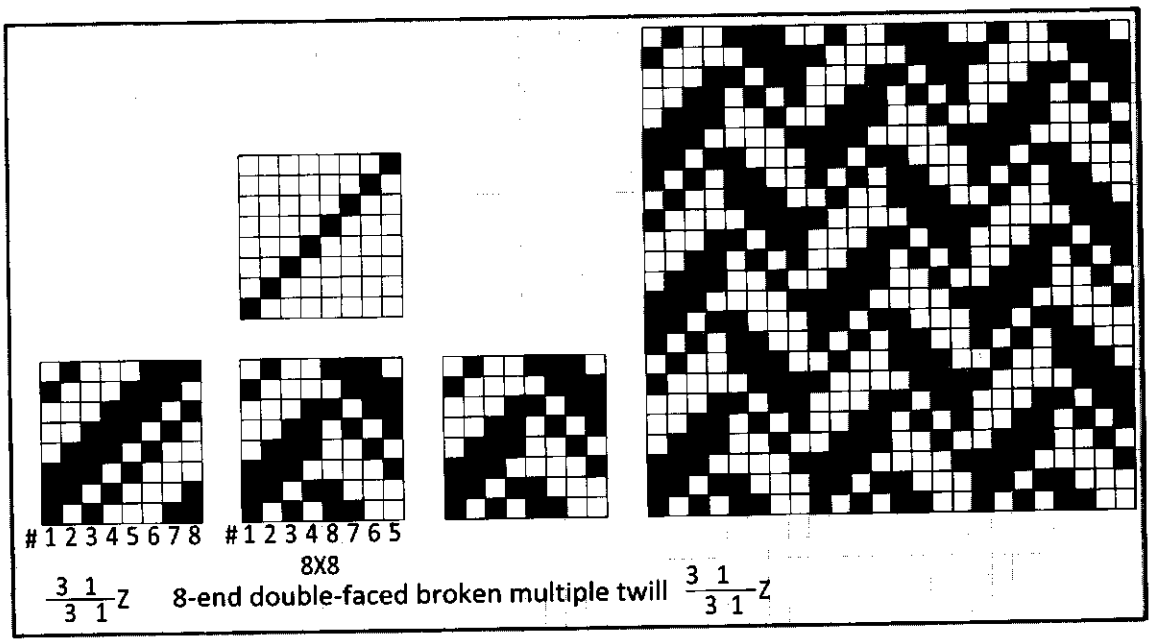


Close-up view of broken twill based on $\frac{2}{2}$ twill weave





Close-up view of broken twill based on $\frac{1}{5}$ twill weave

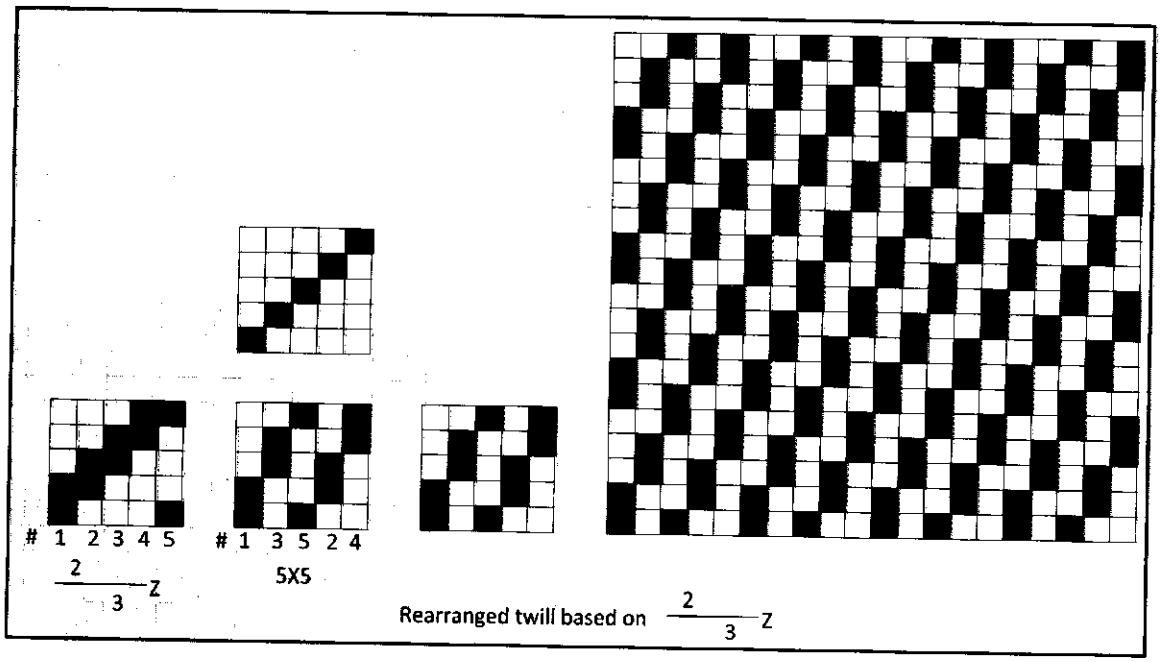


6. Re-arranged Twill weave or Transposed Twill weave:

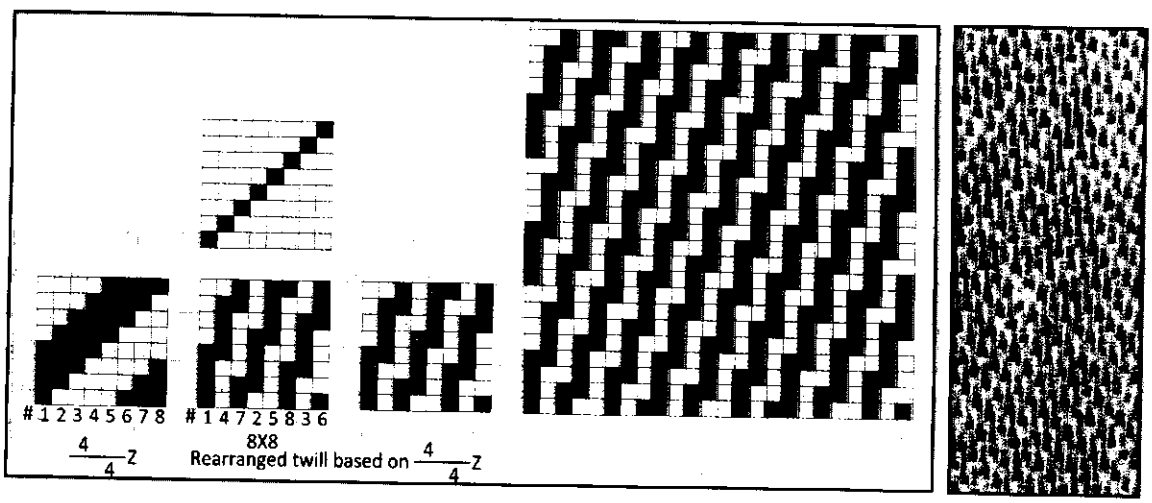
Rearranging a weave means taking single thread or group of threads of the base weave and arranging them in a different order. If the rearrangement does not exceed the repeat of the base weave, the same straight draft can be used. The pattern can be rearranged either in the warp or in the weft direction. By this rearrangement the different types of novelty and attractive designs can be developed in the fabric. The appearance of some rearranged twill is same as broken twill. This twill weave is created by the following different methods.

Rearrangement of individual threads:

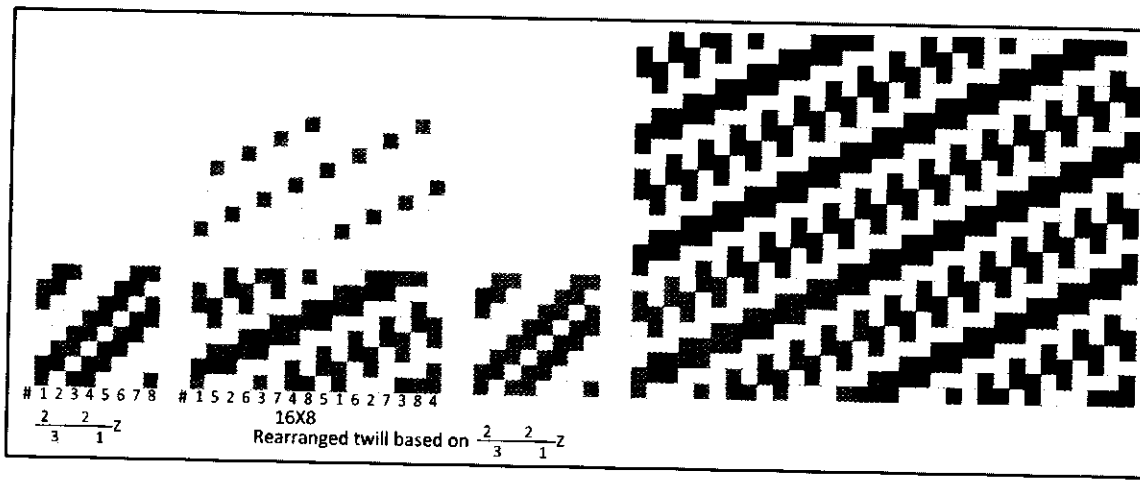
One can rearrange weaves by changing the sequence of the warp ends. The following figure represent 5 – end expanded weft twill $\frac{2}{3}$, rearranged as a steep or elongated twill by changing the warp sequence to every 2nd end.



The following figure represents a 8 – end double-faced twill $\frac{4}{4}$, rearranged like satin with step 3. This weave is also called a "mock satin" but, unlike the real satin, is double-faced.

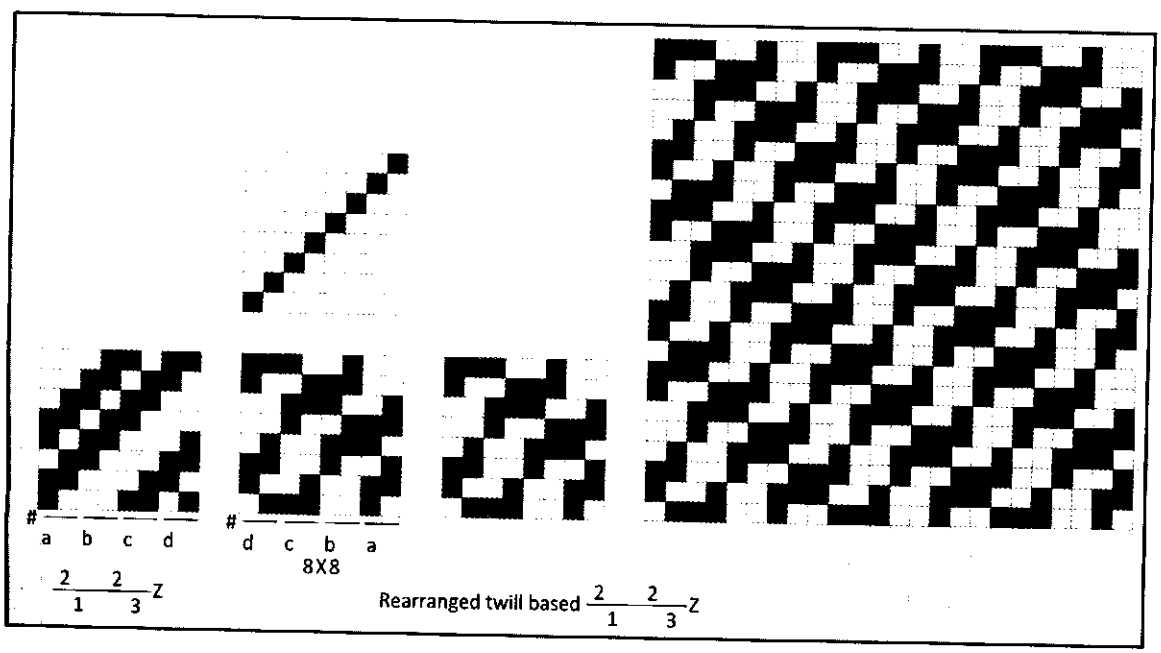


The following figure represents a 8 – end multiple twill $\frac{2\ \ 2}{3\ \ 1}$ where the warp ends are rearranged in the sequence 1,5; 2,6; 3,7; 4,8; 5,1; 6,2; 7,3; 8,4.

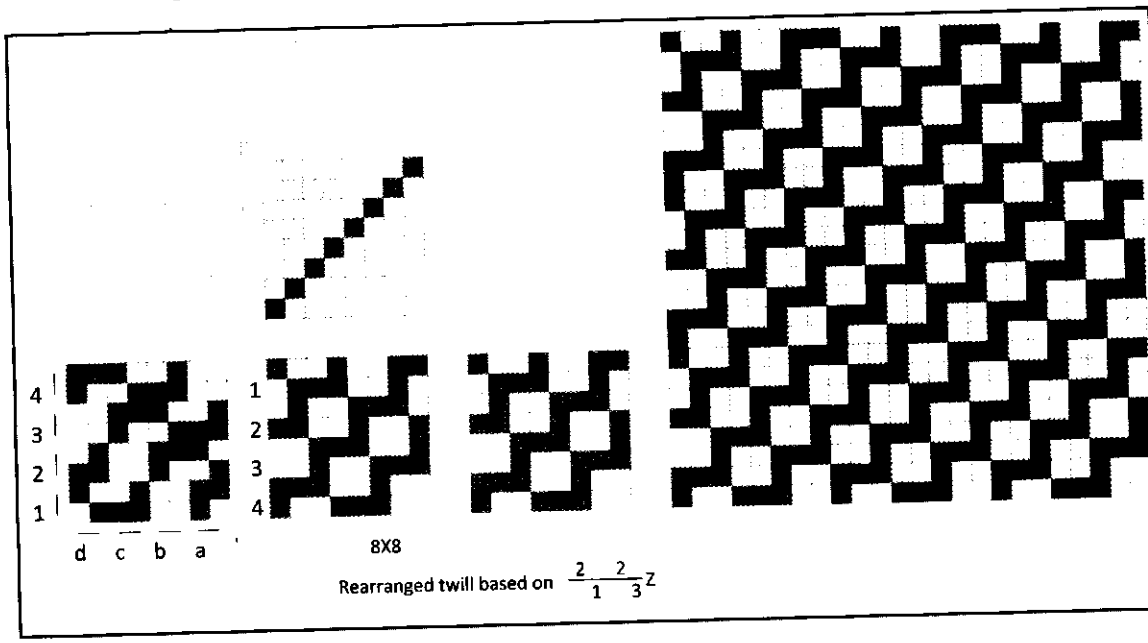


Rearrangement of groups of threads:

With this type of rearrangement, one divides the original weave into groups of two or more ends and changes their sequence, e.g. by reversing it or arranging them in satin fashion. The following figure represents 8 – end multiple twill $\frac{2\ \ 2}{1\ \ 3}$, divided into groups of two ends which are placed in reverse sequence. The sequence within the group remains unchanged.



The following figure represents the rearranged weave of the just previous figure is divided into groups of two picks each and these are also arranged in reverse order.



Corkscrew Weave:

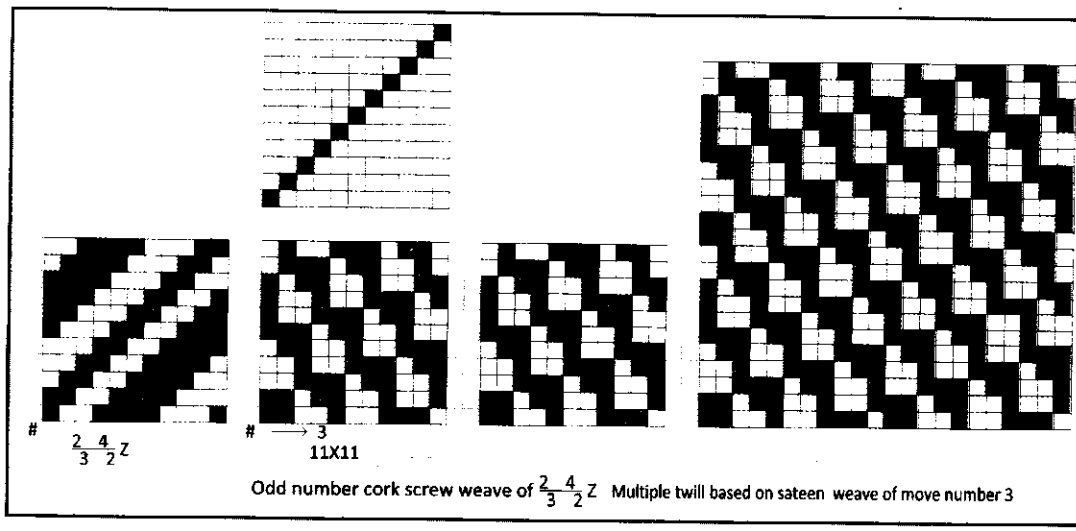
Corkscrew weaves are a variety of rearranged twill. These are characterized by a some what subdued twill formation with either warp or weft face. These weaves, also called diagonal ribs. The peculiar feature of corkscrew weaves is the combination of two or more distinct twill lines, which may be of different colours. Corkscrew fabrics, which are usually made of fine worsted, should be set close in the warp, otherwise the twill will look thin and ragged.

They are used either alone or in combination with other weaves for variety of purpose. They are used for garment for which they are capable of producing firm and compact textures of greater strength, warmth and durability. They are of two kinds, such as –

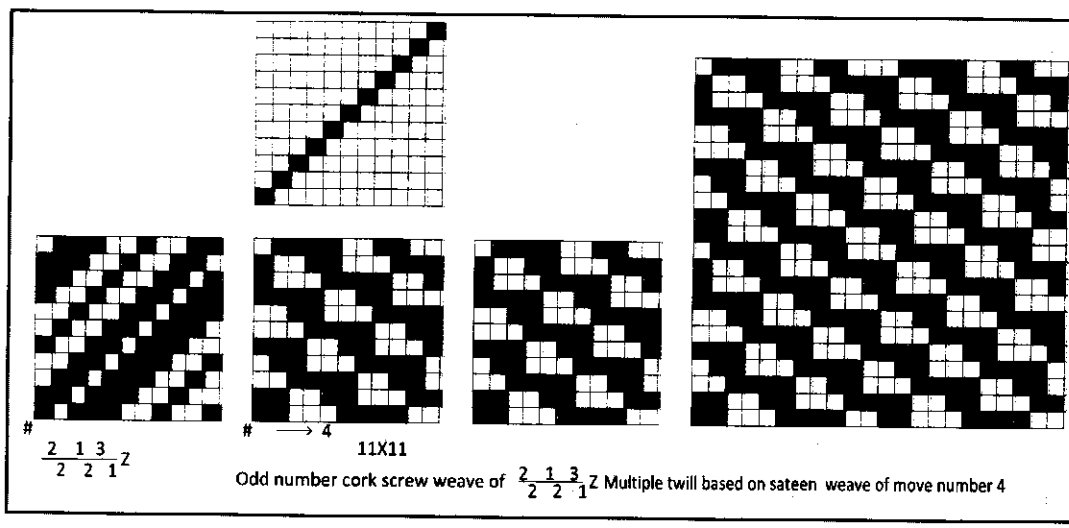
- Odd number corkscrew weave, and
- Even number corkscrew weave.

Odd number corkscrew weave:

Odd number corkscrew weave is created by rearranging any type of regular twill weave in a sateen order. Both warp and weft face types are available. Warp-face – warp floats are one thread longer that weft floats. Same in the case of weft face. They are developed from odd number of ends and picks. The following figures show the odd number corkscrew weave from respective regular twill weave with drafting and lifting plan. Straight drafting system is normally used to produce this weave.



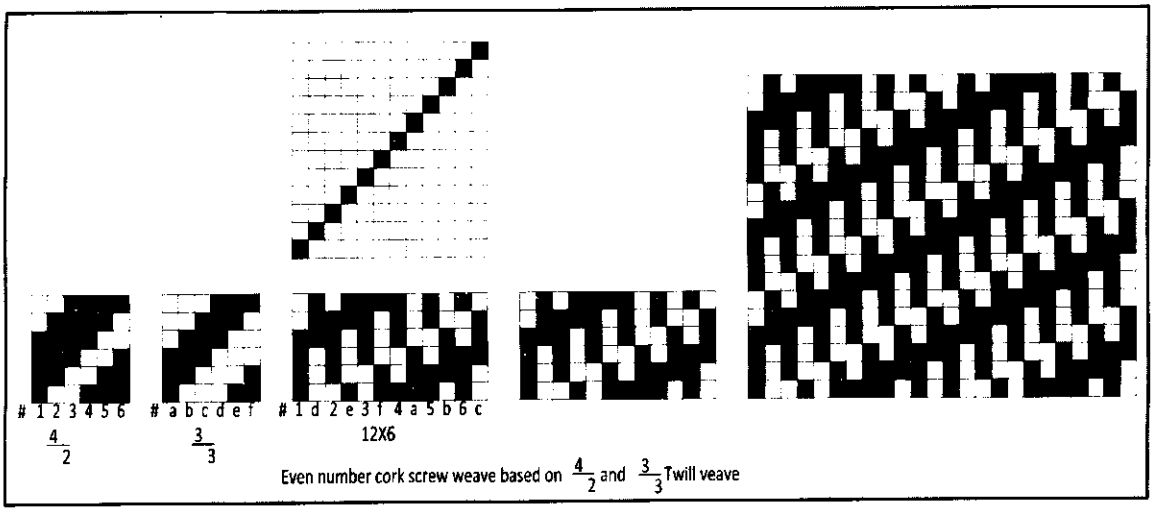
Odd number cork screw weave of $\frac{2}{3}\ \frac{4}{2}\ Z$ Multiple twill based on sateen weave of move number 3



Odd number cork screw weave of $\frac{2}{2}\ \frac{1}{2}\ \frac{3}{1}\ Z$ Multiple twill based on sateen weave of move number 4

Even number Corkscrew weave:

Even number corkscrew is produced from two different regular base twill of the same repeat size. In this case the number of warp yarn in the repeat size of the resultant corkscrew weave will be the sum of the number of warp yarn of the base twill weave and the number of weft yarn is equal to the base twill. For example, if the repeat size of the base twill is 6 × 6 then the repeat size of the resultant even number corkscrew weave is 12 × 6. Straight drafting system is normally used to produce this corkscrew weave. The following figure show the even number corkscrew weave from respective regular twill weave with drafting and lifting plan.



7. Stepped Twill weave:

These weaves are generated by introducing a step into the design after a certain number of ends or picks. At the step, every thread changes from up to down or vice versa. If the original weave is not double-faced, this means that, at every step, a warp twill changes into a weft twill or vice versa. There are three types of step twill weave, such as –

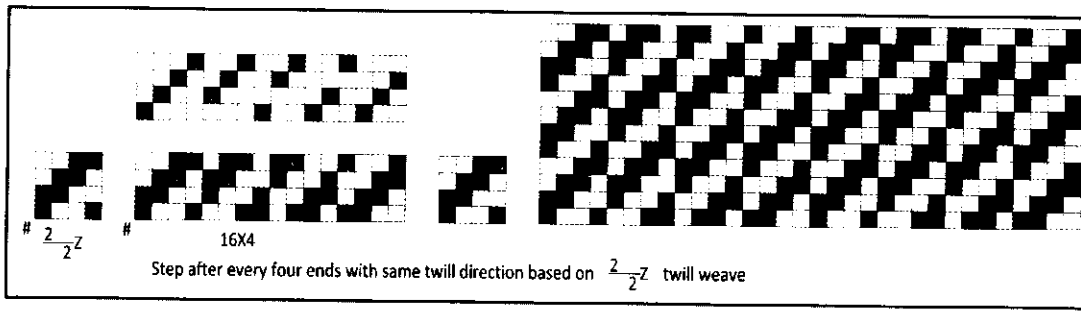
- Warp-way step twill
- Weft-way step twill, and
- Both warp and weft-way step twill weave.

Warp-way step twill weave:

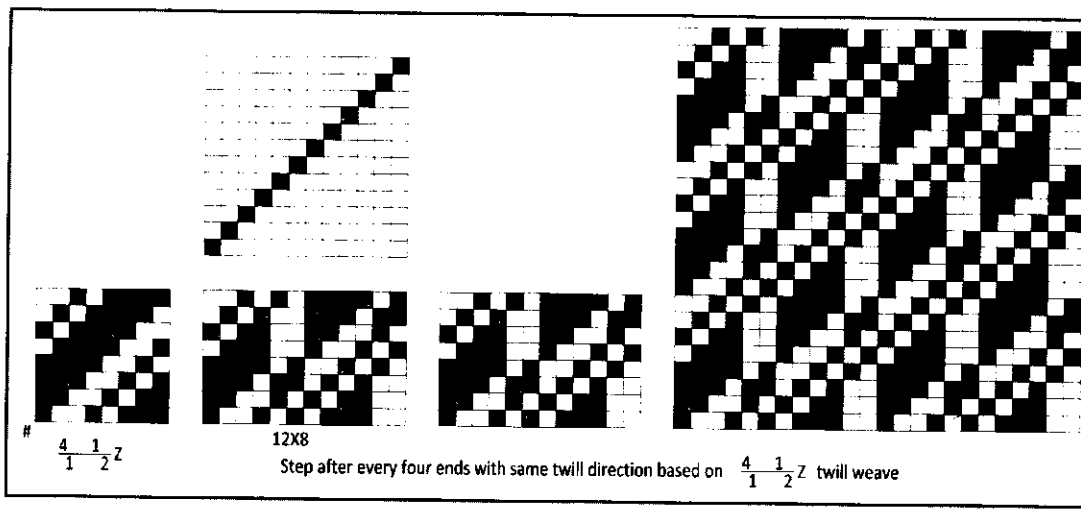
There are two types of warp-way step twill. One is created in the same twill direction and another one is created by reversal of the twill direction.

Same twill direction:

In the same twill direction step may be occur after the repeat or any desired number of thread. The following figure represents 4 – end double-faced twill $\frac{2}{2}$ with step after every four ends and same twill direction.



The following figure represents 8 – end multiple twill $\frac{4\ 1}{1\ 2}$ with a step after every four and two ends alternately and same twill direction.



Reversal of the twill direction:

Same as horizontal herringbone twill weave. It already discuss in the previous section.

Weft-way step twill weave:

There are also two types of weft-way step twill like as warp-way step twill weave. One is created in the same twill direction and another one is created by reversal of the twill direction.

Same twill direction:

In the same twill direction step may be occur after the repeat or any desired number of thread like as warp-way step twill weaveThe following figure represents 4 -end

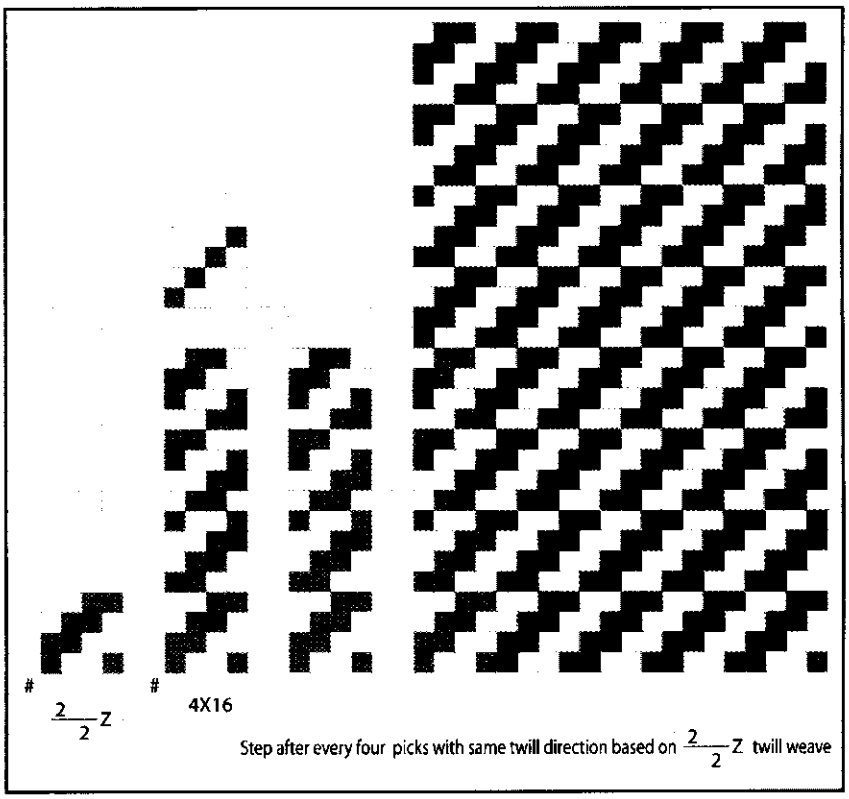
double-faced twill $\frac{2}{2}$ with step after every four picks and same twill direction. Straight drafting system is normally used to produce this weave.

Reversal of the twill direction:

Same as vertical herringbone twill weave. It already discuss in the previous section.

Both warp and weft-way step twill weave:

Same as diaper design. These are also discussed in the previous section.



Step after every four picks with same twill direction based on $\frac{2}{2}$ Z twill weave

8. Elongated or Steep Twill weave:

A peculiar form of twill, known as an elongated or steep twill, is obtained when the warp float of each thread rises two or more picks instead of one pick above the float of the preceding thread. A steep twill can be made by drafting in succession the alternate threads of a regular twill.

This is a term applied to a regular twill which has been altered to achieve a steeper or flatter angle. The angle of elongated twill is either below 45^0 or above 45^0. These are based on a square sett (same number of ends and picks per one inch and an identical yarn count). Any deviation from this will automatically influence the angle. The angle of

the twill line is determined by the step number (the rate of advance from one interlacing point to the next).

There are two types of elongated twill, such as warp way elongated twill i.e. warp-way elongation and weft way elongated twill i.e. weft-way elongation. There are two methods by which elongated twills are developed.

Method – 1: By using step number:

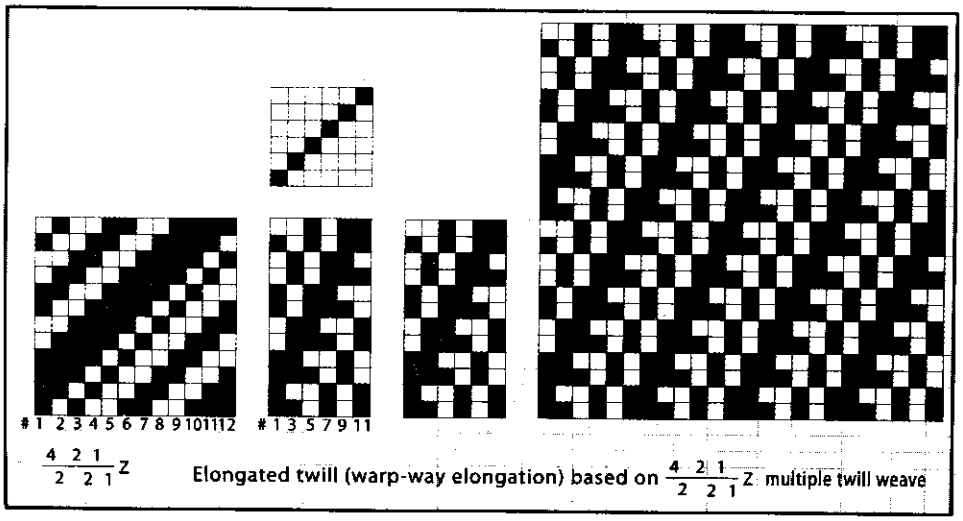
The angle of the elongated twill is determined and this also decides the step number. Assuming the step number required is two, then starting with the first end and using only odd numbered ends will automatically achieve a step of two.

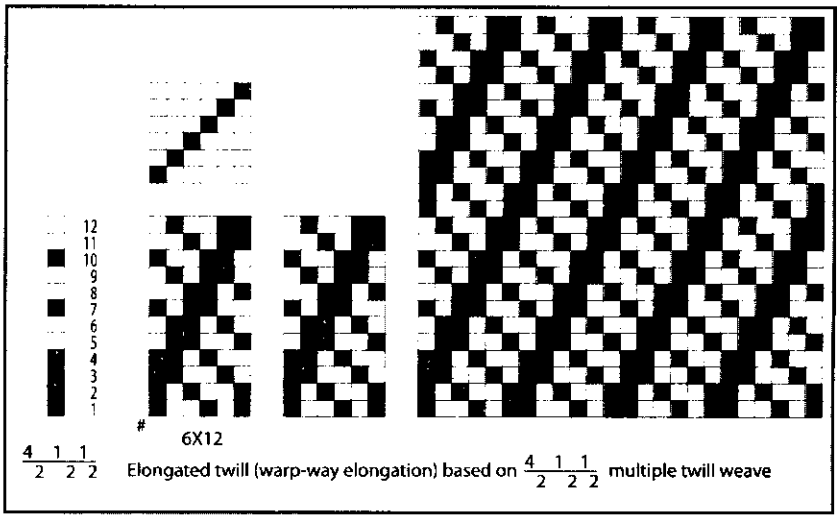
Method – 2: By selecting a base line:

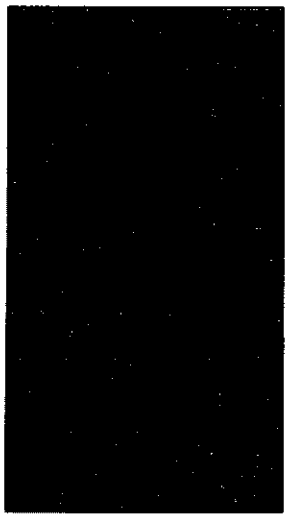
Only a base line is selected with a step number divisable through the repeat of this line. Repeat of base line: 12 ÷ 2 = 6 ends repeat, 9 ÷ 3 = 3 ends repeat, 15 ÷ 3 = 5 ends repeat, 15 ÷ 5 = 3 ends repeat, etc. This is a more efficient method, eliminating drawing out the base weave in full.

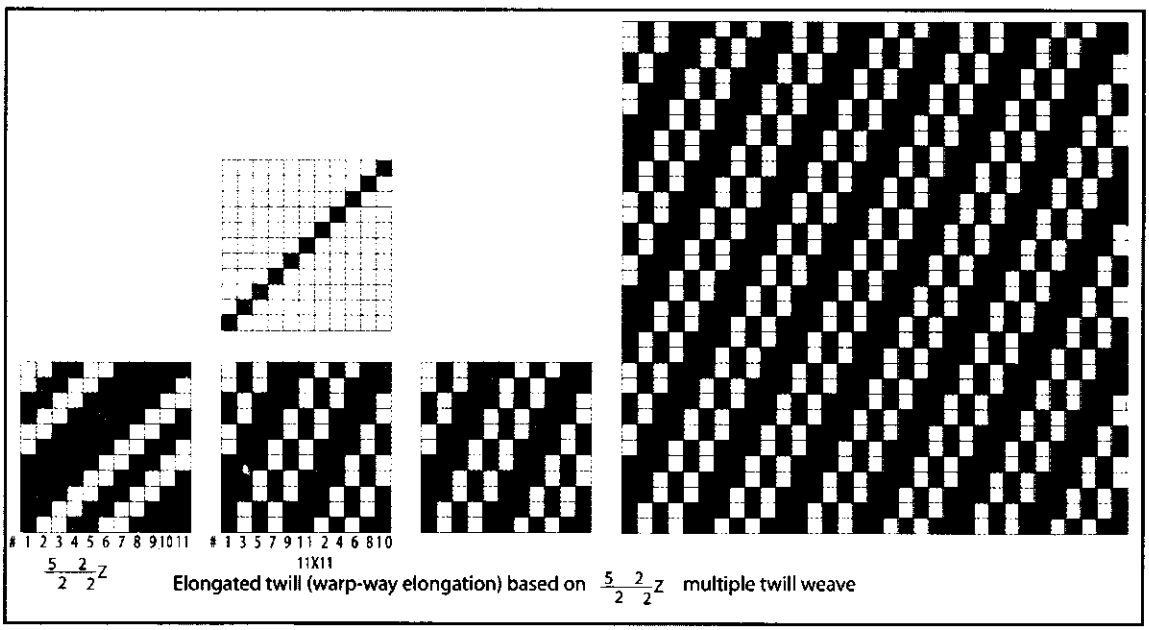
Warp way elongation:

Warp way elongated twill is developed from the warp-way regular twill weave. If the repeat size of regular twill is even number, then the number of warp yarn in the repeat size of the elongated twill is half of the regular twill and the number of weft yarn is same as regular twill weave, when the step number is two. When the repeat size of regular twill is odd number then the repeat size of elongated twill is same as regular twill. Straight drafting system is used to produce this weave. The following figures show the weave plan with drafting and lifting plan of some warp way elongated twill fabric.



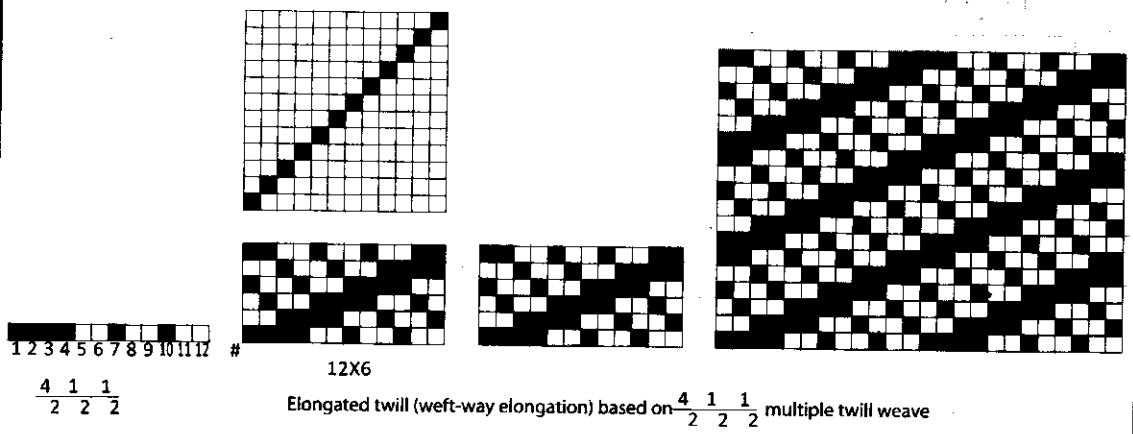




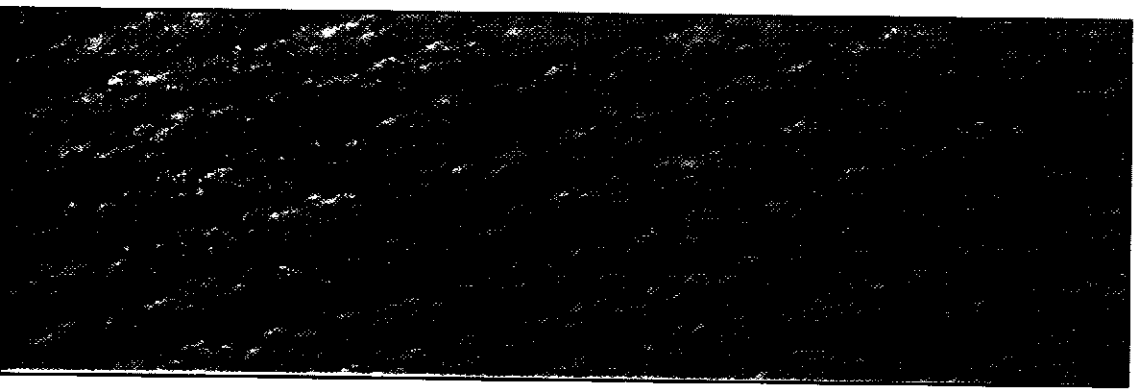


Weft way elongation:

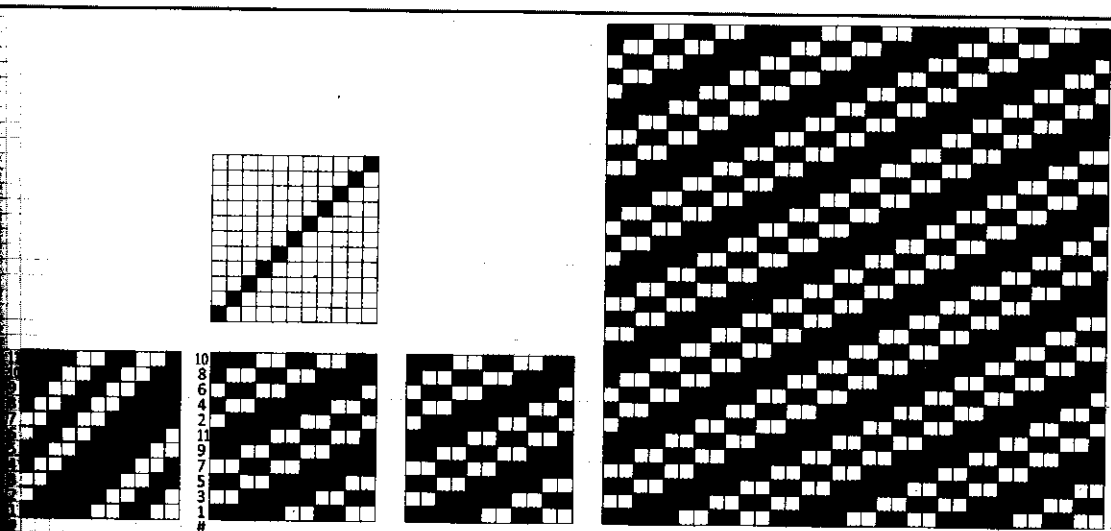
Weft way elongated twill is developed from the weft-way regular twill weave. If the repeat size of regular twill is even number, then the number of weft yarn in the repeat size of the elongated twill is half of the regular twill and the number of warp yarn is same as regular twill weave, when the step number is two. When the repeat size of regular twill is odd number then the repeat size of elongated twill is same as regular twill. Straight drafting system is used to produce this weave. The following figures show the weave plan with drafting and lifting plan of some weft way elongated twill fabric.



$\frac{4\ 1\ 1}{2\ 2\ 2}$ Elongated twill (weft-way elongation) based on $\frac{4\ 1\ 1}{2\ 2\ 2}$ multiple twill weave



Close-up view of a weft-way elongated twill, based on $\frac{4}{4}$ weft-way twill weave



$\frac{5\ 2}{2\ 2}Z$ Elongated twill (weft-way elongation) based on $\frac{5\ 2}{2\ 2}Z$ weft-way multiple twill weave

9. Combined Twill weave or combination of twill weave

The object of combined twill is to produce useful and new weaves of greater variety and interest. Combined twills are those produced by arranging the threads of two continuous regular twill weaves alternately with each other. The repeat size of two regular twill weaves may be equal or different. This combination may occur in warp direction or weft direction. According to this combination, there are two types of combined twill, such as warp-way combined twill and weft-way combined twill.

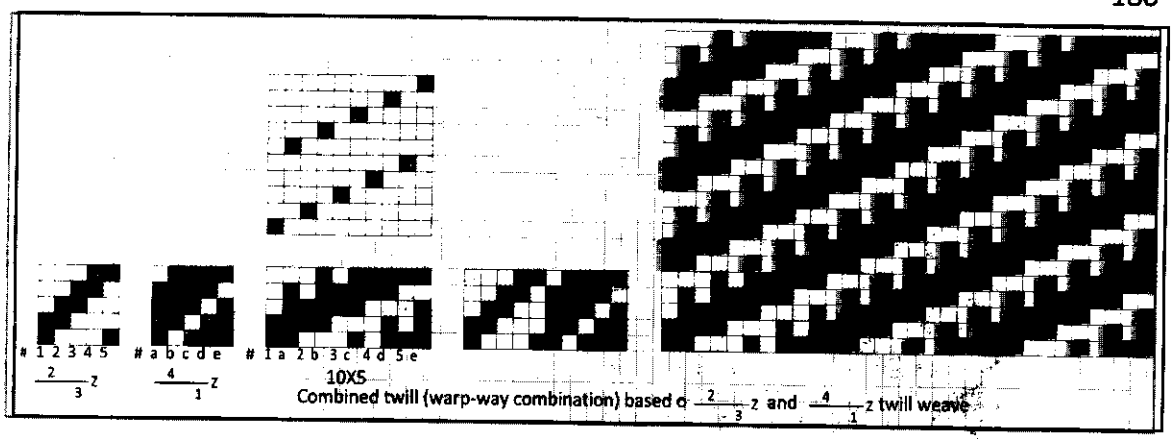
For the construction of combined twill, the repeat sizes of two regular base twills play an important role. The repeat size of the combined twill depends on the repeat size of the regular base twill. If the repeat sizes of two base twills are same, then the number of warp yarn in the repeat size of the warp-way combined twill is twice of regular base twill and the number of weft yarn is same as regular twill. Similarly for the weft-way combined twill, the number of weft yarn in the repeat size is twice of regular base twill and the number of warp yarn is same as regular twill. But if the repeat sizes of the base twills are not same, then it is important to calculate their (repeat sizes of the base twills) **lowest common multiple (LCM).** In this case the selection of repeat size depends on this LCM value. For warp-way combined twill, the number of warp yarn in the repeat size is twice of LCM value and the number of weft yarn is same as LCM value. Similarly for weft-way combined twill, the number of weft yarn in the repeat size is twice of LCM value and the number of warp yarn is same as LCM value.

Warp-way combination:

When the repeat sizes of the base twills are same then the construction principle as follows:

- At first select base twills, such as $\frac{2}{3}Z$ and $\frac{4}{1}Z$.
- Mark the repeat of twice the number of ends of the base twills and same as the number of picks of the base twills. In this case the calculated repeat size will be 10×5.
- Transfer all ends of the base twill $\frac{2}{3}Z$ to the odd numbered ends and transfer all ends of base twill $\frac{4}{1}Z$ to the even numbered ends.

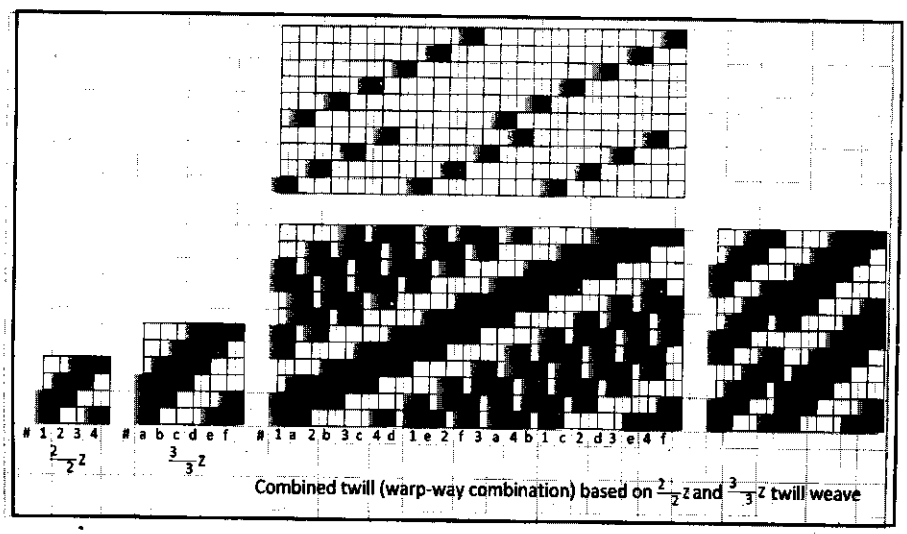
The following figure show the weave plan of the above mentioned warp-way combined twill with drafting and lifting plan. Divided drafting system is normally used to produce warp-way combined twill fabric.

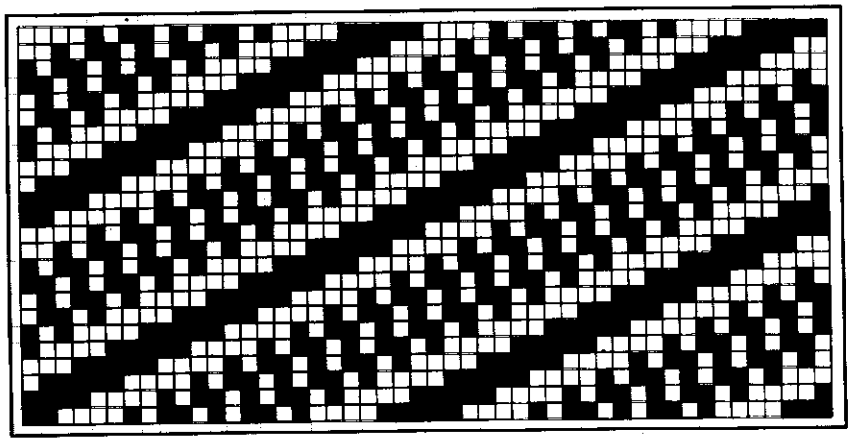


When the repeat sizes of the base twills are different then the construction principle as follows:

- At first select base twills, such as $\frac{2}{2}$ Z and $\frac{3}{3}$ Z .
- Calculate the LCM value of the repeat sizes (4 × 4 and 6 × 6) of base twills. In this case the LCM value of the mentioned base twills is 12 (LCM of 4 and 6).
- Mark the repeat of twice the number of ends of the LCM value and same as the number of picks of the LCM value. In this case the calculated repeat size will be 24 × 12.
- Transfer all ends of the base twill $\frac{2}{2}$ Z to the odd numbered ends and transfer all ends of base twill $\frac{3}{3}$ Z to the even numbered ends.

The following figure show the weave plan of the above mentioned warp-way combined twill with drafting and lifting plan. Divided drafting system is also used to produce this weave.



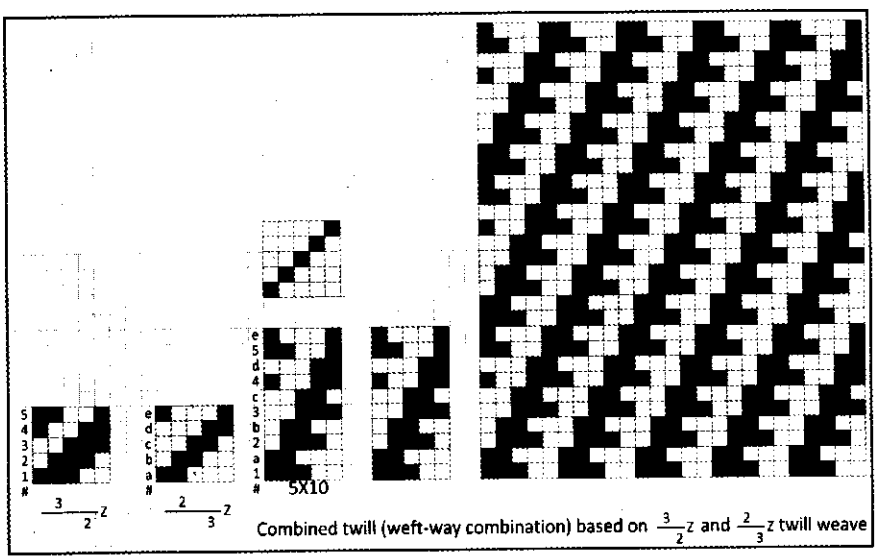


Weft-way combination:

Weft-way combined twill normally developed from the weft-way twill. When the repeat sizes of the base twills are same then the construction principle as follows:

- At first select base twills, such as $\frac{3}{2}$ Z and $\frac{2}{3}$ Z weft-way twill.
- Mark the repeat of twice the number of picks of the base twills and same as the number of ends of the base twills. In this case the calculated repeat size will be 5 × 10.
- Transfer all picks of the base twill $\frac{3}{2}$ Z to the odd numbered picks and transfer all picks of base twill $\frac{2}{3}$ Z to the even numbered picks.

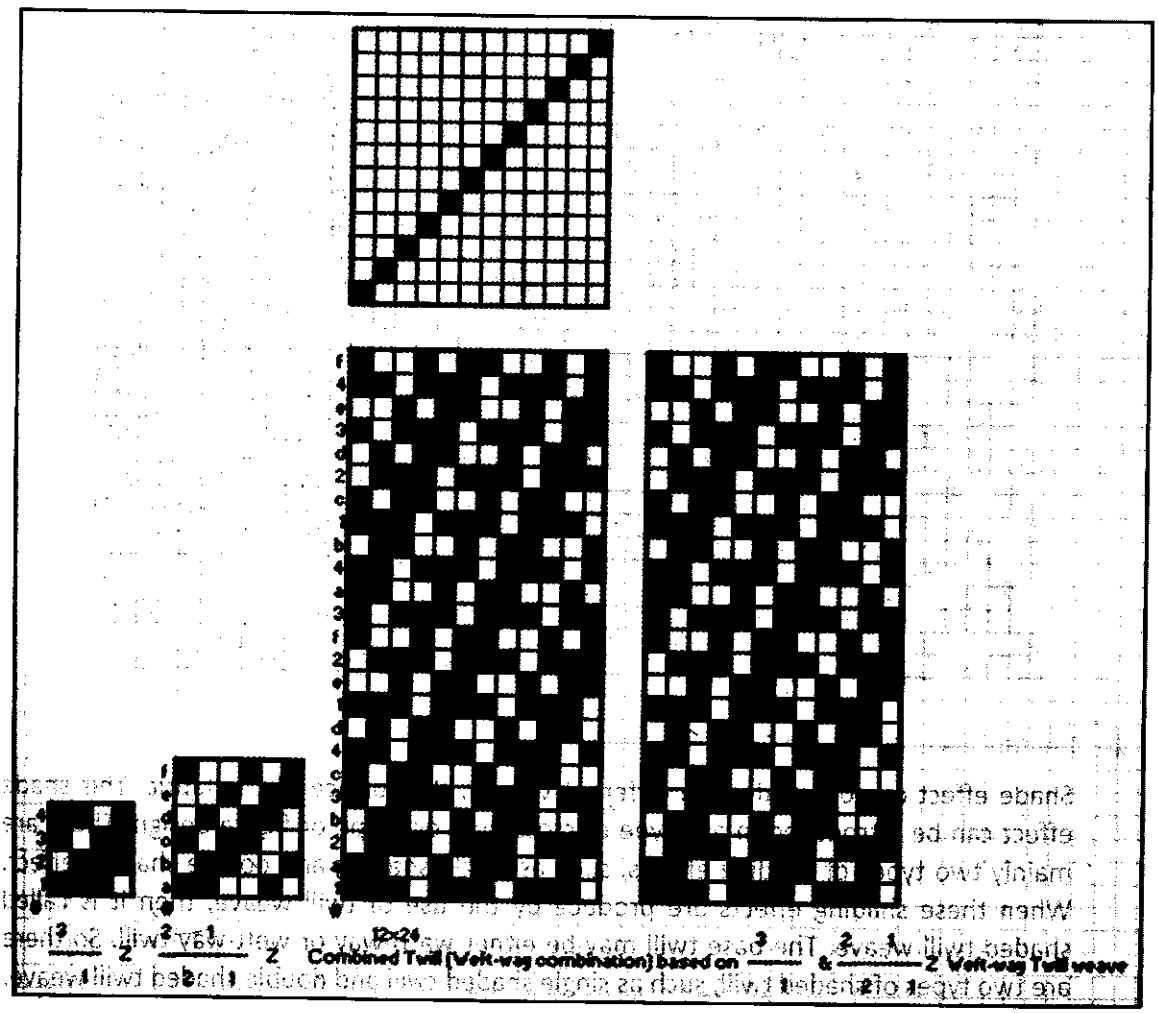
The following figure show the weave plan of the above mentioned weft-way combined twill with drafting and lifting plan. Straight drafting system is normally used to produce weft-way combined twill fabric.

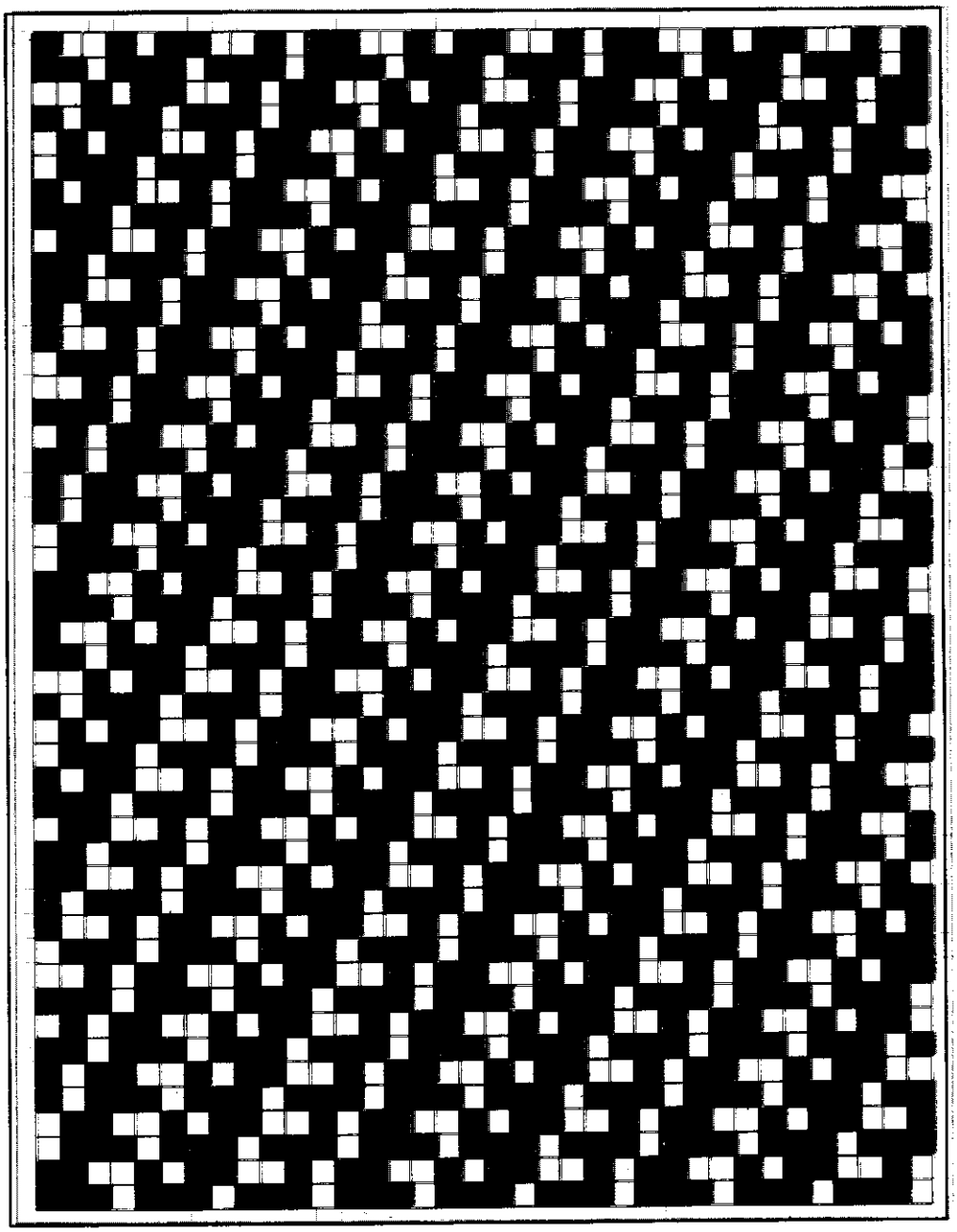


When the repeat sizes of the base twills are different then the construction principle as follows:

- At first select base twills, such as $\frac{3}{1}$ Z and $\frac{2\ 1}{2\ 1}$ Z weft-way twill.
- Calculate the LCM value of the repeat sizes (4 × 4 and 6 × 6) of base twills. In this case the LCM value of the mentioned base twills is 12 (LCM of 4 and 6).
- Mark the repeat of twice the number of picks of the LCM value and same as the number of ends of the LCM value. In this case the calculated repeat size will be 12 × 24.
- Transfer all picks of the base twill $\frac{3}{1}$ Z to the odd numbered picks and transfer all picks of base twill $\frac{2\ 1}{2\ 1}$ Z to the even numbered picks.

The following figure shows the weave plan of the weft-way combined twill with drafting and lifting plan. Straight drafting system is also used to produce this weave.





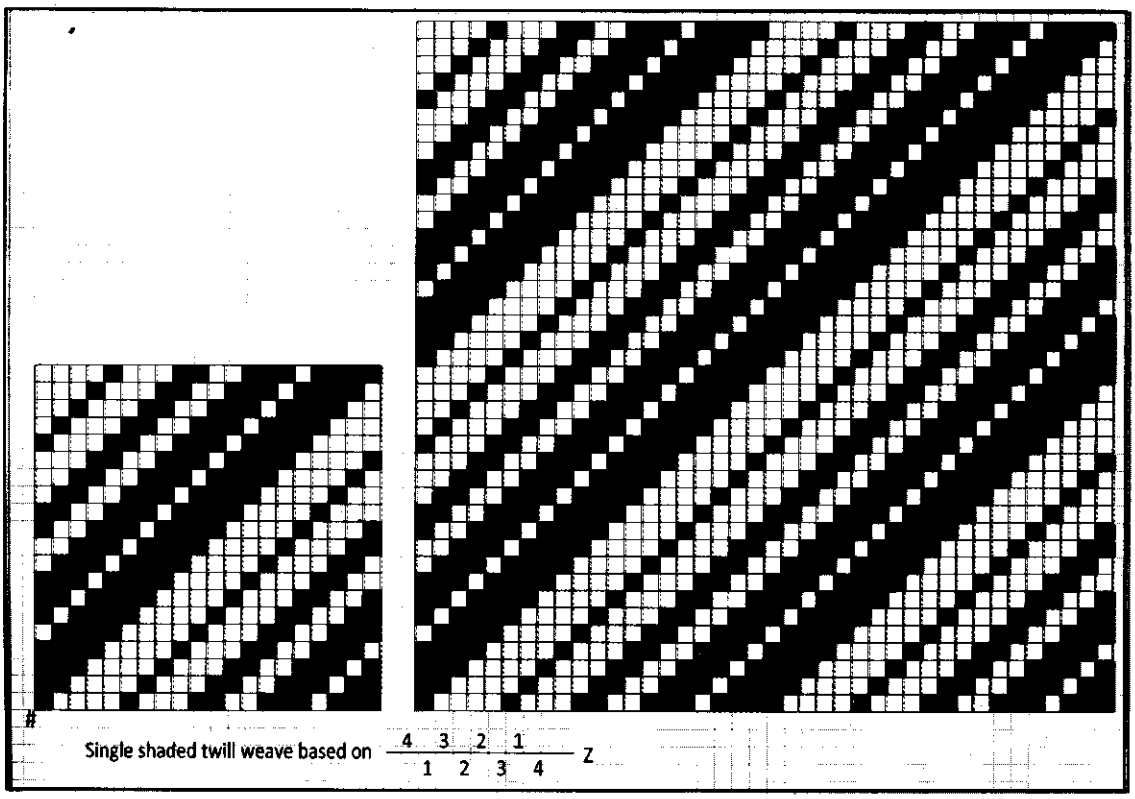
10. Shaded Twill Weave or Shaded design

Shade effect can be produce in different way on the surface of the fabric. This shade effect can be introduced in any type of cross-over or stripe or figure design. There are mainly two types of shading effects, such as single shading and double shading effect. When these shading effects are produce by the use of twill weave, then it is called shaded twill weave. The base twill may be either warp-way or weft-way twill. So there are two types of shaded twill, such as single shaded twill and double shaded twill weave.

Single Shaded Twill weave:

In this case the shade effect is gradually decreasing from deep to light by decreasing the number of warp or weft floats and vice versa. These effects are produced from the regular multiple twill. In these multiple twills, the warp and weft floats are arranged in a regular order. Such as $\frac{6\ 5\ 4\ 3\ 2\ 1}{1\ 2\ 3\ 4\ 5\ 6}$, $\frac{5\ 4\ 3\ 2\ 1}{1\ 2\ 3\ 4\ 5}$, $\frac{4\ 3\ 2\ 1}{1\ 2\ 3\ 4}$, $\frac{3\ 2\ 1}{1\ 2\ 3}$ etc.

The following figure shows the weave plan of the single shaded twill fabric.



Single shaded twill weave based on $\frac{4\ 3\ 2\ 1}{1\ 2\ 3\ 4}$ Z

Double Shaded Twill weave:

In this case the shade effect is gradually increasing from light to deep by increasing the number of warp or weft floats and again gradually decreasing from deep to light by decreasing the number of warp or weft floats. These effects are produced from the regular multiple twill. In these multiple twills, the warp and weft floats are arranged in a typical order. Such as $\frac{1\ 2\ 3\ 4\ 5\ 5\ 4\ 3\ 2}{5\ 4\ 3\ 2\ 1\ 2\ 3\ 4\ 5}$, $\frac{1\ 2\ 3\ 4\ 4\ 3\ 2}{4\ 3\ 2\ 1\ 2\ 3\ 4}$, $\frac{1\ 2\ 3\ 3\ 2}{3\ 2\ 1\ 2\ 3}$ etc.

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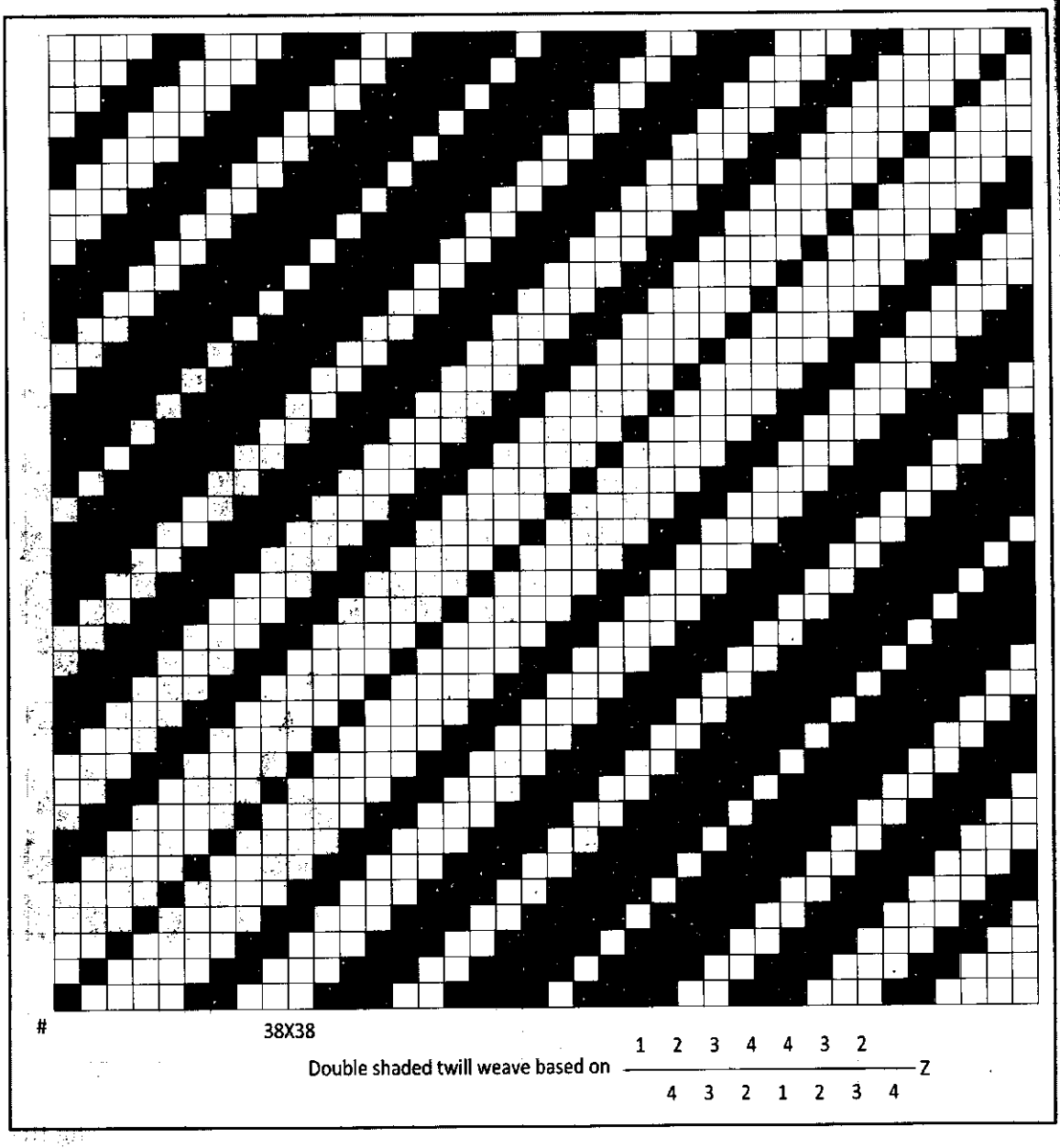
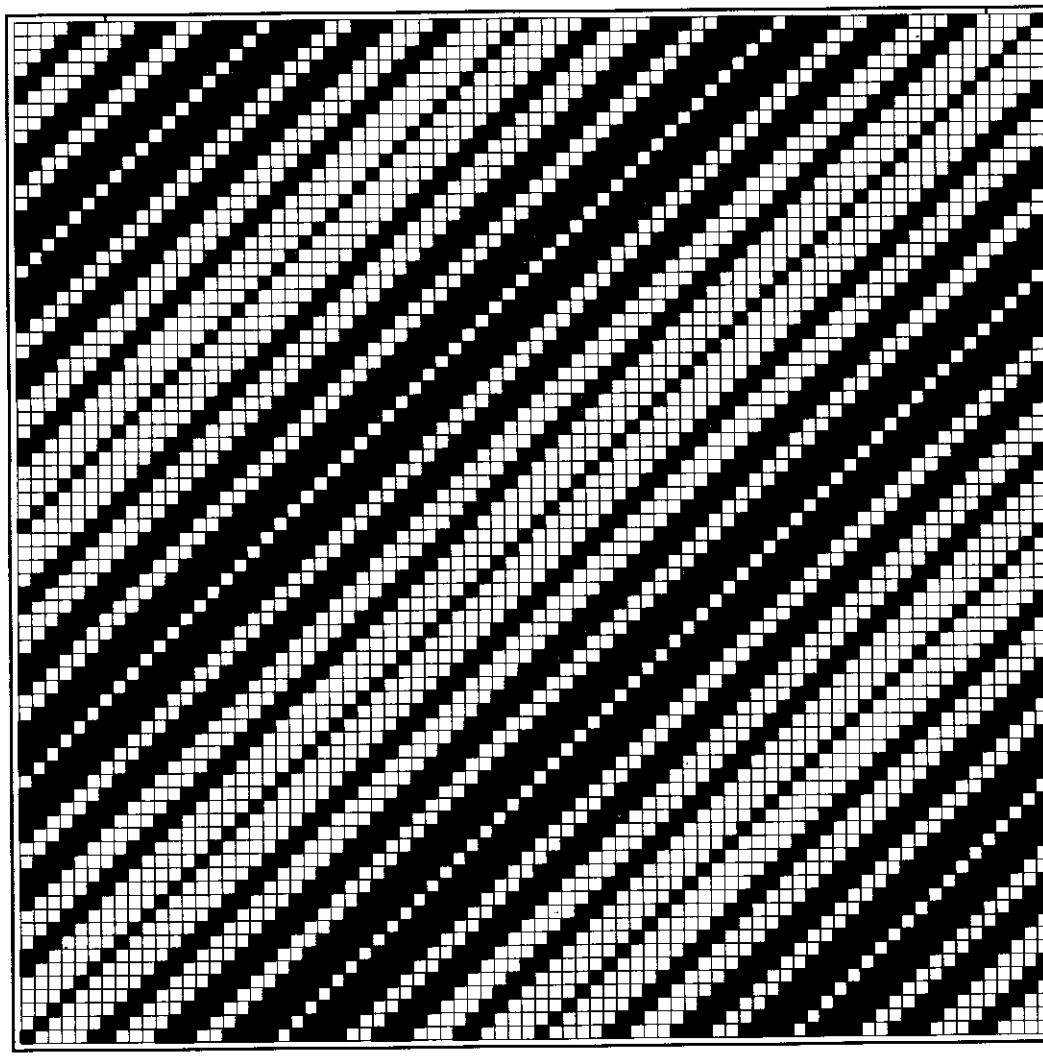
The following figure shows the weave plan of the double shaded twill fabric.



For the construction of shaded twill, there is no special system; it is same as regular twill construction. Only specialty is that, the arrangement of warp and weft floats in the formula number.



Advantages and disadvantages of twill weaves:

Twill weaves usually make fabrics closer in texture, heavier, and stronger than do plain weaves. This is why twills are so suitable for men's clothing fabrics. Also, it is possible to produce more fancy designs in twills than in plain weaves. In addition to their distinctive appearance and high strength, twill fabrics tend to show soil less readily than plain-weave fabrics. However, twills are more expensive to produce than plain-weave fabrics because loom productivity is frequently reduced by the increased complexity of shed formation with additional heald-shafts.

The major advantages of a twill fabric are that it is durable and wears well, resists soiling, and has good resistance to wrinkling. Its disadvantages are that, once soiled, it is more difficult to clean than plain weave fabrics and it usually has a right and wrong side, which may make garment design difficult. Unless given special treatments, some uneven twill fabrics produce garments that are prone to twisting or skewing on the body after laundering.

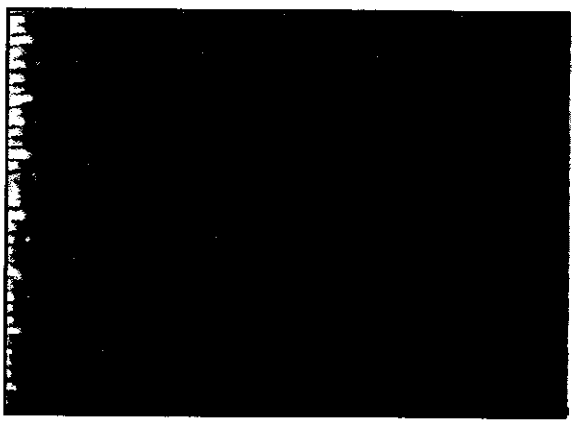
SATIN WEAVE

Introduction:

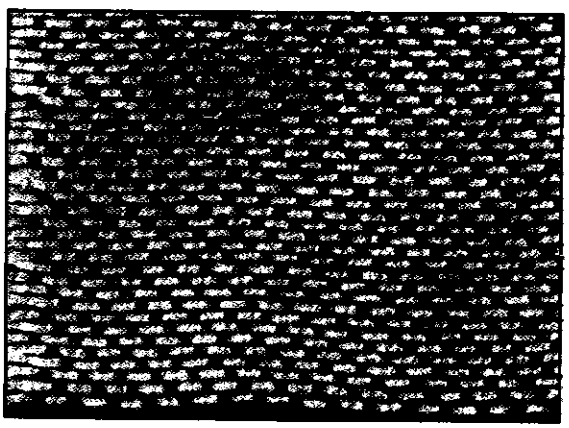
Satin is the third basic weave of the woven fabrics. In basic construction, the satin weave is similar to the twill weave but generally uses from five to as many as twelve harnesses, producing a five to twelve-shaft construction. It differs in appearance from the twill weave because the diagonal of the satin weave is not visible; it is purposely interrupted in order to contribute to the flat, smooth, lustrous surface desired. There is no visible design on the face of the fabric because the yarns that are to be thrown to the surface are greater in number and finer in count than the yarns that form the reverse of the fabric.

Satin weaves produce a smooth, even and glossy fabric surface. This is due to the interlacing points being covered up by the floats of the neighbouring threads. The smoothness of the fabric surface can be improved by:

- High thread density
- Smooth yarn with low twist
- Filament yarn from man-made fibre.



Close-up view of Satin weave



Close-up view of Sateen weave

Each end and each pick makes one, and only one intersection and the intersections are distributed in an orderly manner. Uniformly separated from each other, and nowhere adjacent. Satin is more loose structure fabric, when compare with plain and twill fabrics. Satin is widely used for the foundation of jacquard design.

Classification of satin weave:

One distinguishes between warp and weft satins depending on whether the fabric face shows the warp or the weft. Weft satins are also called sateens. With the most common simple warp satin, each warp end is lowered only on one pick in the repeat while, with the weft satin, it is only raised on one pick. The smallest regular satin weave is the 5 – end satin which can be represented either by $\frac{1}{4}(2)$ or by $\frac{4}{1}(3)$ where the figure in the bracket shows the size of the step.

So the warp satin is denoted by the formula number $\frac{A}{1}(B)$, where 'A' indicates the number of warp floats and 'B' indicates the step value of satin weave. Similarly the weft satin is denoted by the formula number $\frac{1}{A}(B)$, where 'A' indicates the number of weft floats and 'B' indicates the step value of satin weave. It is important to note that when the face side of a fabric composed by the warp satin weave then the reverse side of this fabric should be composed by the weft satin weave.

Both warp and weft satins are divided into two groups, such as

- Regular warp satin and irregular warp satin
- Regular weft satin and irregular weft satin.

There is a step value or move number for regular warp or weft satin weave but there is no step value for the irregular warp or weft satin weave. In general 4 – end and 6 – end satin weaves are irregular, because they have no step value. Other 5 – end to 16 – end satins are regular, because they have step values.

Move number or Step value selection for Satin weave:

With the satin weave, the distance between consecutive interlacing points is always the same and is referred to as the step or step values or move numbers of the satin. The weaves are developed with the help of this move or count number. To establish this number certain rules have to be considered. The number must be larger than one and must not be one less than the number of threads in the repeat, as this would create a twill. The number must not be a factor. The move number can be applied by counting warp-ways or weft-ways.

The value of the step indicates by how many picks the interlacing point on the next warp end to the right moves upward. One obtains the value of the step by dividing the repeat number (i.e. the number of ends or picks in the weave repeat) into pairs of numbers. Of the two numbers of a pair, either both or none can be used as a step value. Usable steps must meet the following conditions:

- Neither number must be unity.
- None of the numbers must be a factor of either the other number or of the repeat number.
- The two numbers must not have a common factor.

For example, in case of 8 – end satin, 1 and (8 – 1) or 7 does not accepted as step value. Consider any two numbers but the sum of this two numbers should be equal to 8 and 8 is not divided by this selected number i.e. there is no common factors of 8. So 3 or 5 can be choosing as a step value.

Usable step values for satin weaves:

Repeat size of the weave		Usable step values
4 – end	4 × 4	No
5 – end	5 × 5	2,3
6 – end	6 × 6	No
7 – end	7 × 7	2, 3, 4, and 5
8 – end	8 × 8	3 and 5
9 – end	9 × 9	2, 4, 5, and 7
10 – end	10 × 10	3 and 7
11 – end	11 × 11	2, 3, 4, 5, 6, 7, 8, and 9
12 – end	12 × 12	5 and 7
13 – end	13 × 13	2, 3, 4, 5, 6, 7, 8, 9, 10, and 11
14 – end	14 × 14	3, 5, 9, and 11
15 – end	15 × 15	2, 4, 7, 8, 11, and 13
16 – end	16 × 16	3, 5, 7, 9, 11, and 13
etc.		

Construction Principle of Satin Weave:

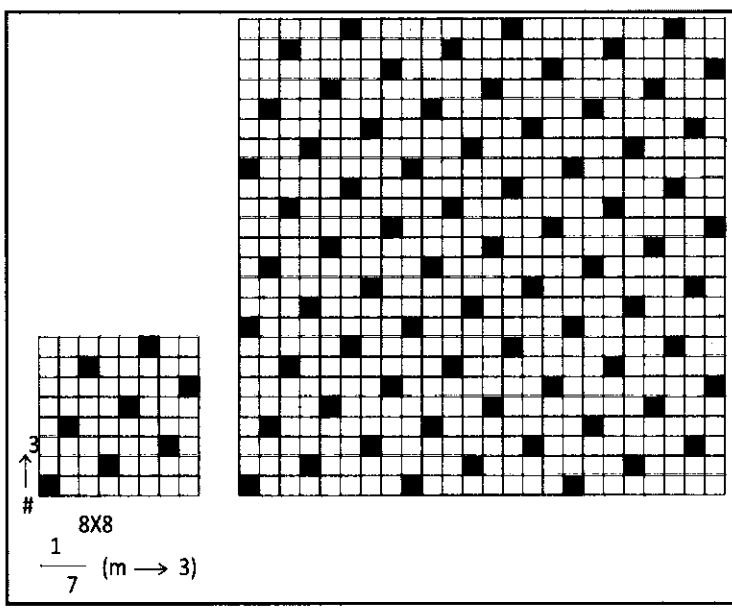
Weft satin (sateen weave):

In this construction, the weft yarn lies on the surface of the fabric as it passes regularly over and under the warp yarns. For instance, a weft yarn may pass over four warp yarns and under one. The floats are consequently made up of the weft yarns, and the luster appears in the weft direction. There are two types of weft satin, such as regular and irregular sateen weaves.

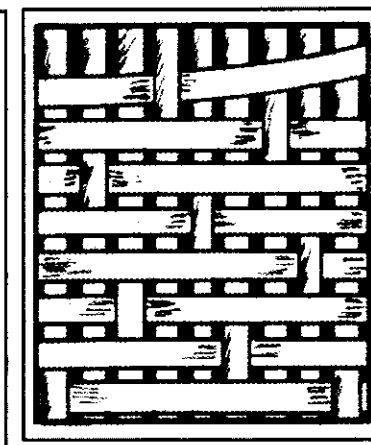
Regular Weft satin (sateen weave):

Designing a weft satin construction – An eight-shaft construction i.e. 8 – end sateen illustrates here the rules that must be followed to select a suitable interval.

- Arrange in pairs the numbers that will add up to the desired repeat number. For an eight-end weft satin, the shaft or repeat number is 8. The pairs are 1 and 7, 2 and 6, 3 and 5, 4 and 4.
- Eliminate the pair that contains the umber 1 and the number below the repeat number, which is 7 (8-1) in this case. A contiguous diagonal would result if these intervals were used, producing the conventional twill weave.
- Next, eliminate the pairs that have a common divisor and those that are divisible into the shaft or repeat number. This step eliminates 2 and 6, 4 and 4. The pair 3 and 5 remains. These numbers are the only intervals that can be used in an 8 – end construction. If any of the eliminated numbers were used as an interval, the fabric would show no interlacing whatever for one or more warp yarns; in fact, there would be no fabric because it would fall apart.



8 – end sateen move number 3

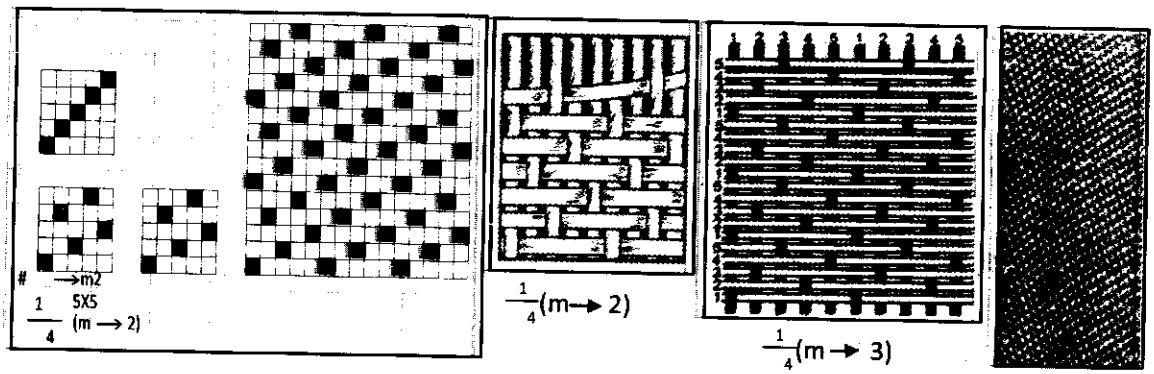


8 – end sateen move number 5

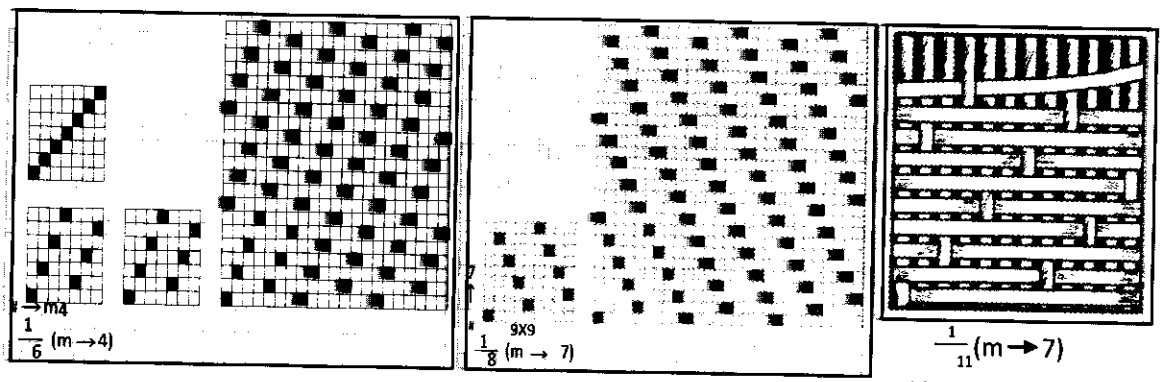
- Now that the only possible interlacings have been worked out, the design can be constructed (in above figure). For convenience, here the interlacing begins in the lower left square. The horizontal rows of squares represent weft yarns – that is, the successive picks on the weaving machine. The vertical columns represent the warp yarns.
- The interval to be used for this particular design could be 3 or 5; in this case 3 has been selected. As this is to be an 8 – end construction, the interlacing on the first pick will be 7 squares (warp yarns).
- To find the warp yarn that will interlace on the second pick, count 3 to the right, beginning with the square above the interlacing that is already started at the starting point. Adjacent interlacing on the same line will be similarly 7 squares apart.

- To find the warp yarn that will interlace on the third pick, start with the square above interlacing point of previous pick. Count 3 to the right, and interlacing point is plotted. Adjacent interlacings will be 7 squares apart.
- This same procedure determines the interlacing points on successive picks, additional interlacings always being 7 squares apart.
- On the ninth pick, the design starts to repeat, which proves the accuracy of the construction of an 8 – end weave.
- Where it is not possible to plot subsequent interlacing by continuing to count to the right, because of the small area of the design, interlacings on successive picks can be determined by counting 5 to the left instead of 3 to the right. If the interval 5 had been used to count to the right, 3 would have been used to count to the left.

The following figures show the weave plan, drafting plan, lifting plan, interlacing diagram and close-up view of different regular sateen fabrics.



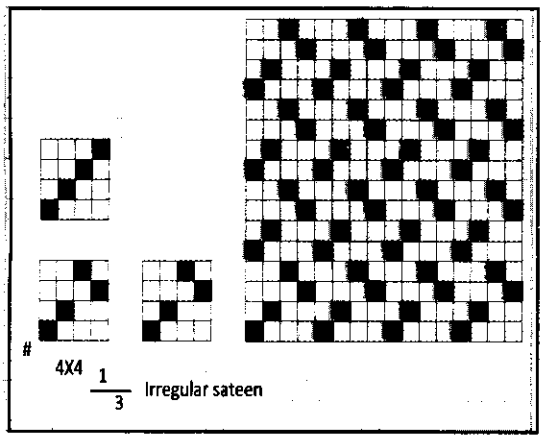
5 – end sateen move number 2 5 – end sateen move number 3



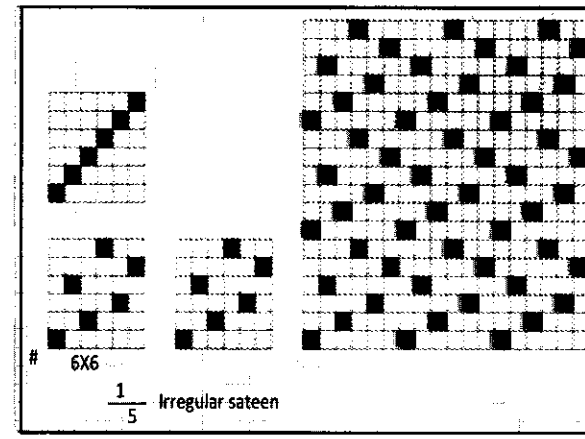
7 – end sateen move number 4 9 – end sateen move number 7 12 – end sateen move number 7

Irregular Weft satin (sateen weave):

There is no step value or move number to construct the irregular sateen. So the above mentioned rule is not applicable for the construction of irregular sateen. Only 4 – end and 6 – end sateens are irregular. The following figures show the weave plan with drafting and lifting plan of these two irregular sateen fabrics. Straight drafting system is used to produce this weave.



4 – end irregular sateen



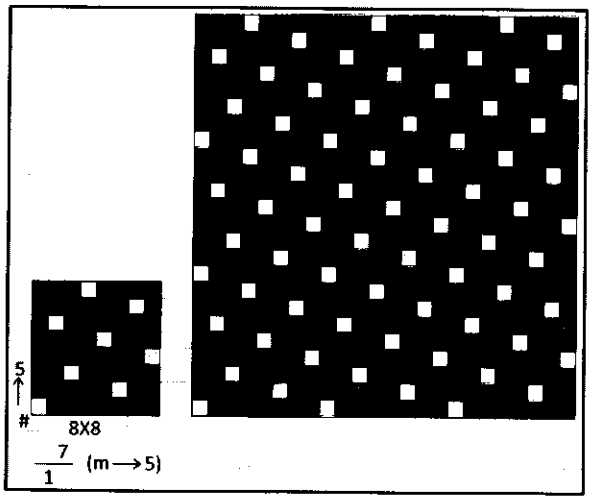
6– end irregular sateen

Regular Warp Satin (Satin weave):

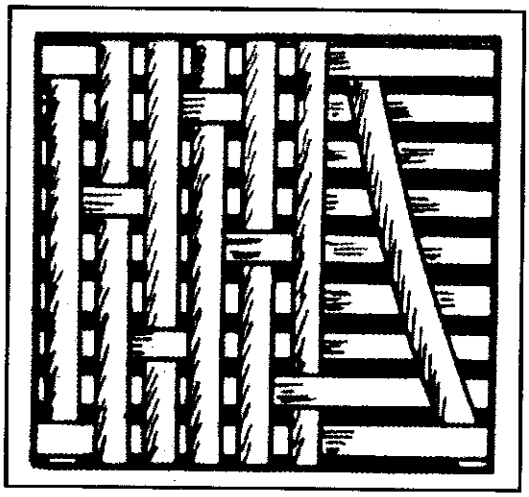
Warp satin is woven so that the warp may be seen on the surface of the fabric. For example, in a five-end construction, the warp may pass over four weft yarns and under one; in a 12 – end construction, the warp may pass over 11 weft yarns and under 1. Since the warp lies on the surface and interlaces only 1 weft yarn at a time, the lengths of warp between the weft yarn are called floats. These floats lie compactly on the surface with very little interruption from the yarns going at right angles to them. Reflection of light on the floats gives satin fabric its primary characteristic of luster, which appears in the direction of the warp.

Designing a satin construction – When making a design for a satin construction, the interlacings on successive lines must be separated by a proper interval to avoid forming the contiguous diagonal. When the proper interval for any shaft or repeat construction is selected, the design will not repeat itself until the number of successive picks that make up the desired shaft have been interlaced. In a five – end construction, for example, the design begins to repeat on the sixth line; in an eight – end, on the ninth line; in a nine – end, on the tenth line.

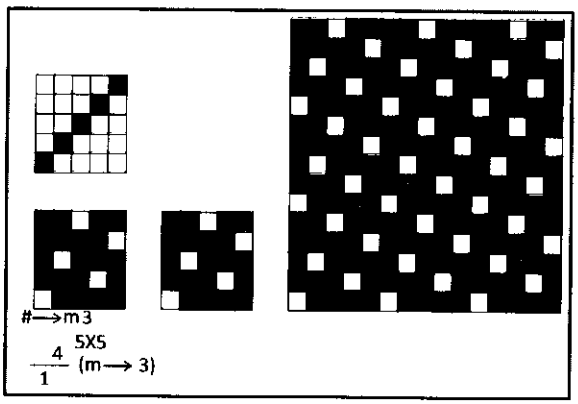
The following figures show the weave plan, drafting plan, lifting plan, interlacing diagram and close-up view of different regular satin fabrics.



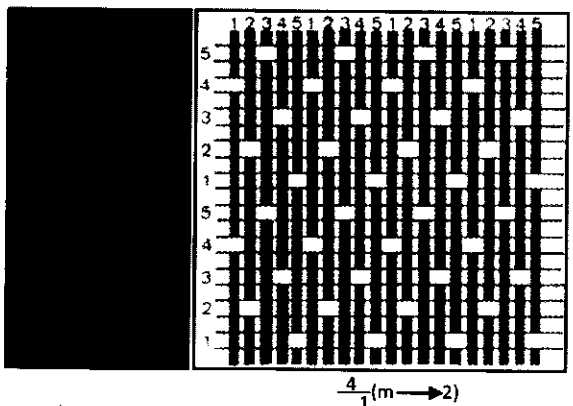
8 – end satin move number 5



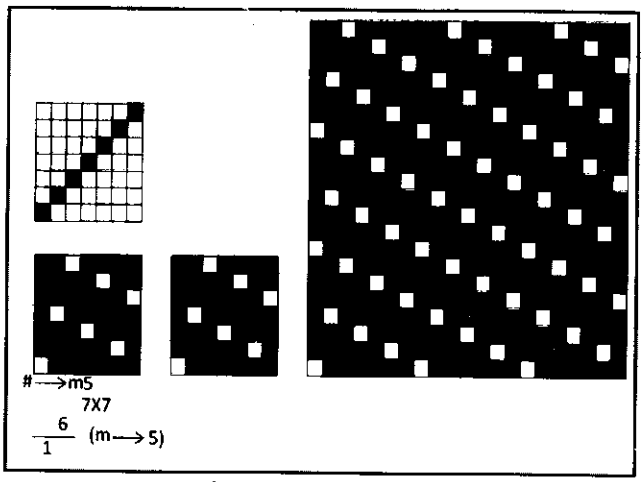
7/1 (m → 5)



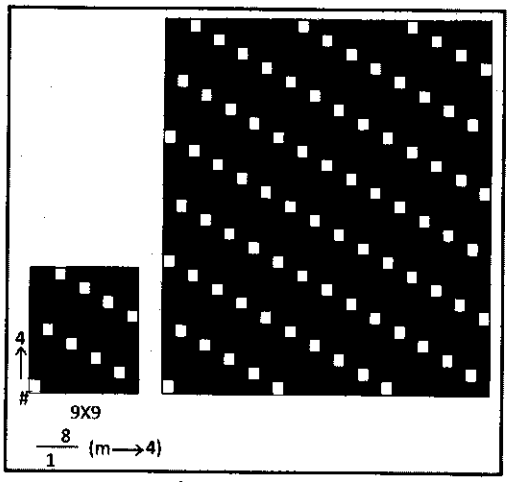
5 – end satin move number 3 with Close-up view



5 – end satin move number 2



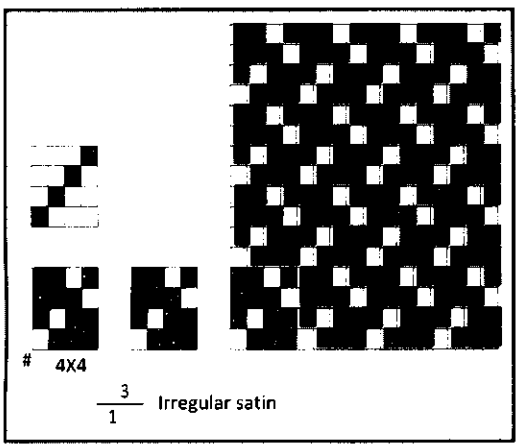
7 – end satin move number 5



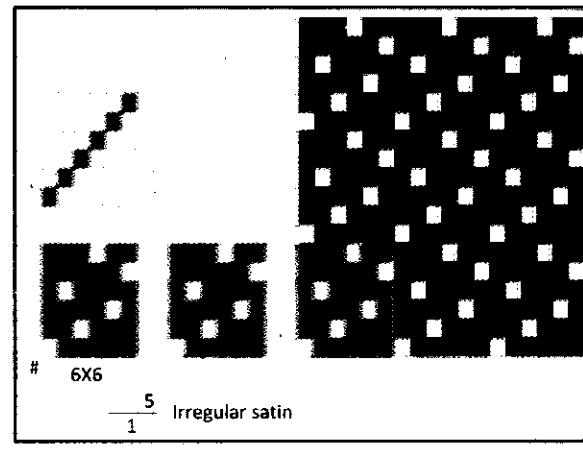
9 – end satin move number 4

Irregular Warp satin (satin weave):

There is no step value or move number to construct the irregular satin like as sateen. So the above mentioned rule is not applicable for the construction of irregular satin. Only 4 – end and 6 – end satins are irregular. The following figures show the weave plan with drafting and lifting plan of these two irregular satin fabrics. Straight drafting system is used to produce this weave.



4 – end irregular satin



6 – end irregular satin

Advantages and disadvantages of satin weave:

These constructions produce smooth, lustrous, rich-looking fabrics that give reasonably good service if they are not subjected to excessive hard wear. Short-float fabrics are more durable than long-float fabrics, for the former have less exposed yarn to catch on rough objects; long floats, although they increase the sheen of a fabric, snag and pull if there are any protrusions or splinters on furniture.

When style calls for luxurious fabrics for formal wear, satin is often chosen. It is an especially suitable fabric for coat linings because its smooth surface allows coats to be slipped on and off very easily. In general, it sheds dirt well, but a bright rayon in a long-float satin weave will often have a metallic sheen that may appear greasy after continuous wear.

Satin weave usually requires more shafts in the weaving than do the plain or twill weaves, thereby increasing the cost of production.

Materials that are made in the satin weave include antique satin (millions of yards per year), bridal satin, charmeuse, cotton satin, dress satin, satin bengaline, satin crepe, satin faille, slipper satin, and Venetian satin.

Derivatives of Satin Weave:

Weaves are produced on the satin base is called derivatives of satin weave. Lot of jacquard designs based on this satin weave. In this case the following simple structures those are based on satin weave will be discussed.

1. Crepe Weaves:

The characteristic feature of crepe fabrics is one of texture. Their surface exhibits an all-over, random, small-scale pattern in low relief. There are two ways of obtaining this kind of texture:

- By using a special 'crepe' or 'oatmeal' weave in conjunction with ordinary, normal-twist spun or filament yarns, and
- High-twist crepe yarns in conjunction with plain or other simple weaves such as twill or satin.

The fabric should have a rough irregular surface without any prominent features. This is generally achieved by having approximately equal disposition of warp and weft on the surface of the cloth, and also by avoiding any floats which exceed three.

The characteristics of crepe-weave fabrics depend largely upon the kind of yarn used. If ordinary yarns are used and the crepe weave is employed to give a crepe appearance, then the fabric will have little drapability, low strength, and limited durability. Some crepe fabrics tend to stretch, and some may shrink when subjected to wetting. On the other hand, combinations of yarns and weave construction can produce fabrics of interesting appearance and texture that have good drapability, resilience, stretch, and serviceability.

There are four basic methods of producing crepe weaves:

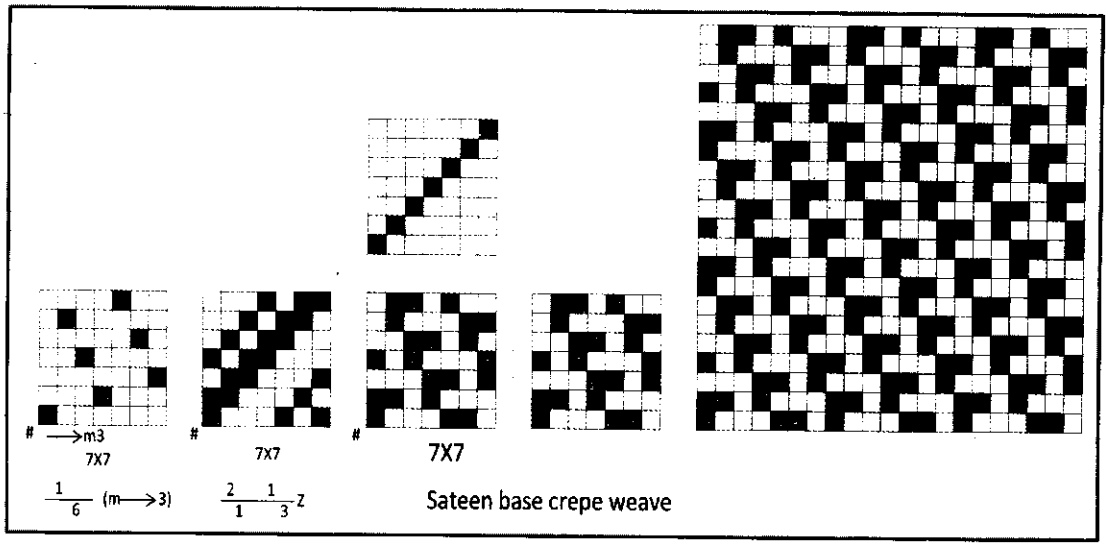
a. On a sateen base
b. By reversing
c. By superimposing
d. On a plain weave base

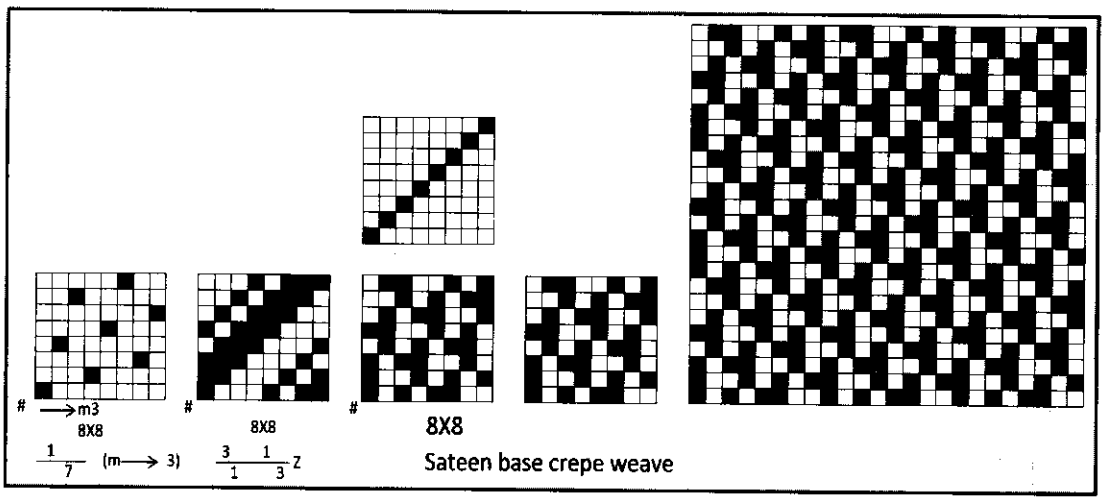
The methods of construction are:

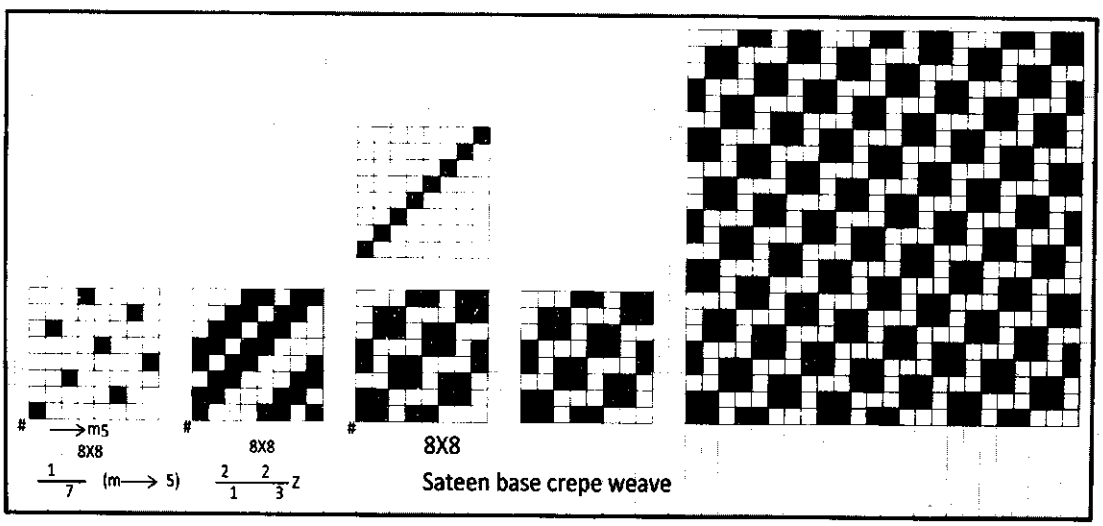
a. Sateen base:

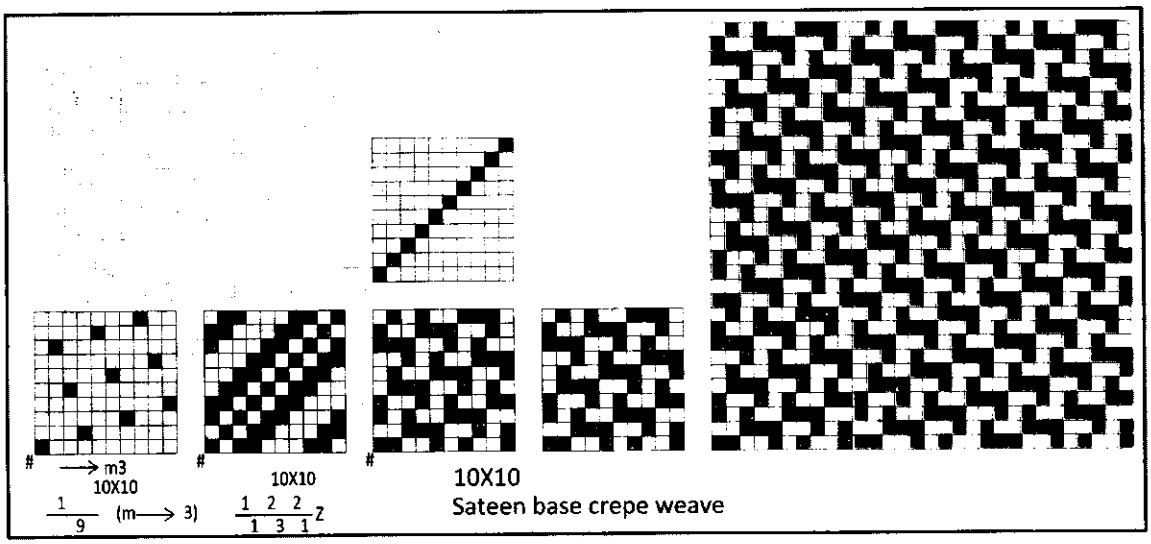
- Construct a sateen weave
- Construct a twill weave on the same repeat size
- Using the sateen base as the starting point of each lift of the twill, rearrange the twill weave on the sateen base. This new weave is called sateen base crepe weave.

The following figures show the weave plan with drafting and lifting plan of different sateen base crepe fabric. Normally straight drafting system is used to produce this weave.


#
→m3
7X7
#
7X7
#
7X7
1/6 (m→3)
2 1/1 3 Z
Sateen base crepe weave


#
→m3
8X8
#
8X8
#
8X8
1/7 (m→3)
3 1/1 3 Z
Sateen base crepe weave

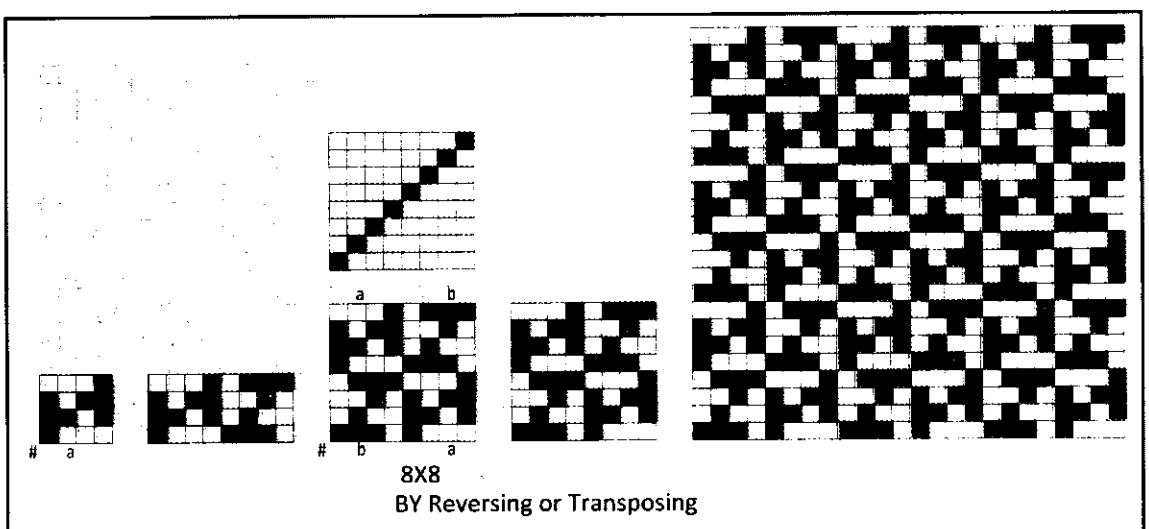

#
→m5
8X8
#
8X8
#
8X8
1/7 (m→5)
2 2/1 3 Z
Sateen base crepe weave

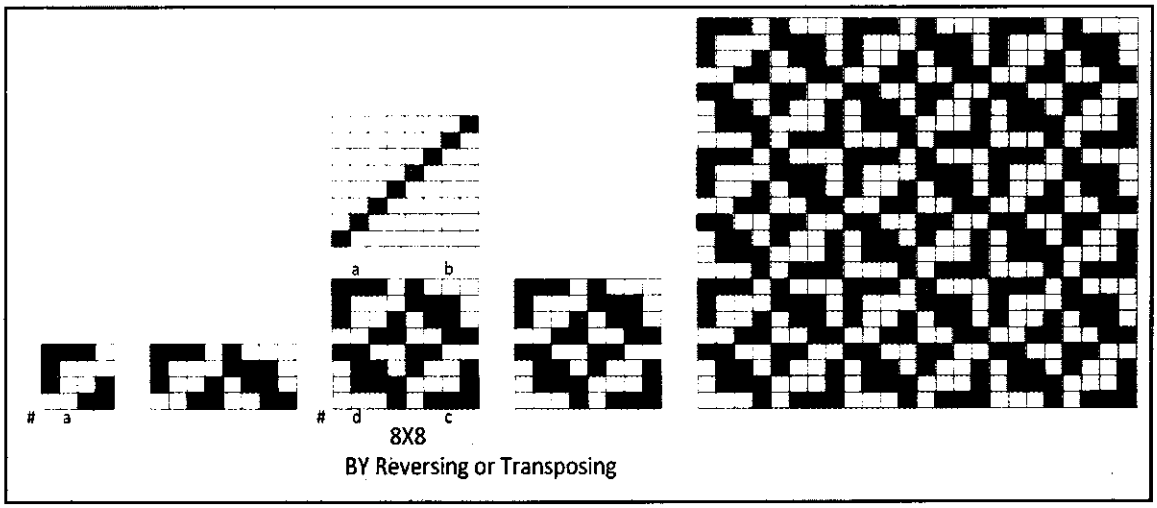


b. Reversing:

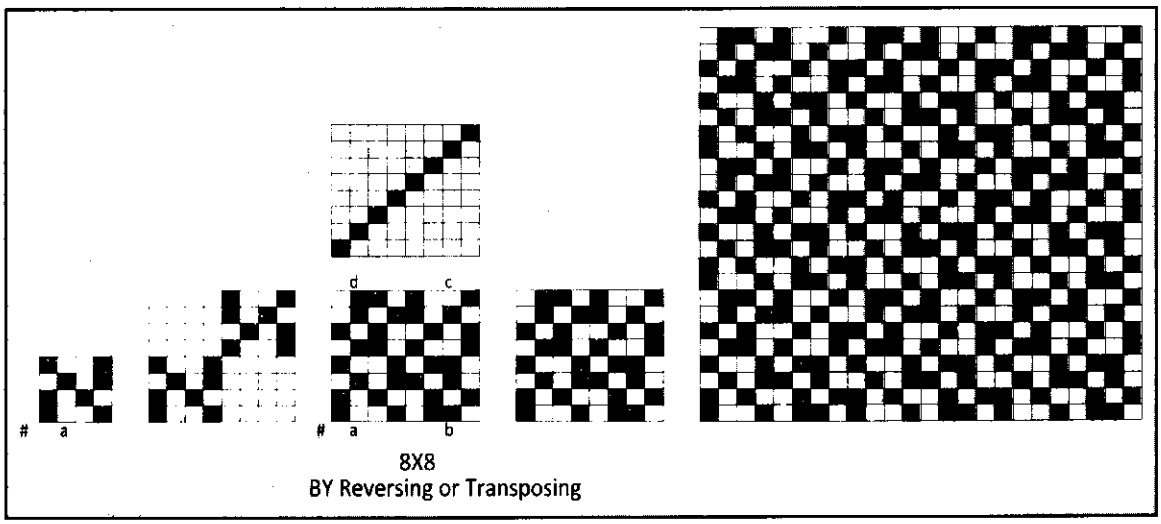
- Make a small motif, as at 'a';
- Reverse 'a' by turning it over, so that the warp lifts of the 4th end become the weft lifts of the 5th end and those of the 4th end become the warp lifts of the 5th end; similarly the 6th, 7th, and 8th ends are the converse of the 3rd, 2nd and 1st, respectively, and the design is now on 8 ends × 4 picks;
- Reverse this by turning it over in the weft direction and using the same technique as described. The final design is thus produced, which is called crepe weave.

The method of constructing this weave may lead to a tendency to create grouping of threads, which is generally undesirable in crepe weaves. The following figures show the weave plan with drafting and lifting plan of different crepe fabric. Normally straight drafting system is used to produce this weave.

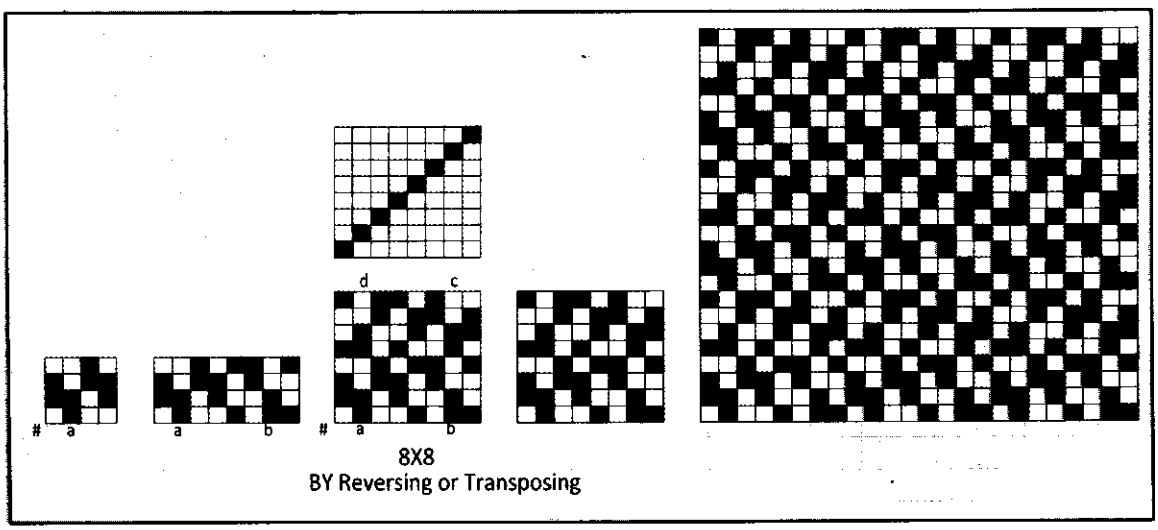




8X8
BY Reversing or Transposing



8X8
BY Reversing or Transposing

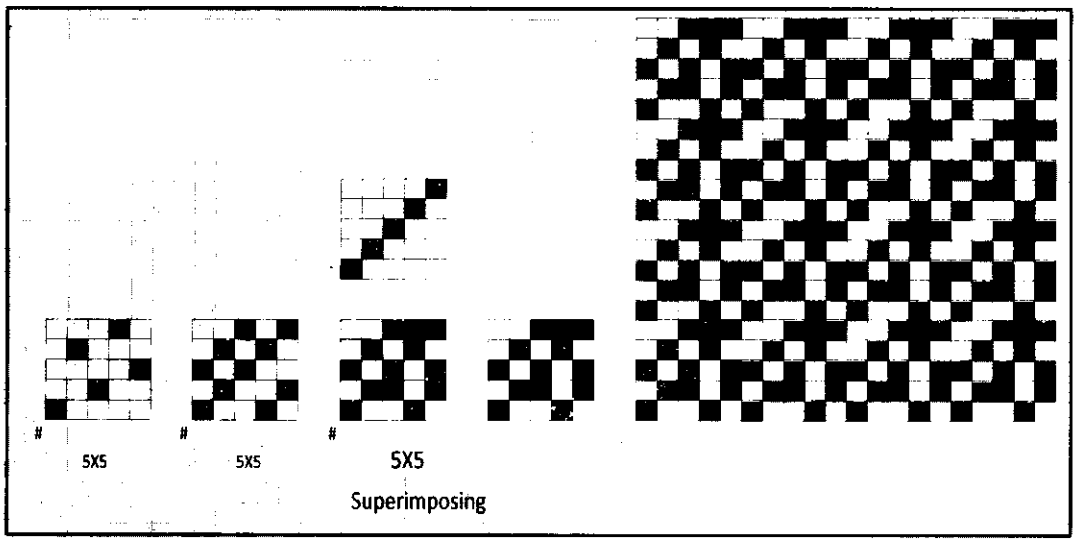


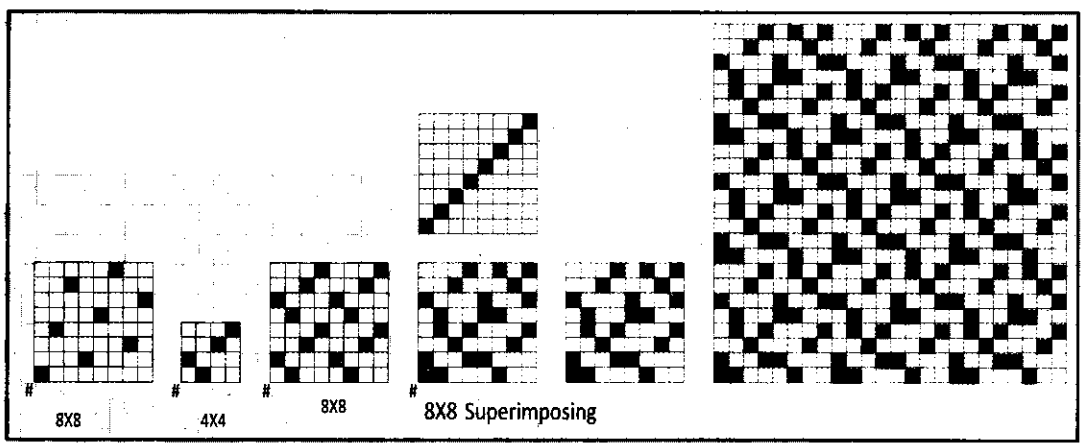
8X8
BY Reversing or Transposing

c. Superimposing:

- Construct two different weaves with same repeat size. As sateen weaves are mainly used in this method, there is always a predominance of weft over warp.
- Superimpose one weave on the other to give the final weave.

The following figures show the weave plan with drafting and lifting plan of different crepe fabric. Normally straight drafting system is used to produce this weave.



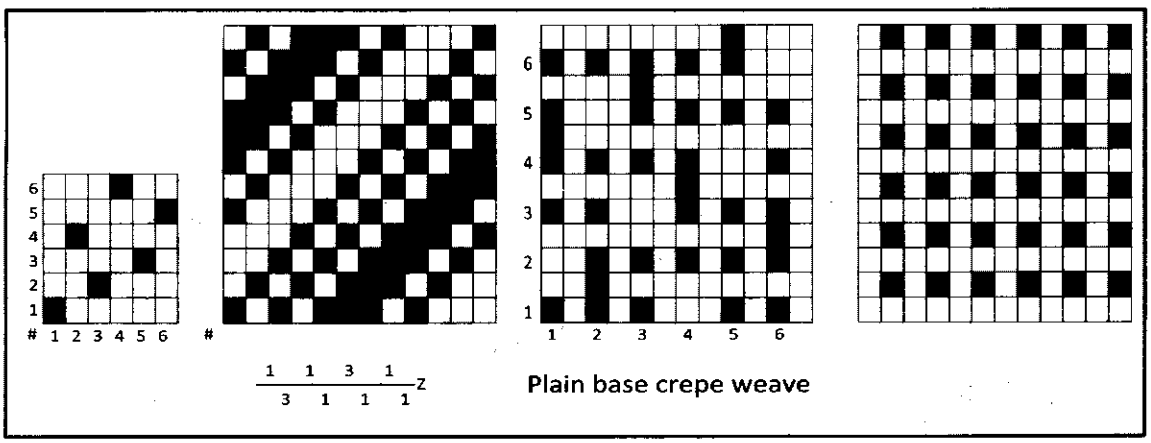


d. Plain base:

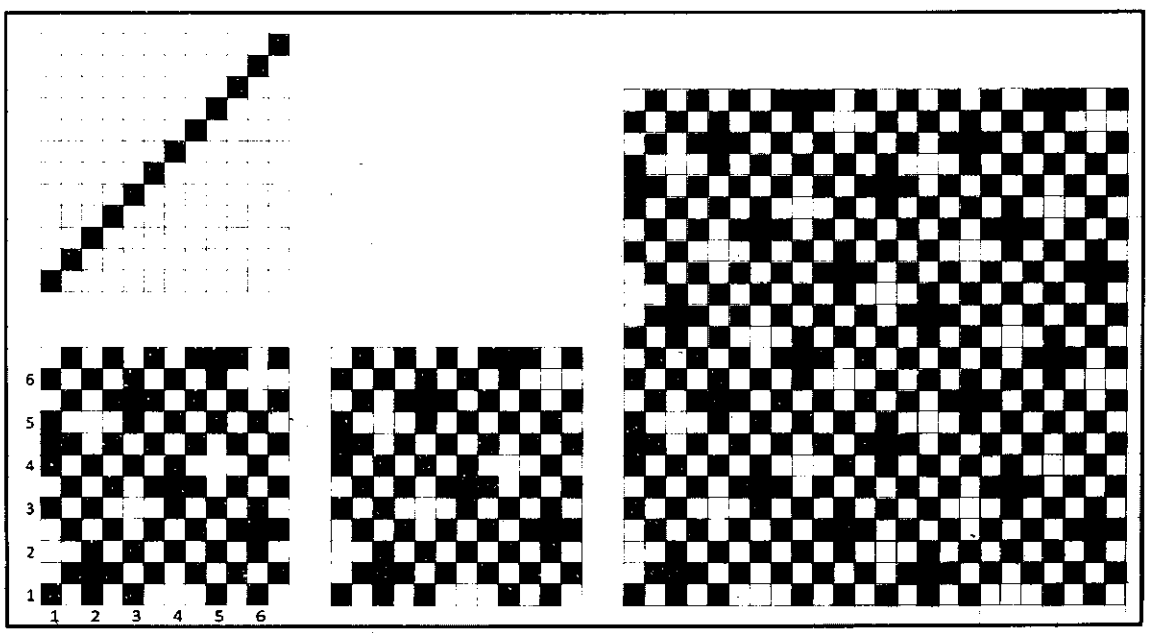
- Design a sateen on half the number of ends and picks required in the final design – a 6-end sateen will be used for a design to be produced on 12 ends × 12 picks;

- Expand this weave so that the sateen base appears on alternate ends and picks only, and use this base as the starting point of each lift of a twill, in this case $\frac{1\ 1\ 3\ 1}{3\ 1\ 1\ 1}$, as shown in the following figure;
- On the remaining ends insert alternate ends of plain weave, i.e. all of these ends will weave the same tabby; care should be taken to lift the warp on the picks opposite to those on which the sateen base appears;
- Now combine these to give the final design, which is repeated in the following figure.

This method provides the most successful attempt to cover pattern formation, but it is always difficult to give an allover effect when the repeat size is small.



Plain base crepe weave



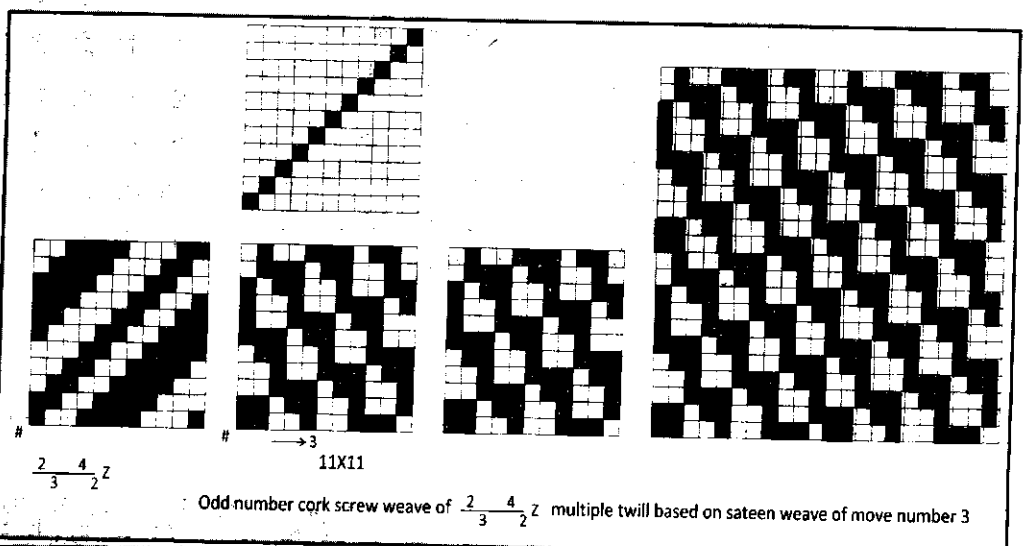
Plain base crepe weave

2. Corkscrew Weaves:

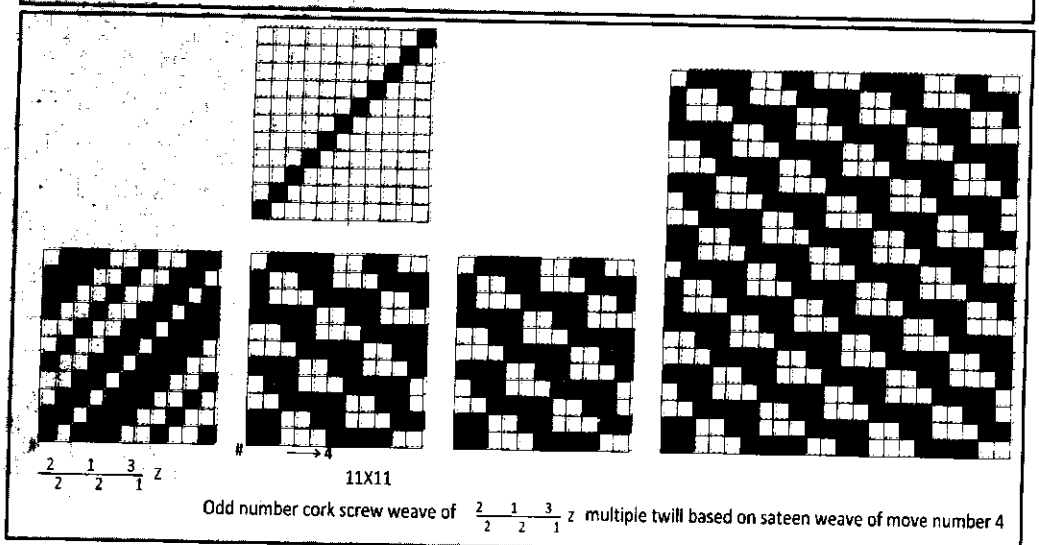
There are two types of corkscrew weave, such as odd number corkscrew weave and even number corkscrew weave. Both are discussed in previous chapter. In this case only odd number corkscrew weave will be discussed, because this is a sateen derivatives.

Odd number cork screw weave:

The construction principle of odd number corkscrew weave is same as satin base crepe weave. For the construction of this weave it is important to select odd number repeat size. Then construct a sateen and a twill weave with the same selected repeat size. Using the sateen base as the starting point of each lift of the twill, rearrange the twill weave on the sateen base. This new weave is called odd number corkscrew weave. The following figures show the weave plan with drafting and lifting plan of different odd number corkscrew fabric. Normally straight drafting system is used to produce this weave.



Odd number cork screw weave of $\frac{2}{3}\ \frac{4}{2}$ Z multiple twill based on sateen weave of move number 3



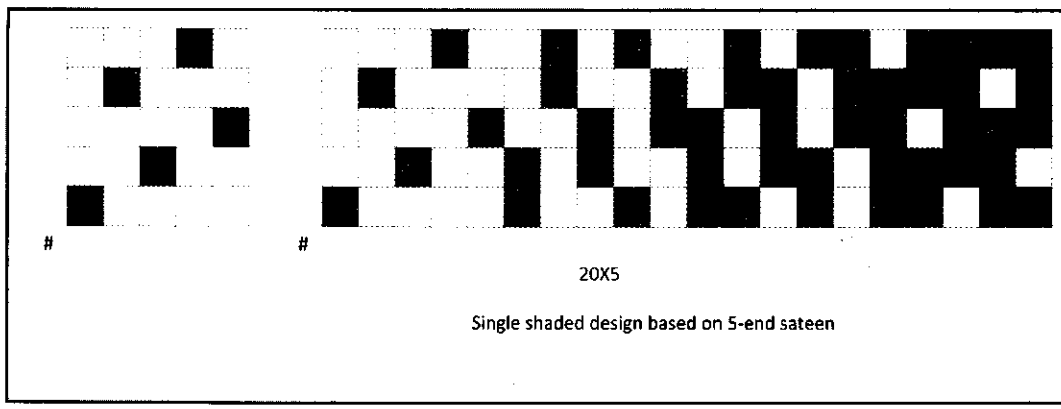
Odd number cork screw weave of $\frac{2}{2}\ \frac{1}{2}\ \frac{3}{1}$ Z multiple twill based on sateen weave of move number 4

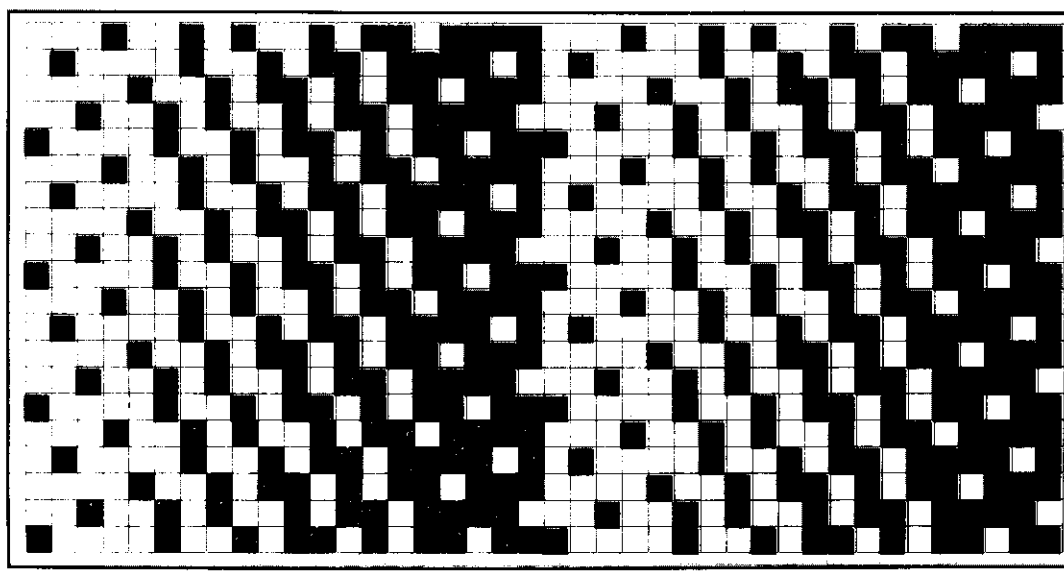
3. Shaded Weaves:

With a weft satin, one can gradually add interlacing points until it turns into a warp satin. The gradual change-over produces a shaded effect in the fabric, particularly if warp and weft have different colours. There are two types of shaded design like shaded twill weave, such as – Single shaded design, and Double shaded design.

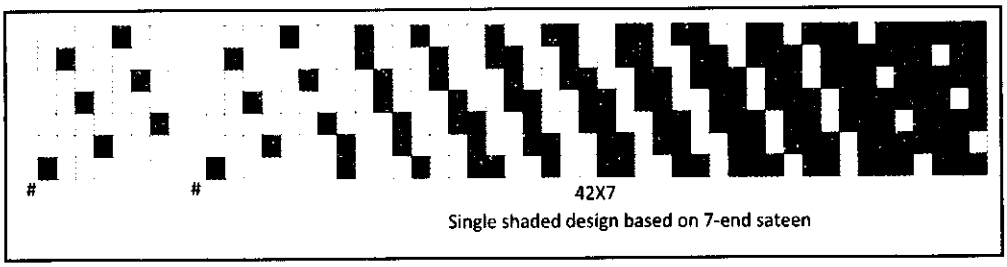
Single Shaded design or weaves:

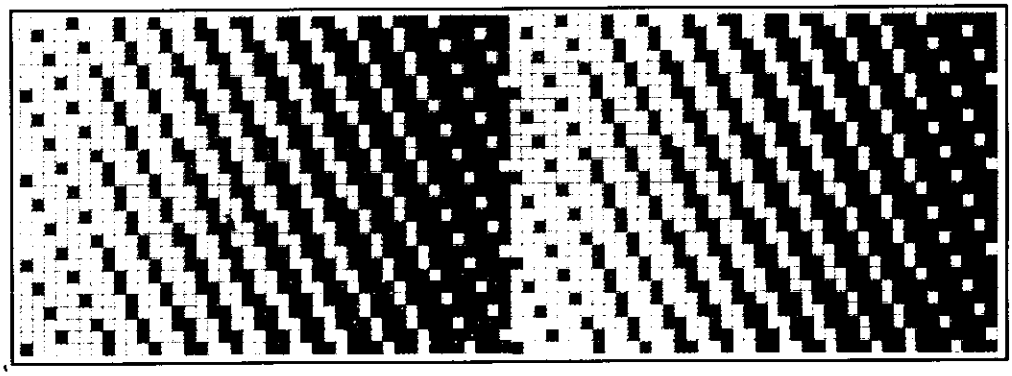
In this case numbers of weft satins are developed side by side at first. Then these sateen units are divided into the number of groups. With each group of sateen one can gradually add warp floats with the interlacing points until it turns into a warp satin. After this the resultant weave will be a single shaded design. The following figures show the different single shaded design.





Single shaded design based on 5 – end sateen

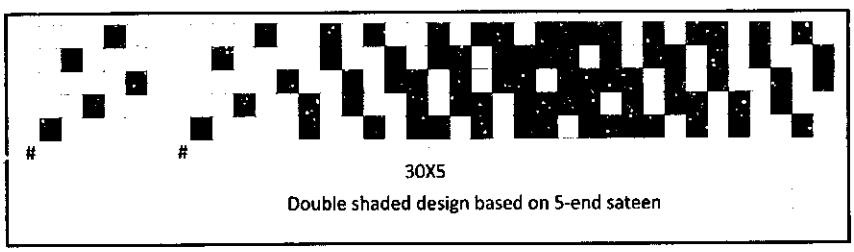


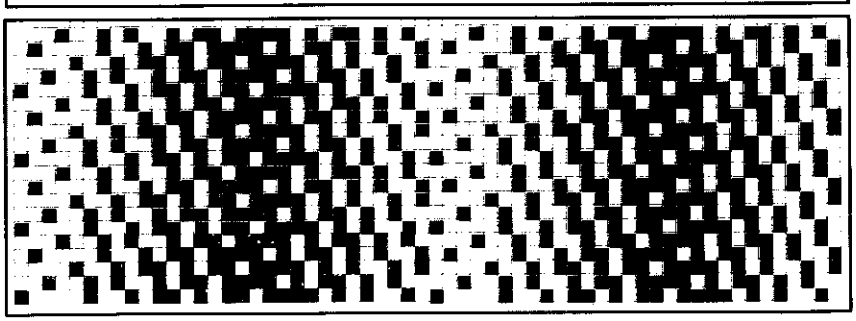


Single shaded design based on 7 – end sateen

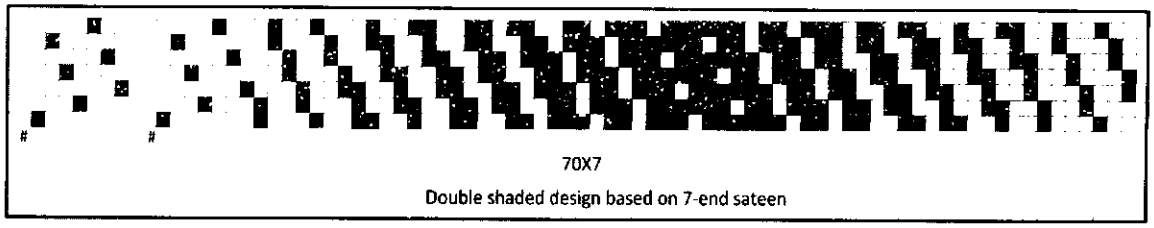
Double Shaded design or weaves:

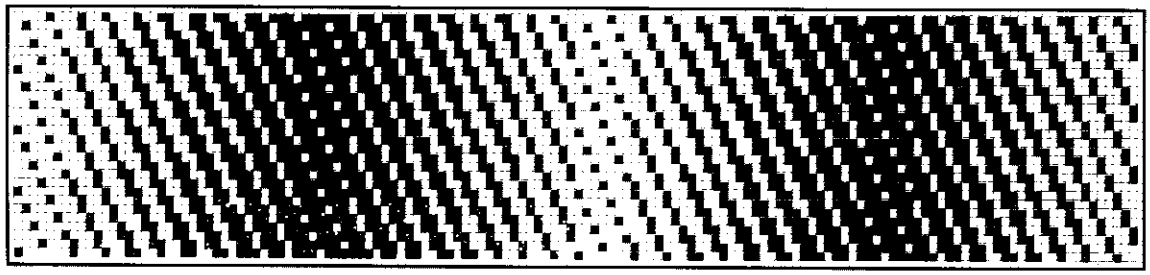
Like as single shaded design at first numbers of weft satins are developed side by side. Then these sateen units are divided into the number of groups as per requirements. With each group of sateen one can gradually add warp floats with the interlacing points until it turns into a warp satin. From this warp satin with each group of sateen one can gradually minus warp floats with the interlacing points until it turns into the previous weft satin or sateen. After this the resultant weave will be a double shaded design. The following figures show the different double shaded design.





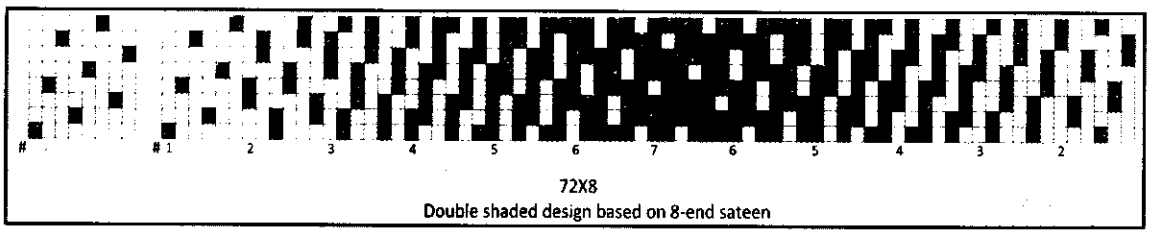
Double shaded design based on 5 – end sateen

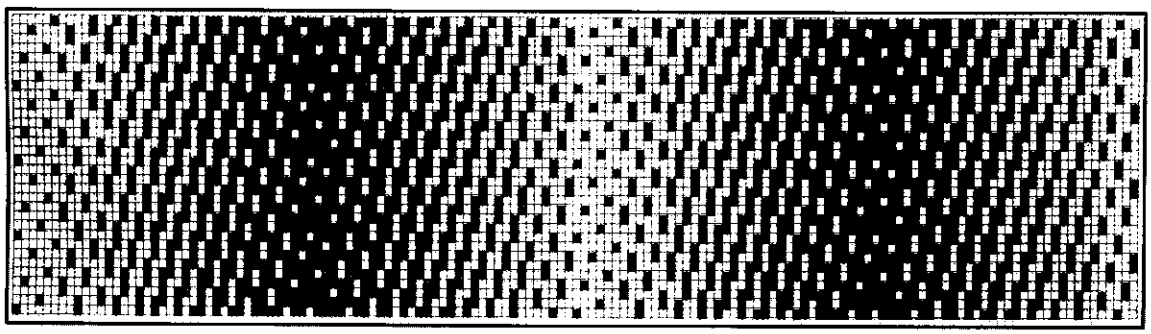




Double shaded design based on 7 – end sateen

Warp shading in an 8 – end satin which is divided into groups of six ends each. At the beginning of a new group, an interlacing point is added in the warp direction, i.e. on the picks following the warp lifts. In order to achieve adequate fabric strength, it is advisable to add plain weaving ends (after each group). These are additional to the satin ends in the denting of the front reed.





Double shaded design based on 8 – end sateen

FANCY DESIGN OR STRUCTURE OF FABRICS

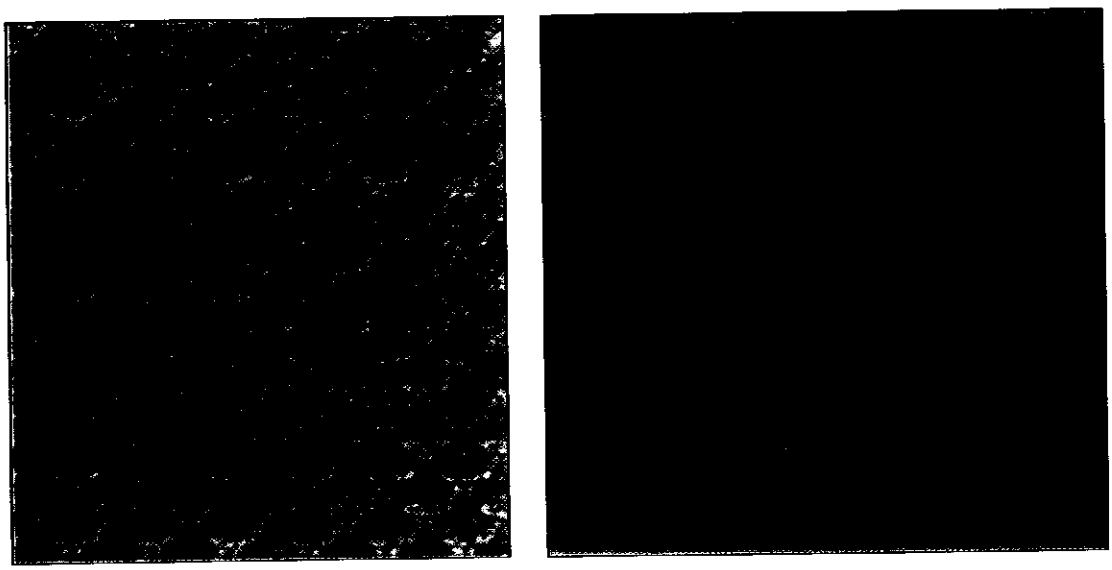
The interlacing of the threads in a form which varies from that of the basic weaves already described, is accomplished with a view to producing a fabric which is decorative in appearance and may also utilize the characteristic features of the weave for some useful purpose. The important features and construction principle of some decorative fabrics will be discussed in this chapter.

Huckaback Weaves:

Main features:

These weaves are generally applied in the manufacture of non-pile towels. The main features of this weave are as follows:

- This weave is characterized by a rough surface, which is produced by floating threads in groups arranged on a plain weave basis.
- A more balanced huckaback is produced if the weave-repeat size is twice an odd number (i.e. 2 × 5 = 10; repeat size = 10 ends × 10 picks), but it is by no means impossible to produce the weave on a repeat which is complete on twice an even number of threads.



Close-up view of Huckaback fabric

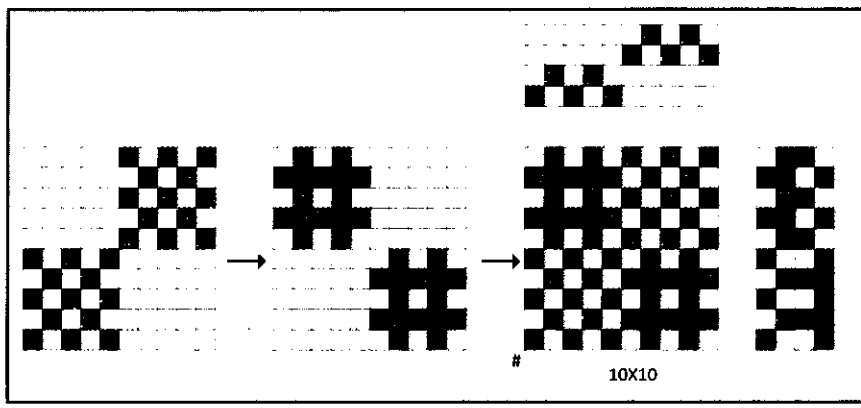
- With these constructions hardwearing and extremely thick, moisture absorbing fabrics are produced.

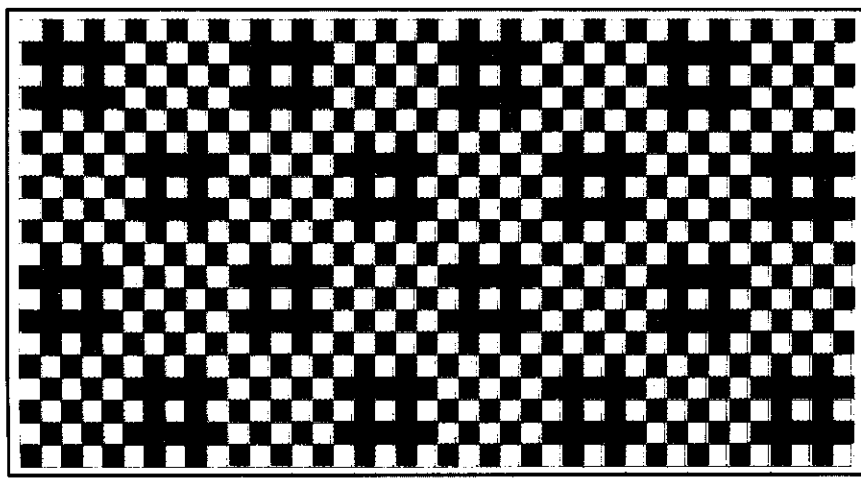
- Groups of plain weave are exchanged with groups of One end plain weave and one end floating. To achieve a more prominent raised effect in the area where the threads are floating correct denting plays an important part. Whenever possible the long floating ends should be drawn into the same dent.
- 10 × 10 is the widely used repeat size.
- This weave can be divided diagonally into equal two parts.

Construction principle:

The following figure shows the stages in constructing the huckaback weave:

- Mark out the repeat size, divide into quarters and fill in plain weave in two opposite ones as shown at first;
- Fill in a motif in the other two quarters, which is preferably produced by taking plain weave and adding or removing some lifts, as at second one; care should be taken to ensure that the motif and the plain weave bind together effectively;
- The final weave is produced by combining first and second one.





10 × 10 Huckaback design

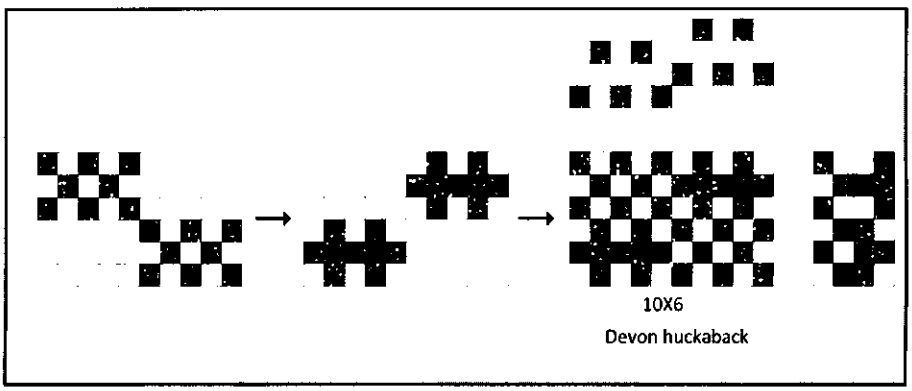
Drafting system:

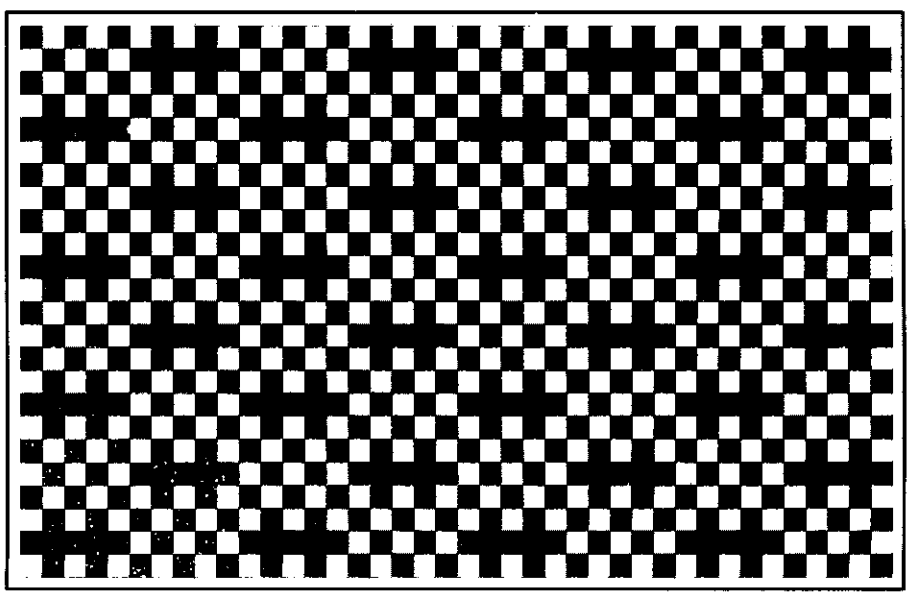
Different drafting systems are used to produce this fabric. The draft which is generally used is so arranged that the odd number threads are carried by the two front heald-shafts and the even number threads by the back two heald-shafts.

Uses:

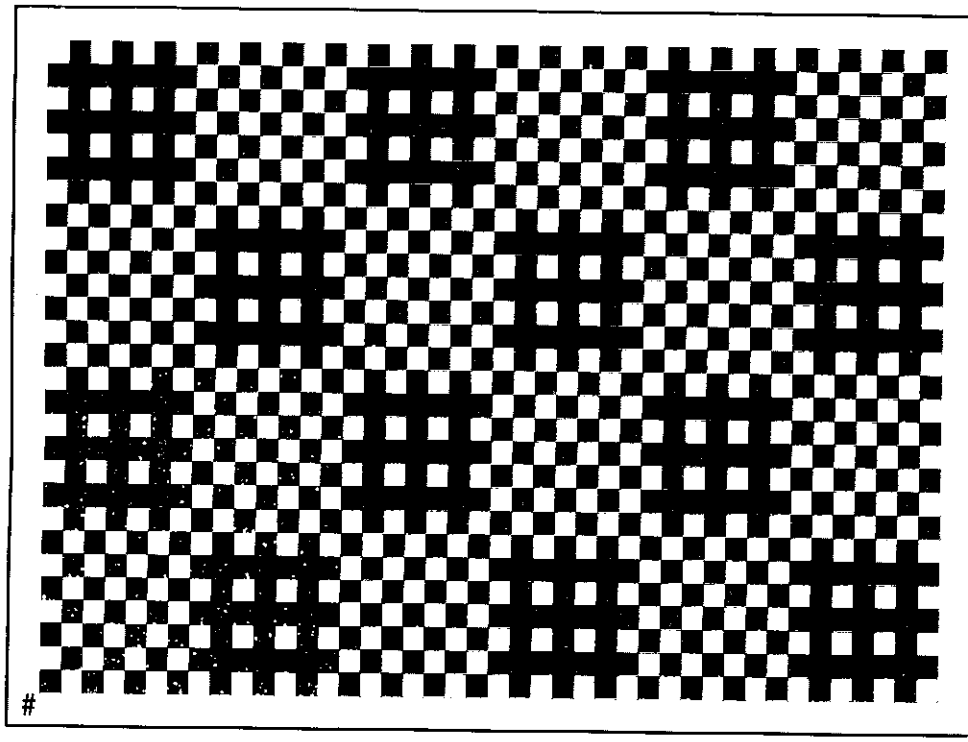
Linen and cotton yarns are commonly used, and in coarser qualities they are particularly suitable for hand towels, glass cloths, roller towels and quiltings. Shirtings, dresswear and table linen are produced in the finer qualities.

The following figures show the weave plan with drafting and lifting plan of different types of huckaback fabrics:

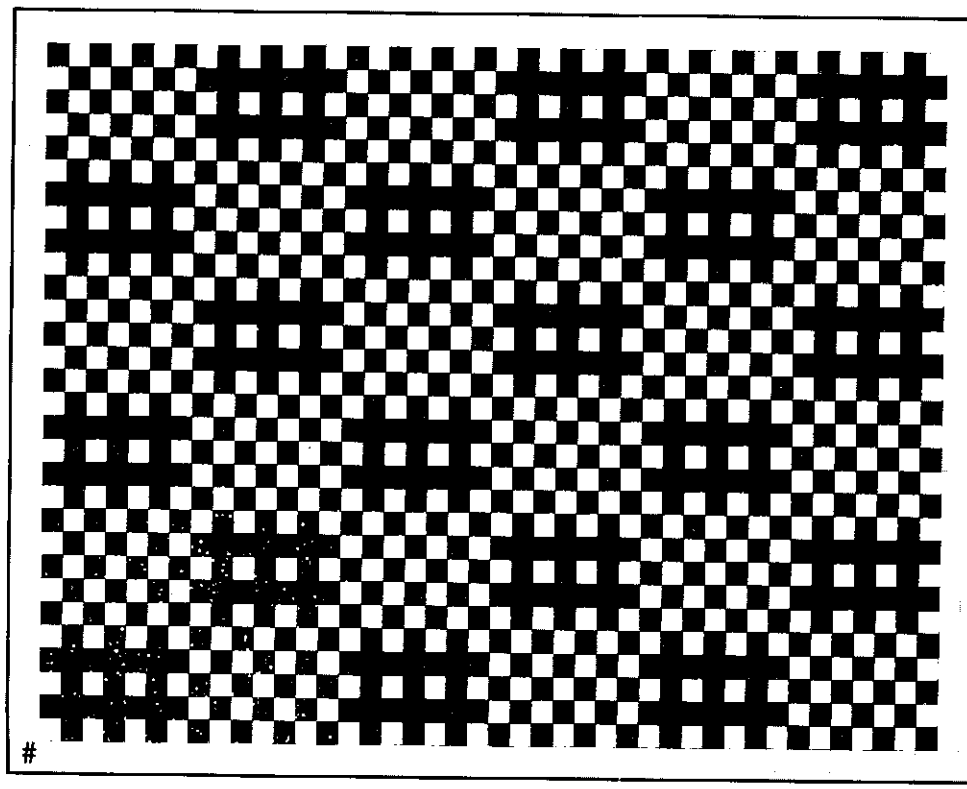




10 × 6 Huckaback design (Devon huckaback)



14 × 14 Huckaback design



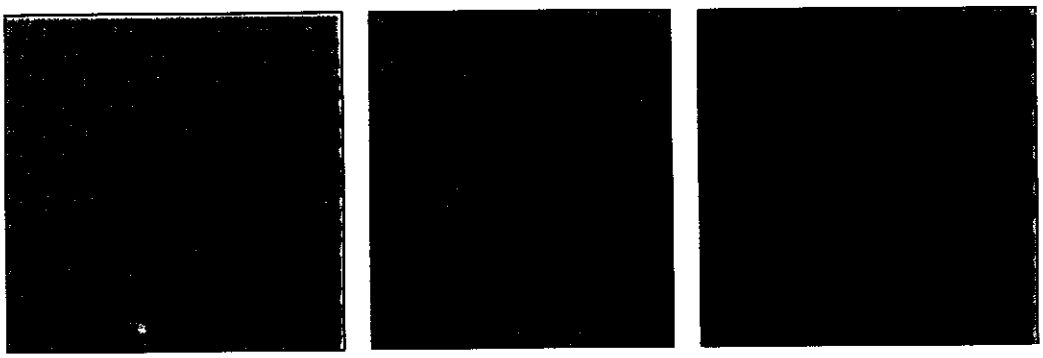
14 × 10 Huckaback design

Mock leno weaves:

Main features:

This weave is also referred to as imitation gauze weave. The main features of this weave are as follows:

- It is an open perforated weave like as leno fabrics.
- It is produced in the ordinary way without special leno shafts.
- The similarity of this weave to the huckaback is quite obvious, but the method of denting is different, as it is necessary to encourage thread grouping.
- The weave is arranged in groups of equal or unequal sizes. Threads working in plain weave alternate with threads floating on the face or back of the fabric. The ends from each individual group are whenever possible drawn into the same dent; this bunches the floating ends together and causes a slight gap or opening in the fabric giving an appearance similar to a gauze or leno weave, hence the name 'mock leno'.
- Even number repeat size is normally used to produce this weave.
- This weave can also be divided diagonally into two equal parts.
- The smallest repeat size of this weave is 6 × 6.



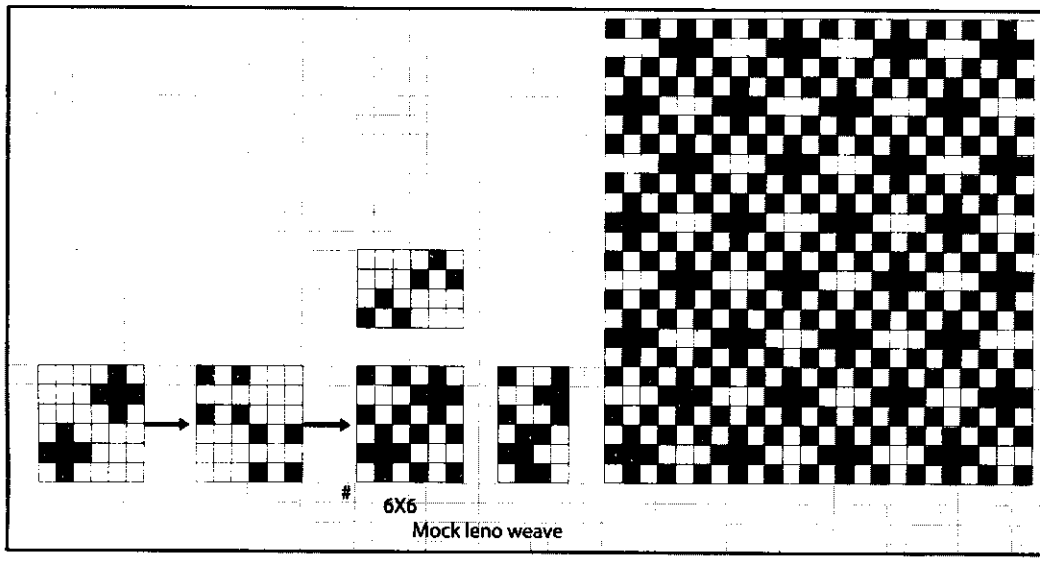
Close-up view of Mock leno fabrics

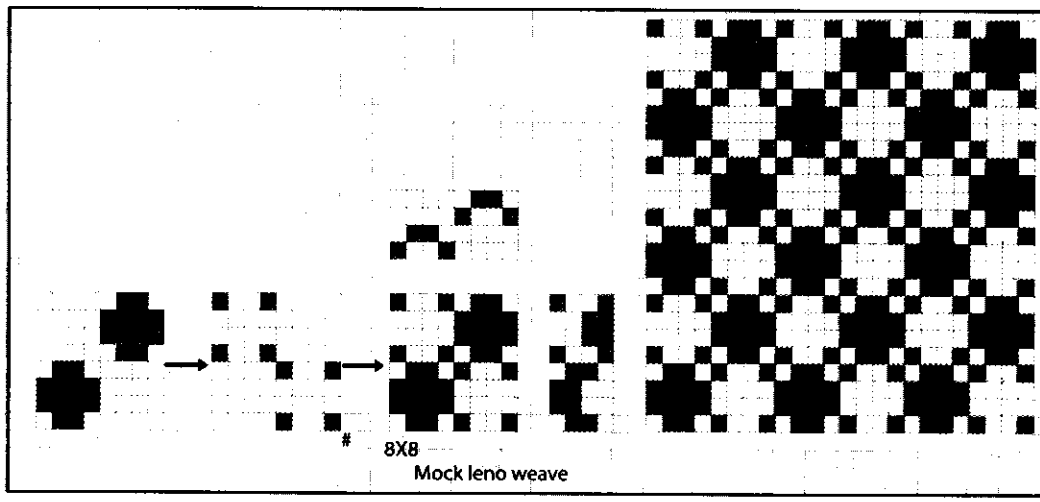
Construction principle:

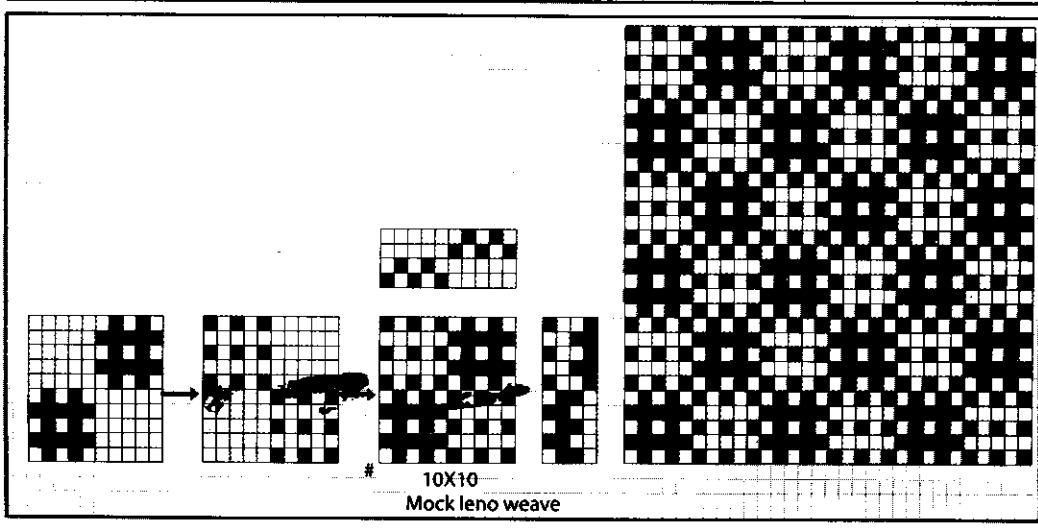
The stages in producing the weave are illustrated by the following figure:

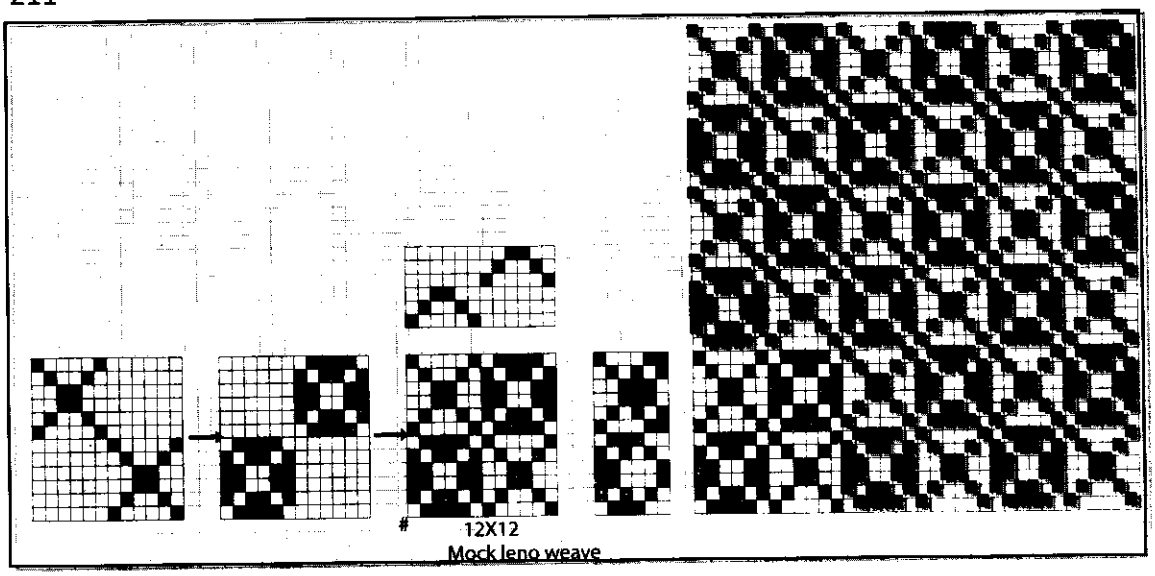
- Mark out the repeat size, divide into quarters and fill a small motif in opposite quarters, as in first step;
- Completely reverse this motif in the two remaining quarters, by substituting warp lifts for weft lifts and vice versa, as in second step;
- Combine first and second steps to give the final weave.

The following figures show the weave plan with drafting and lifting plan of different types of mock leno fabrics:


#
6X6
Mock leno weave


#
8X8
Mock leno weave


#
10X10
Mock leno weave



12 × 12 mock leno weave

End uses:

Because of the decorative all-over effects, the end uses range from curtains to table linen and apparel fabrics. Fabrics produced with this weave are used for embroidery cloths, canvas cloths and light-weight window curtains, but it is also popular in combination with other weaves, particularly plain, in tablelinen, brocades, blouses and dress-wear.

Honeycomb weave:

The term is applied to weaves which resemble honeycomb cells. The cellular formations appear square in the cloth. They are formed by some ends and picks interlacing tighter than others and therefore developing a higher tension. Usually single cloths made by progressively lengthening and shortening both warp and weft floats to form ridges and hollows on a square pattern, to give a cellular appearance. Sometimes called waffle or waffle piqué.

There are two types of honeycomb weave, such as – ordinary honeycomb and brighton honeycomb.

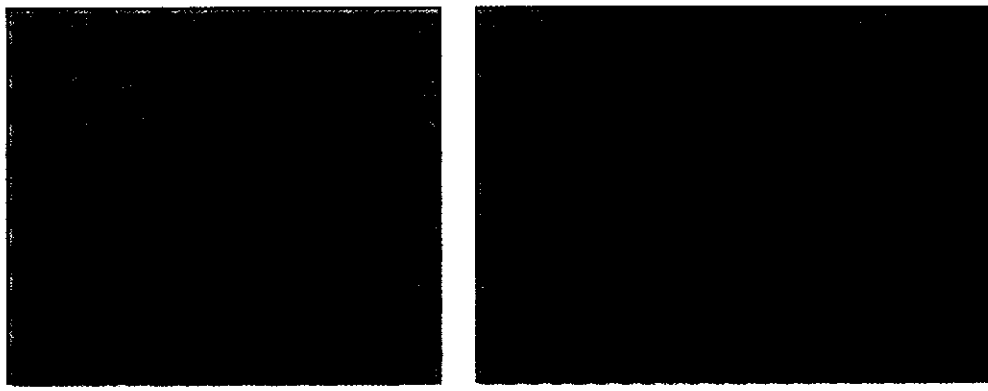
Ordinary Honeycomb:

Main features:

The main features of ordinary honeycomb are as follows:

- The characteristic features of this weave are alternate raised and sunk diamond-shaped areas which give the effect of a honeycomb.
- Both sides of the fabric look the same and the surface of the fabric is rough.
- It has long floats of warp and weft yarns.

- In the repeat size the number of ends and picks may be equal or unequal and multiple of two.
- In the larger repeat size, a double row of binding has been constructed by using a $\frac{1\ 1}{1\ a}$ twill weave at first stage, so that a firmer structure will be produced.
- The long floats in the centre of the diamonds are not equal, and if the fabric is being produced with a square sett, this can be detrimental to the appearance of the cloth as they will produce a rectangular pattern instead of a square one. Two methods are available for improving the appearance when this occurs: adjust either the sett or the weave.



Close-up view of Ordinary honeycomb fabric

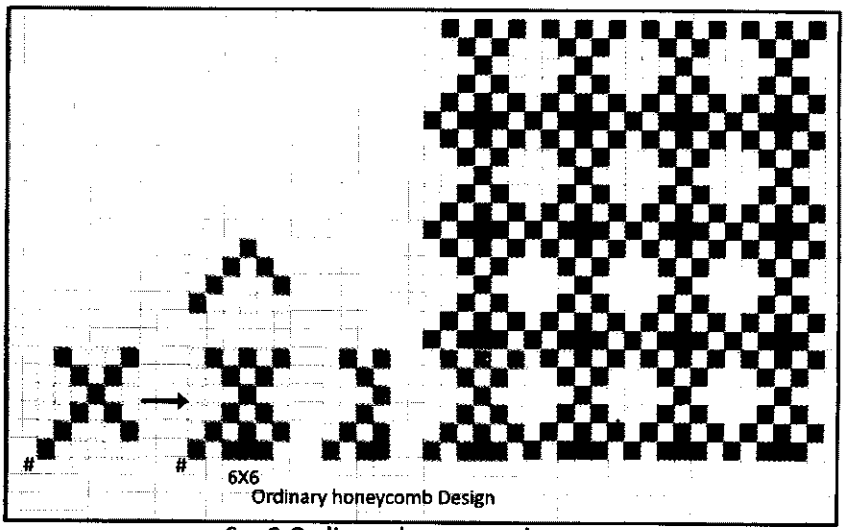
- When equal floats are required in the construction, it is necessary to construct a honeycomb in which the shorter of the two long floats is the same as the required float length in the final design. For example, the original 10 ends × 10 picks honeycomb with the first end having a float of seven. The two indicated centre ends are removed to give the final design on 8 ends × 10 picks, with equal longest floats of seven in both the warp and weft directions. Similarly the two indicated centre picks are removed to give the final design on 10 ends × 8 picks, with equal longest floats of seven in both the warp and weft directions.
- Pointed drafting system is normally used to produce this weave.

Construction principle:

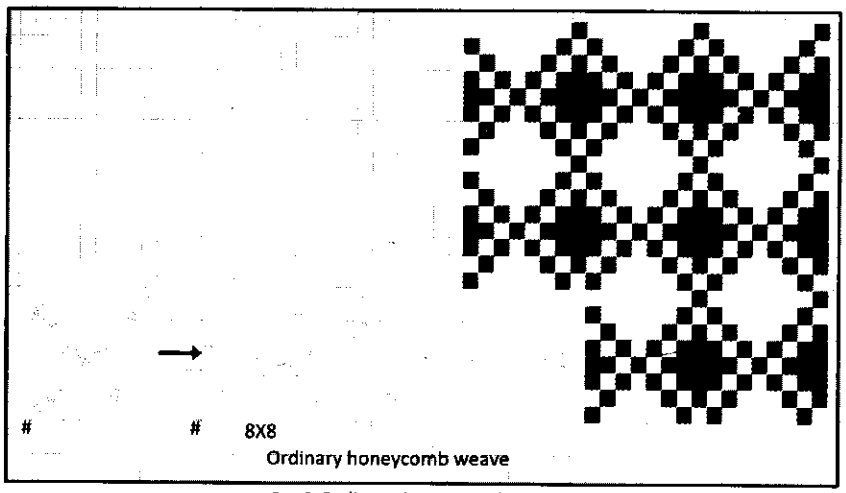
The stages of constructing an ordinary honeycomb weave are as follows:

- Construct a $\frac{1}{a}$ Z twill starting in the bottom left-hand corner, then a similar one running in the opposite direction and starting one square in or one square down from the top left-hand corner, so that there will be a clean intersection of the twill lines, as at first stage;
- In one of the two diamonds produced, leave a row of stitching points and then lift the remainder of the diamond solid. This is the final weave.

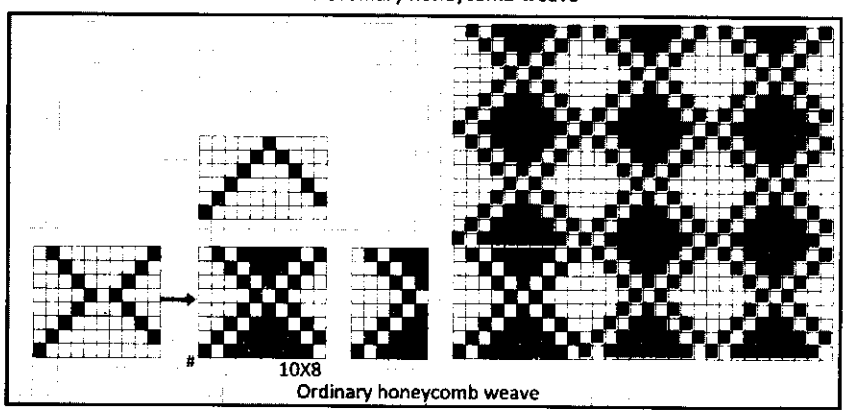
The following figures show the weave plan with drafting and lifting plan of different equal and unequal repeat sizes of ordinary honeycomb weaves.



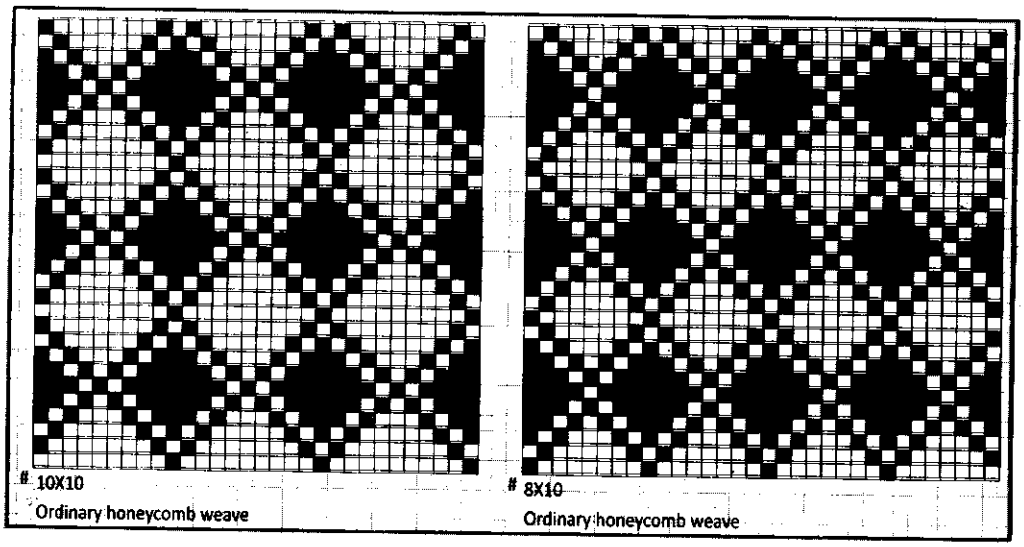
6 × 6 Ordinary honeycomb weave



8 × 8 Ordinary honeycomb weave

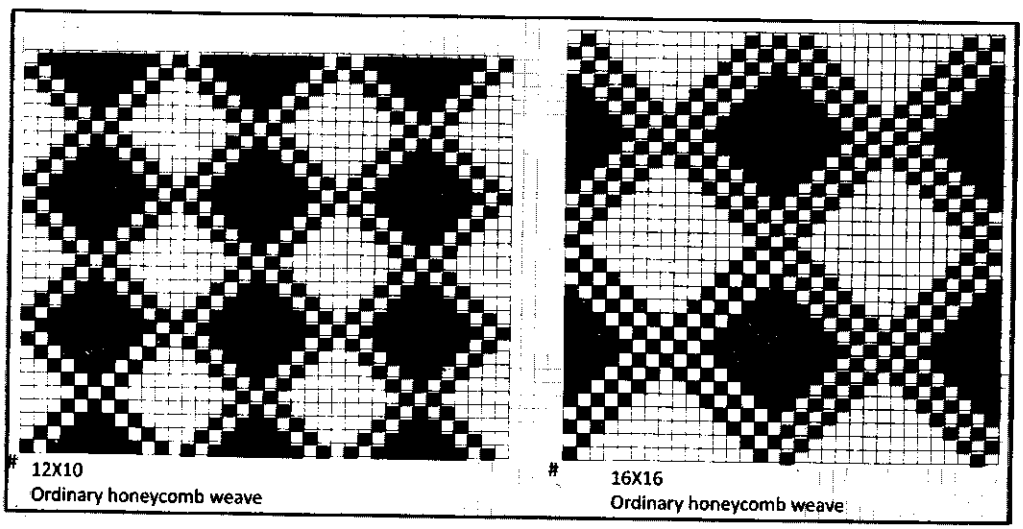


10 × 8 Ordinary honeycomb weave



Ordinary honeycomb weave

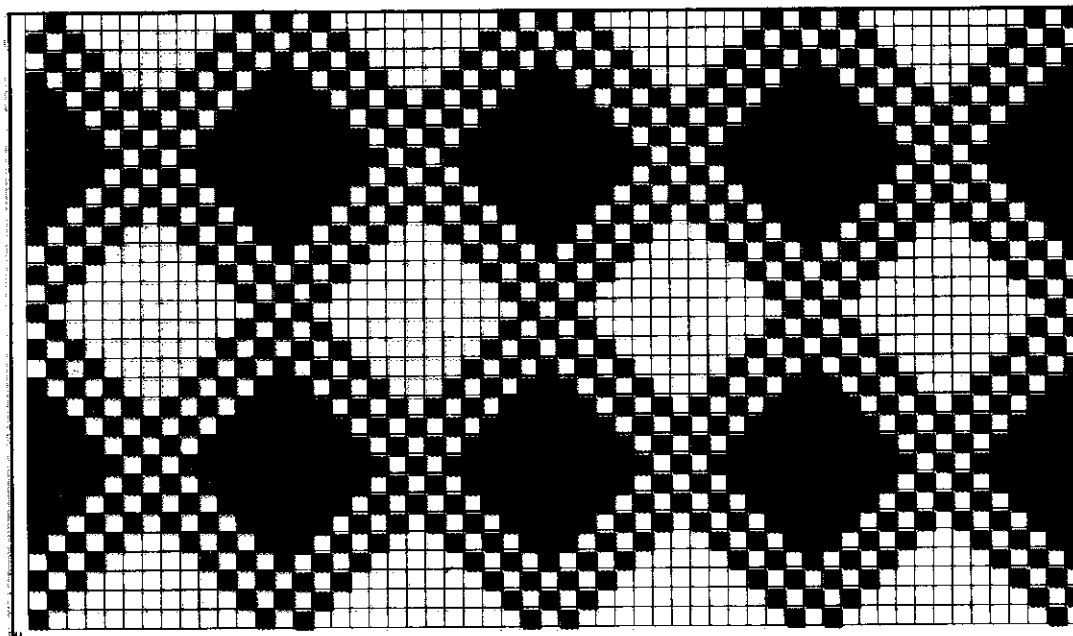
The following figure (left-one) shows a honeycomb produced on a larger repeat, and with the warp lift designed in the opposite diamond, whilst the right-side figure shows a honeycomb weave on an even larger repeat size; in this case, a double row of binding has been constructed by using a $\frac{1\ 1}{1\ a}$ twill weave at first stage, so that a firmer structure will be produced.



Ordinary honeycomb weave

End uses:

This weave particularly suitable for hand towels, glass cloths, dispensed roller towels and bath mats, where moisture absorption properties are particularly desired, but in similar coarse cotton qualities it is also used for quilts and soft furnishings, and in finer qualities for shirts and brocades. In conjunction with the newer textured yarns, it is produced in very coarse qualities for cellular blankets.



14X16 Ordinary Honeycomb Design

Brighton Honeycomb:

Main features:

Brighton Honeycomb is a complex structure. The main features of brighton honeycomb are as follows:

- More honeycomb cells of varying size are produce in this weave.
- The fabric surface is also rough like as ordinary honeycomb.
- When making the weave, the number of threads per repeat should always be a multiple of four (i.e. 12 ends × 12 picks), whilst the longest float should always be one less than half the number of threads in the repeat (i.e. $\frac{12}{2} - 1 = 5$).
- Both sides of the fabric look the same like as ordinary honeycomb.
- Straight drafting system is used to produce this brighton honeycomb weave.

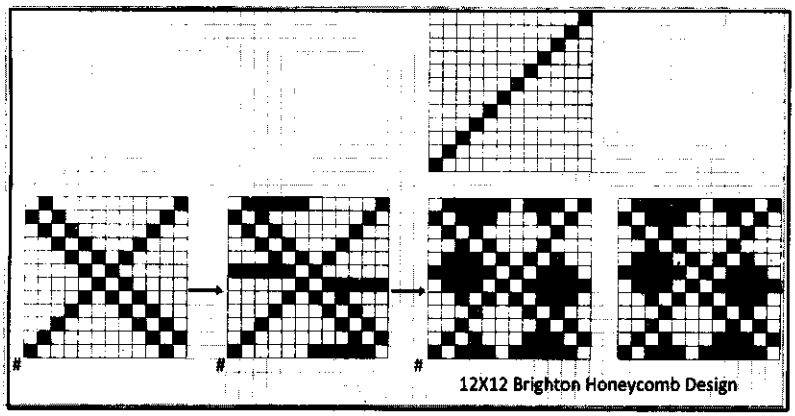
Construction principle:

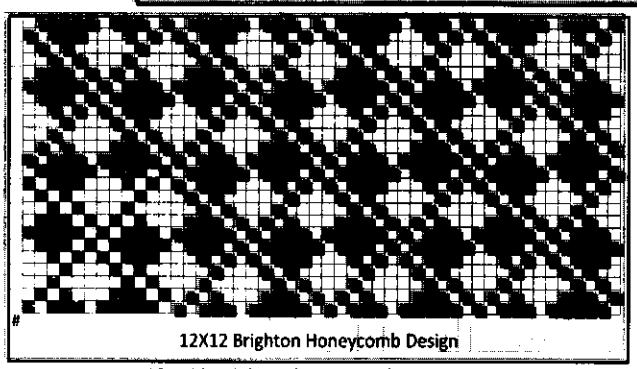
The construction, more complicated than the ordinary honeycomb, is illustrated by figures below, with the following stages:

- Construct a $\frac{1}{a}$ Z twill, starting in the bottom left-hand corner, and then construct a $\frac{1\ 1}{1\ a}$ S twill, starting with the first warp lifts in the squares to the right and below the square in the top left-hand corner, and indicate the points on the double row of binding which are immediately adjacent to those of intersection that will allow extensive floats in the weft direction, as illustrated in first stage;

- Using the points indicated in first stage as the extreme lift of the longest float, lift the remaining adjacent ends, as in second stage;
- Each of these warp floats now form the centre float of a diamond which can be completed. This is the final weave.

The draft of the brighton honeycomb is straight, thus producing a lifting plan which is identical with the design; therefore, there is no saving of heald-shafts as is the case with the pointed or V– draft of the ordinary honeycomb.

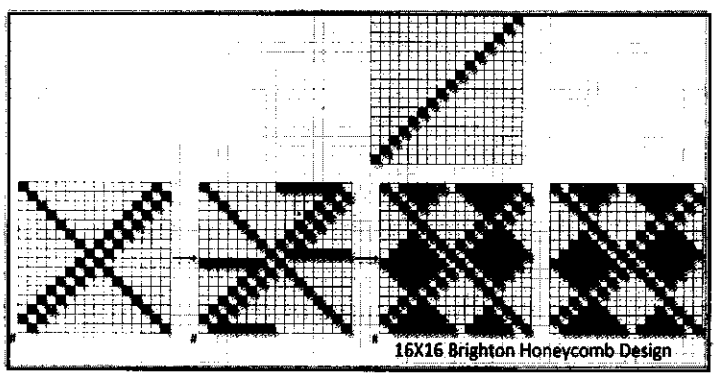


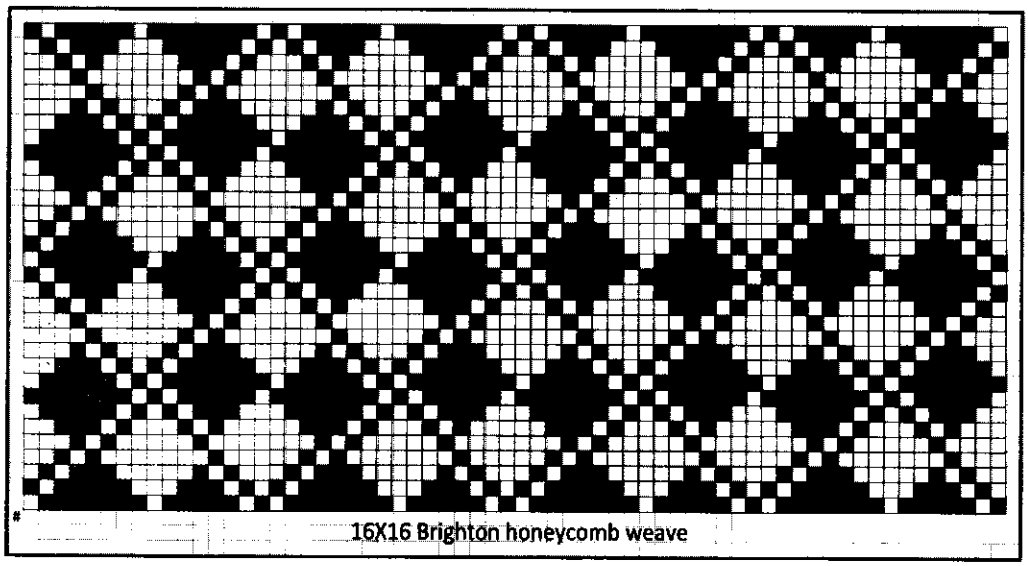


12 x 12 Brighton honeycomb weave

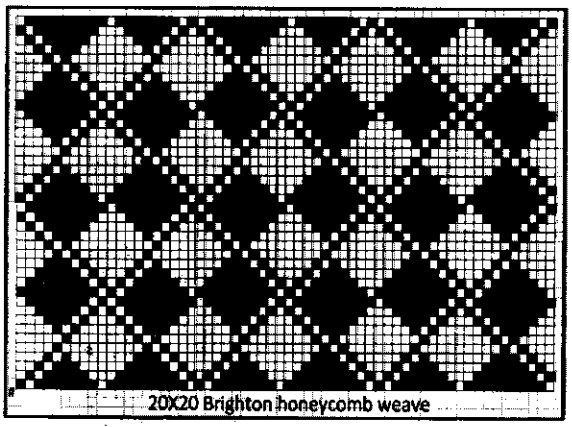
Close-up view of Brighton honeycomb fabric

The following figures show the weave plan with drafting and lifting plan of different Brighton honeycomb weaves.

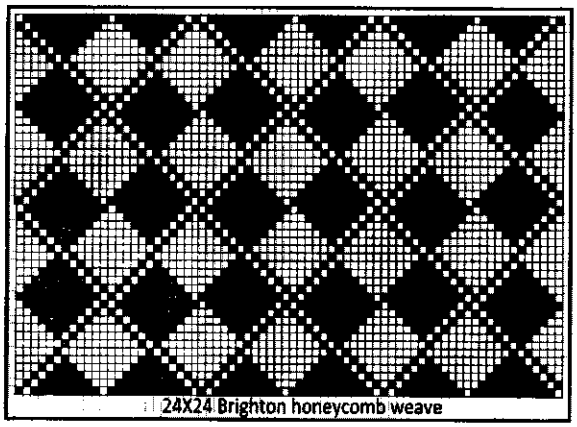




16X16 Brighton honeycomb weave



20X20 Brighton honeycomb weave



24X24 Brighton honeycomb weave

End uses:

Although the weave is not as popular as the ordinary honeycomb, it is used in similar qualities for more decorative end uses such as quilts and brocades and, in some cases, hand towels and glass cloths. It is also suitable for crockery towels.

Distorted Thread Effect:

Main features of distorted thread effect:

- Leno weave can also be used to create a figured appearance by causing a coarse ends to cross a number of standing ends.
- In this weave, the crossing end is made to lie at an angle to the normal direction of the warp and weft threads.
- Imitations of this effect can be produced by other weaves designed to cause certain selected threads to be distorted.

- The latter must float freely on the surface of the fabric; a firm ground weave (e.g. plain) helps to develop the effect.

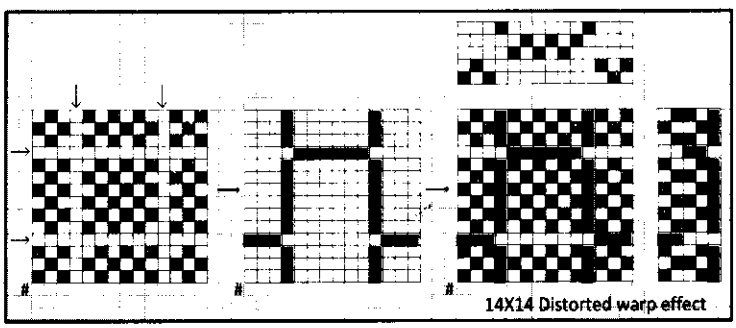
Types of distorted thread effect:

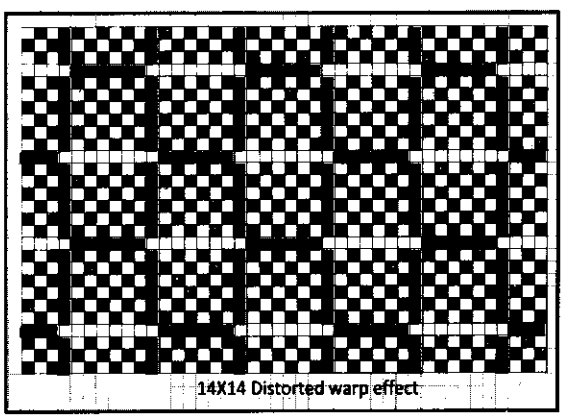
There are two types of distorted thread effect. Such as – distorted warp effect and distorted weft effect. The construction principles of these weaves are described as follows:

a. Distorted Warp effect:

The frequency of the distorted threads should be decided and shown as in the following figure, where the design is constructed in stages:

- After indicating the threads in the warp and weft direction which are essential for forming the distortion, fill in plain weave on all the remaining ends and picks, as at first stage;
- For a warp distortion, lift the preselected warp threads of first stage except where they cross the preselected weft threads, and then lift all remaining ground ends over the preselected weft threads in one group on the first pick and in the other group on the second pick, as at second stage;
- The completed design, third stage, is then formed by combining first and second stage.





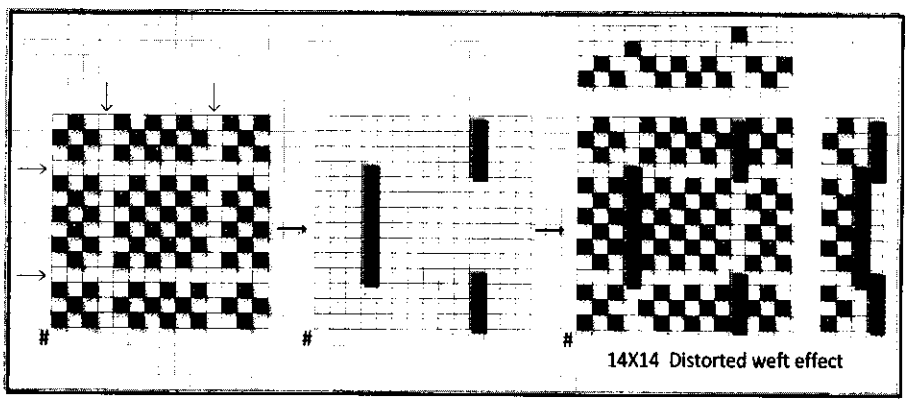
14 × 14 Distorted warp effect design

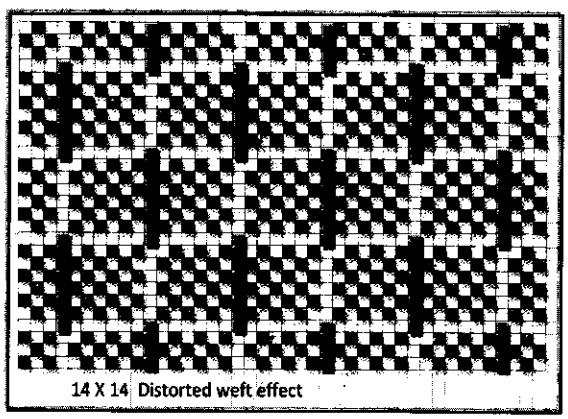
When the fabric is relaxed after weaving, the floating ends are distorted and assume approximately the zigzag conformation.

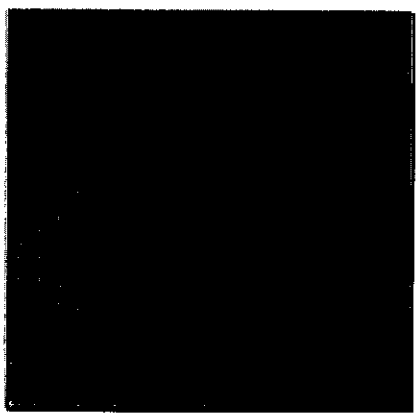
b. Distorted Weft effect:

The frequency of the distorted threads should be decided and shown as in the following figure, where the design is constructed in stages:

- After indicating the threads in the warp and weft direction which are essential for forming the distortion, fill in plain weave on all the remaining ends and picks, as at first stage;
- For a weft distortion, lift the preselected weft threads of first stage except where they cross the preselected warp threads, and then lift all remaining ground picks over the preselected warp threads in one group on the first end and in the other group on the second end, as at second stage;
- The completed design, third stage, is then formed by combining first and second stage.







Distorted-thread effect fabric (weft thread distorted)

When the fabric is relaxed after weaving, the floating picks are distorted and assume approximately the zigzag conformation.

End uses:

Fabrics produced with this characteristic are used in ornamental dresswear and shirting fabrics when produced in light-weight cotton and spun rayon qualities. In heavier qualities they serve for soft furnishings in cotton, for suitings in worsted and for coats in woolen fabrics. The above close-up view clearly shows distorted weft threads lying on the surface of a cloth which is popular for ladies' dresswear.

Cord weave:

The main characteristic of this weave are cords running in warp or weft direction. They have some similarity in appearance to the preceding weft or warp rib weaves but they are not reversible. The end use is mainly for apparel fabrics.

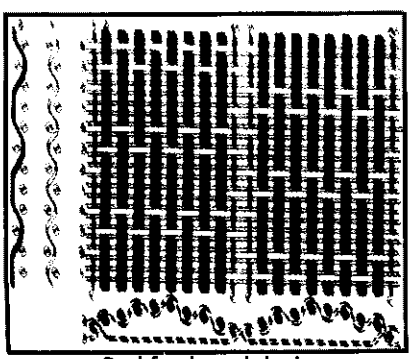
Cord effect in the cloth -

- By using of thick yarns
- Weave produces cord effects
    a. Bedford cord weave,
    b. Pique weave.

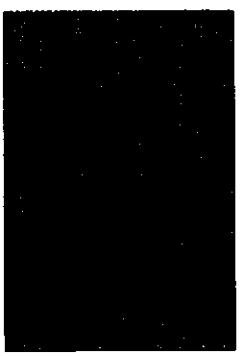
a) Bedford Cord weave:

Main features:

- The Bedford cord class of weaves produces longitudinal warp lines in the cloth with fine sunken lines between the cords.
- Warp face cloth.
- In one repeat two or more cords are produced.
- Wadding or padding are used to give greater prominence of the cord effect.
- Ends and picks are always even number. In special cases ends may be odd number.
- Picks number always 4. ie. 12X4, 16X4, 20X4 etc. (for plain-face Bedford cord).

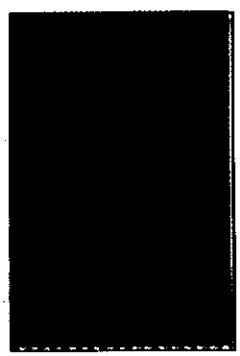


Bed ford cord design



Close-up view of face side

Close-up view of back side



Wadded Bedford cord

Cords running down the piece in the warp direction form the main characteristic of this weave. The face of the cloth is usually plain weave and the corded effect is produced by allowing alternate pairs of weft threads to float on the back of the fabric behind each cord. These threads interweave in plain order with the outside ends of each cord and are known as the cutting ends (sunken line).

Types of Bedford cord:

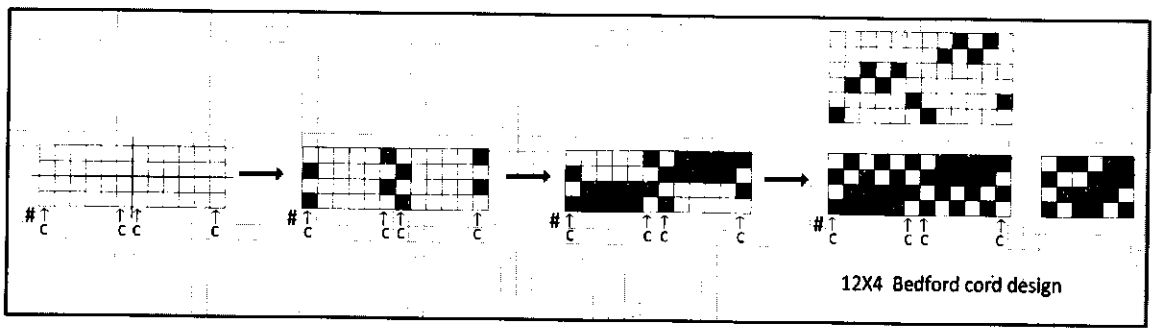
There are five types of Bedford cord design, such as -

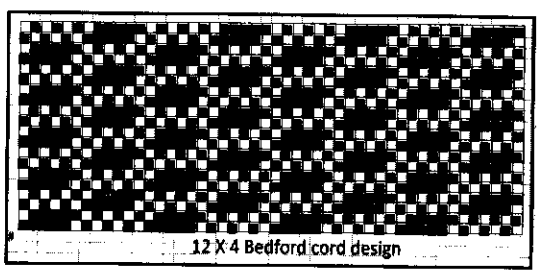
1. Plain face Bedford cord
2. Wadded Bedford cord
3. Crepon Bedford cord
4. Bedford cords, arranged with alternate picks
5. Twill face Bedford cord.

Construction principles of plain-face Bedford cord weave:

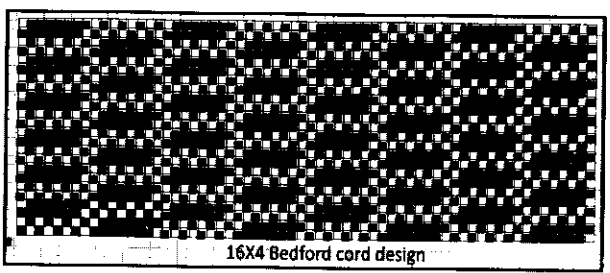
The stages of building up a Bedford cord weave, illustrated by the following figure are:

- Indicate the width of two cords (in this example, each cord has six ends), and then show the outside ends of each cord, known as cutting ends, weaving plain throughout, as at first and second stage;
- The first pair of picks float under the warp ends in the first cord and weave plain in the second cord. The second pair of picks weave plain in the first cord but float under the warp ends, and thus on the back of the cloth on the second cord. This fourth stage is the final design.





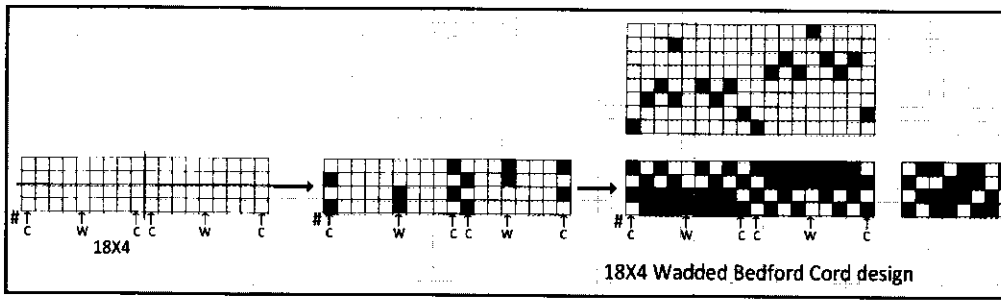
12 × 4 Plain-face Bedford cord design



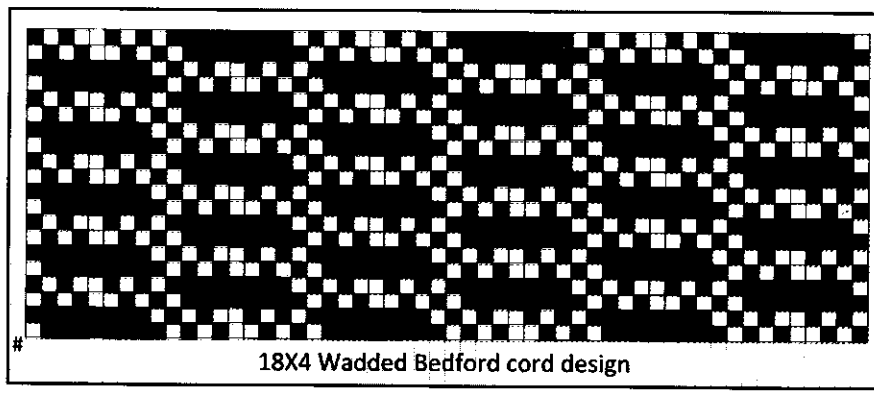
16 × 4 Plain-face Bedford cord design

In order to increase the prominence of the cord effect, wadding ends may be introduced, as illustrated in the following figure. In the following figure, one wadding end in each eight-end cord; it can be seen that it lies between the plain weave face and the floating weft on the back of the fabric. The weave for a Bedford cord with 12 ends in each cord and 3 extra wadding ends is also shown in the next figure (30 × 4 repeat size).

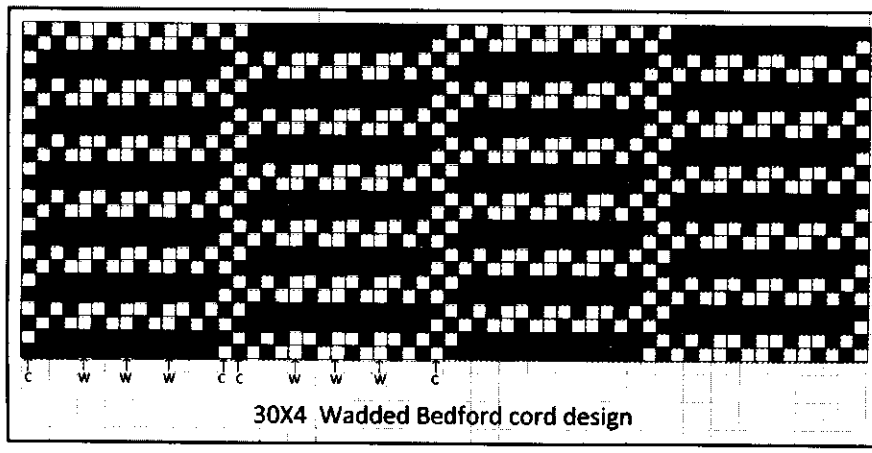
The drafting and lifting plan of these designs are shown in the figure also; it can be seen that the cutting ends are always controlled by the front shafts and the wadding ends by the back shafts. When arranging the order of denting, the cutting ends should be placed on either side of a reed wire, so that they are in adjacent dents of the reed, in order to give uniformity to the edges of the cords.



18X4 Wadded Bedford Cord design



18X4 Wadded Bedford cord design



30X4 Wadded Bedford cord design

End uses:

Fabrics produced with this weave may be made in medium-weight cotton or spun rayon fabrics for ladies' blouses and dresswear, sportswear and ornamental trimmings. In heavier qualities, it is suitable for soft furnishing when produced with cotton yarns or for trouserings when made of worsted yarns.

b) Pique Weave:

Main features:

- A typical pique structure consists of a plain face fabric composed of one series of warp and one series of weft threads, and a series of back or stitching warp threads.
- Continuous sunken lines or cuts i.e. cords are run horizontally in the cloth.
- One cord produces per repeat.
- Normally skip drafting system is used to produce this weave.

Types of pique weave:

There are four types of pique weave such as –

1. Ordinary pique or welt structure / Loose back without wadding picks.
2. Weft wadded welts / Loose back wadded welt structure.
3. Fast back welt or pique structure.
4. Waved pique structure.

The special features of these welts are as follows:

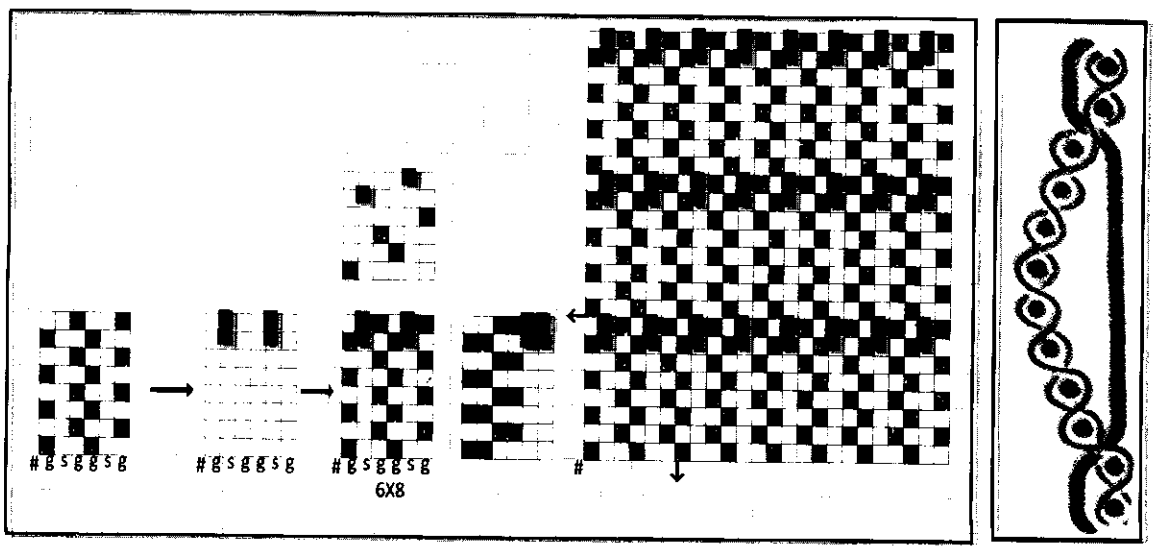
Ordinary welts:

- The number of face picks in the width of a cord is varied according to requirements, but usually the number of consecutive picks that are unstitched should not exceed twelve.
- The order of the warp thread arrangement, which is always one face or ground, one stitching or back end and one ground or face end, in each split of the reed, or in the proportion of two face to one stitching end.

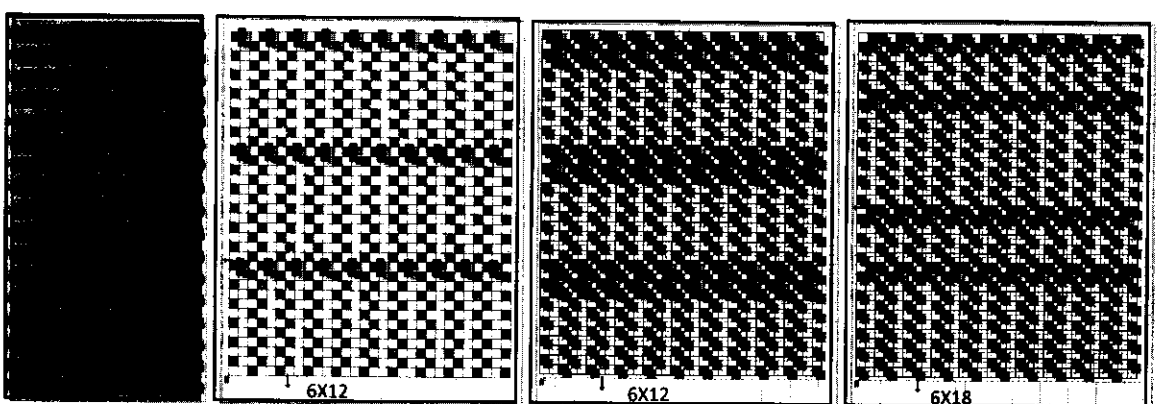
Construction principle of ordinary welt:

The following figure shows a cross-section of the weave through the weft and indicates the stages in the construction:

- Indicate the order of the warp thread arrangement, which is always one ground, one stitching end and one ground end, then fill in plain weave on the ground ends as at first stage;
- The stitching warp is lifted over the required number of picks, as determined by the requirements of the final fabric appearance; at second stage a two pick weave is illustrated;
- The final weave is produced by combining first and second stage.



6 × 8 Ordinary pique design



Close-up view of ordinary pique design

6 × 12 Ordinary pique design

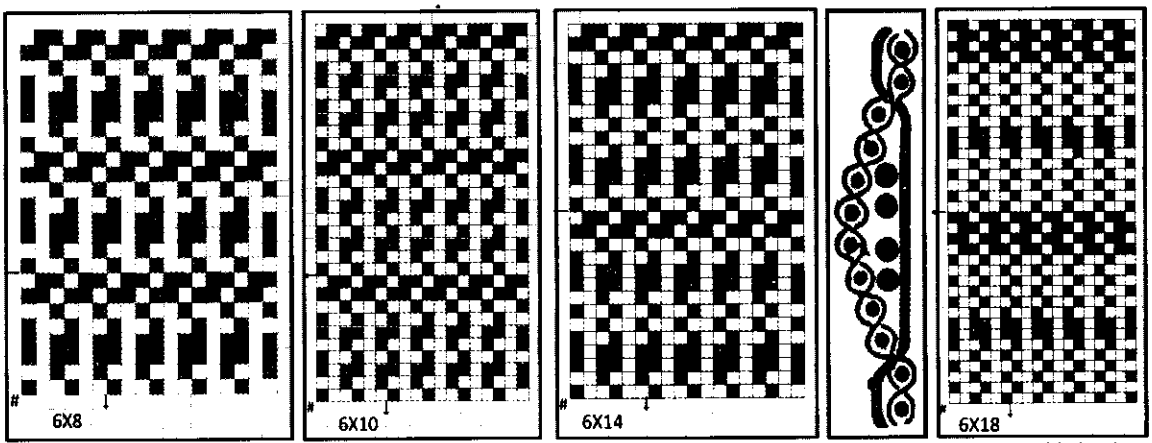
6 × 12 Ordinary pique design

6 × 18 Ordinary pique design

When making the draft for pique it is preferable to control the ground ends from the front shaft (skip-draft) and back two shafts are used for stitching ends. For example, plain weave, may be drawn on two healds, if the cloth is coarse, or on four healds, if the cloth is of medium fineness, or on six healds, if the cloth is very fine. Same ground ends are arranged in different heald shafts for reducing friction.

Wadded welts:

- In order to increase the prominence of the unstitched portions of the cloth, i.e. horizontal cords and to make the cloth more substantial, it is customary to insert wadding picks between the tight back stitching ends and the slack face fabric.
- Usually the wadding weft is thicker than the ground weft, and is inserted two picks at a place, the looms being provided with changing shuttle boxes at one side only. Sometimes, however, the same kind of weft is used for both the face and the wadding, looms with a single box at each side being employed; and, in such a case, one wadding pick at a place may be inserted.

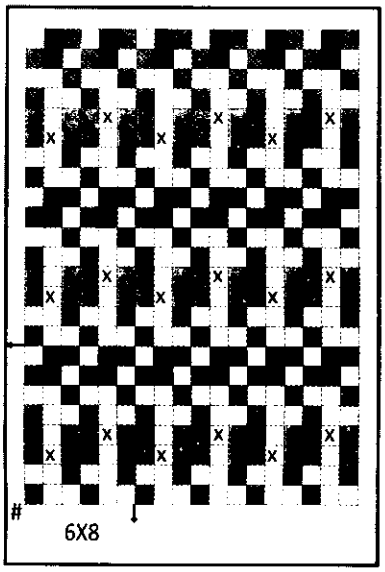


6 × 8 wadded welt design | 6 × 10 wadded welt design | 6 × 14 wadded welt design with longitudinal section | 6×18 wadded welt design

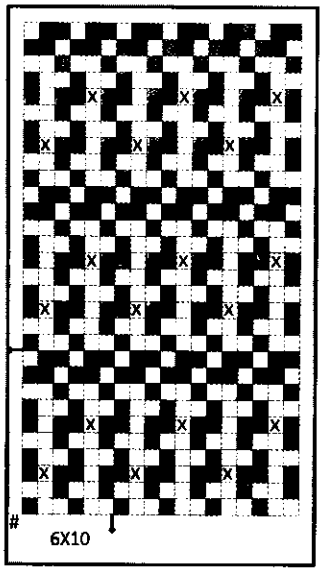
- Again, in some cloths thick wadding picks which are inserted in pairs, are supplemented by single wadding picks of the face weft. All the face ends are raised when the wadding picks are inserted, as indicated by the different colour in the designs, while the stitching ends are left down.
- The stitching ends are placed on a separate beam which is very heavily weighted, whereas the face ends are kept at moderate tension.
- At intervals the tight stitching ends are interwoven into the plain face texture, with the result that the latter is pulled down and an indentation is formed on the surface.

Fast – back welts:

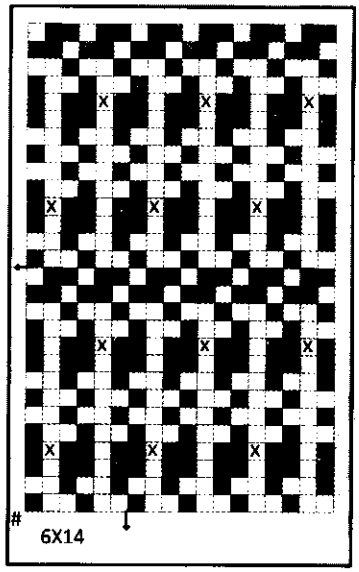
- In each of the foregoing designs, the stitching ends are only lifted to form the indentations, the term "loose-back" being applied to this type of structure.
- The term "fast-back" is applied to cloths in which the stitching ends are interwoven in plain order with all, or some wadding picks. The reduction of the float length of the stitching ends on the back of the fabric which results from this interlacing helps to produce a more serviceable cloth less liable to accidental damage.



6×8 fast-back welt design



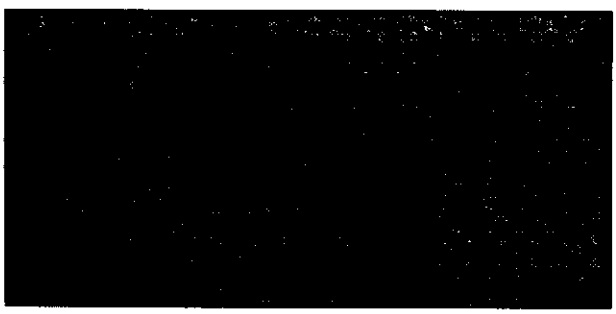
6×10 fast-back welt design



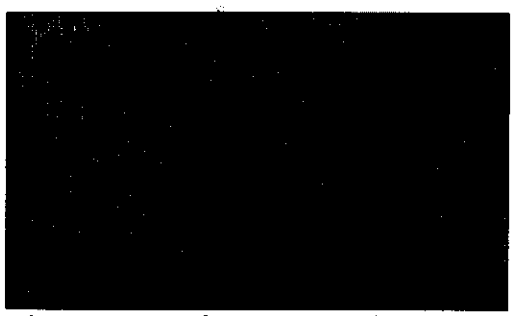
6 × 14 fast-back welt design

Waved piques:

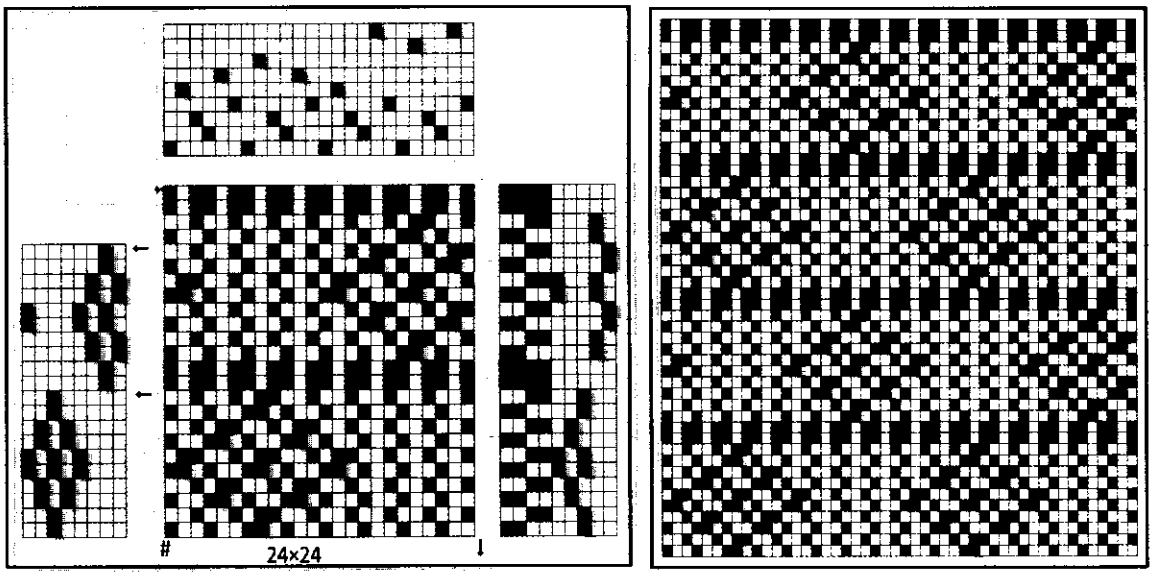
- A waved pique is a simple modification of the welt structure in which the indentations are not in a horizontal line but are arranged in alternate groups, as shown at first in the following figure, the marks in which indicate the lifts of the stitching ends on the face picks.
- The group of marks does not overlap horizontally, as one commences on a face pick immediately following that on which the other has finished.
- Between succeeding groups two wadding picks are inserted, as indicated by the arrows at the side of first figure.
- The complete design to correspond with first figure is given at second figure, in which the ends are arranged in the same order as in a welt, while there are ten face picks to two wadding picks. The lifts of the tight stitching ends force the wadding picks first in one direction and then in the other, so that waved lines are formed across the cloth. The following figures show the weave plan with drafting and lifting plan of a typical waved pique or welt design.



Close-up view of waved pique (face side)



Close-up view of waved pique (back side)



24 × 24 waved pique design

End uses:

It is now used only to a very limited degree, mainly for trimmings and other ornamental uses. It is also used for neckties, ladies light summer holding costume etc.

Sponge Weave:

Any one of a variety of weave arrangements that groups ends and picks together in order to form a cellular structure and to create a soft spongy effect in the fabric. Examples include spot weaves, diamond effects, honeycombs and sateen-based structures with lifts added.

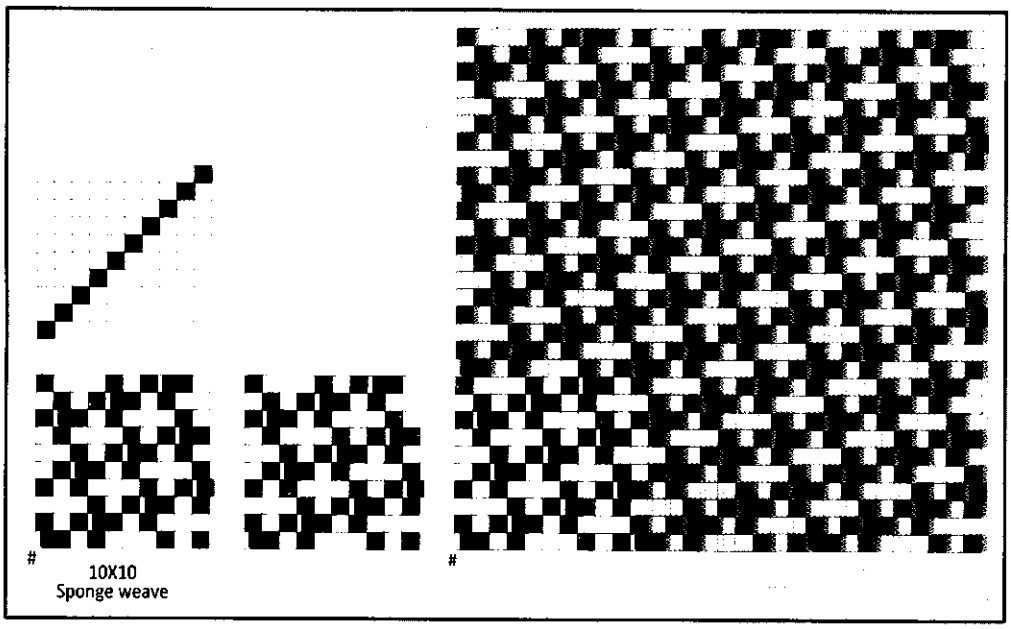
Sponge weave considered as the result of honeycomb effect and also form the cell like honeycomb weave. The characteristics features of this weave are as follows:

- The number of ends and picks are always equal;
- 10 × 10 is the smallest repeat size of this weave;
- Straight drafting system is used to produce this weave;
- Low twisted and coarser yarns are used to produce this fabric. So the fabric produced by this weave is very soft and absorbent;
- For the construction of this weave it is important to calculate the longest float of diamond. This float is depends on the repeat size of the design. The following formula is used to calculate this longest float:

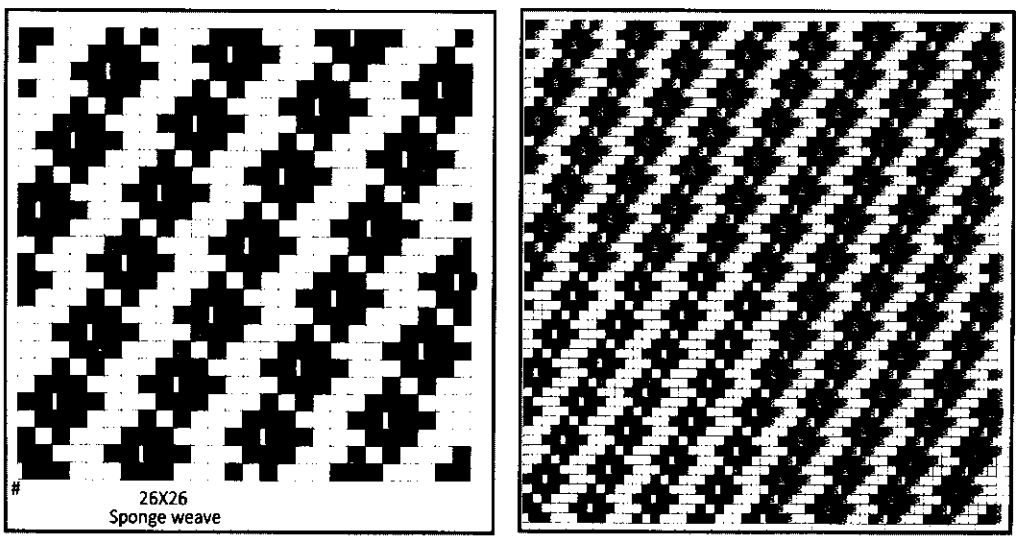
  Longest float of diamond = $\sqrt{\text{Number of ends or picks in the repeat-1}}$

- It is a reversible cloth like honeycomb;

- Honeycomb weave produce one cell on both sides but in this case number of produced cell on both sides of the weave depends on the number of repeat size;
- This weave produce on the sateen base.



10 × 10 Sponge weave



26 × 26 Sponge weave

End uses:

Uses include fancy woolen shawls, bed-sheet, towel, counterpanes, drapes, bathing wraps and dress fabrics. It is also used as ground of jacquard design.

COLOUR AND WEAVE EFFECTS

Simple weaves such as $\frac{1}{1}$ plain, $\frac{2}{2}$ matt and $\frac{2}{2}$ twill may be used in conjunction with two – colour warp and weft patterns to produce small geometrical designs in two colours. The particular design which results depends both on the weave and on the arrangement of the two colours in the warp and weft. These patterns are called colour-and-weave effects. They are very frequently used in woolen and worsted fabrics for costumes, sports jackets and ladies' coats.

There are two types of colour and weave effects, such as –

- Simple colour and weave effects, and
- Compound colour and weave effects.

Order of colouring / Arrangement of threads:

There are two types of order of colouring, such as –

- Simple order of colouring, and
- Compound order of colouring.

Both simple and compound order of colouring again divided into two types, such as- regular order of colouring and irregular order of colouring.

Simple order of colouring:

In this order of colouring, only one ratio of colour is used either for warp or weft, such as -

- Regular order of colouring –
  4 dark, 4 light; 3 dark, 3 medium, 3 light etc. same for both warp and weft.
- Irregular order of colouring –
  2 dark, 1 light; 3 dark, 2 medium, 1 light etc. same for both warp and weft.
- By arranging the weft in a different order from the warp, for example – 2 and 2 warping crossed with 1 and 1 wefting

Compound order of colouring:

In this case more than one ratio of colour is used either for warp or weft, such as -

- 2 dark – 2 light and 4 dark – 4 light; 6 dark – 6 light and 3 dark – 3 light etc. same for both warp and weft.

- In the combination of compound order of colouring, it also may be regular or irregular order like as simple order of colouring.

Order of colouring for warp yarn is called warping and order of colouring for weft yarn is called wefting.

A convenient classification of the orders of colouring for the threads is as follows:

- Simple warping and simple wefting
- Compound warping and simple wefting
- Simple warping and compound wefting
- Compound warping and compound wefting.

In the above combinations the order of warping may be the same or different from the order of wefting. To each order of colouring, simple, stripe and check weaves may be applied. The style of pattern which is produced by the combination of each order of colouring with each type of weave is given below:

Pattern chart for colour and weave effects:

Weave / Order of colouring	Simple Weave	Stripe Weave	Check Weave
Simple warping and Simple wefting	Simple Pattern	Stripe Pattern	Check Pattern
Compound warping and Simple wefting	Stripe Pattern	Stripe Pattern	Check Pattern
Simple warping and Compound wefting	Cross-over Pattern	Check Pattern	Check Pattern
Compound warping and Compound wefting	Check Pattern	Check Pattern	Check Pattern

Construction principle of colour and weave effect:

Order of colouring and weave structure is fixed for a particular pattern. The stages in producing the pattern are illustrated below:

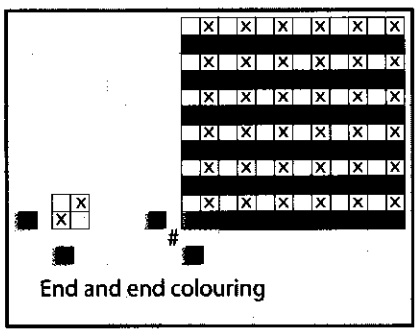
- Mark out the repeat size of pattern according to the order of colouring and repeat of the weave;
- Fill-up the repeat size by particular weave structure with crosses;
- Indicates order of colouring by shade, the shades indicate the dark yarns;
- For warp colouring, colour i.e. shade is put only warp-up position of the particular warp yarn and for weft colouring, colour i.e. shade is put only weft-up position of the particular weft yarn;
- This final pattern is produced by combining the colour and weave structure.

Simple colour and weave effects:

In what follows it is assumed that dark and light yarns are used, although any sufficiently contrasting colours are possible. The following designs are the example of simple colour and weave effects:

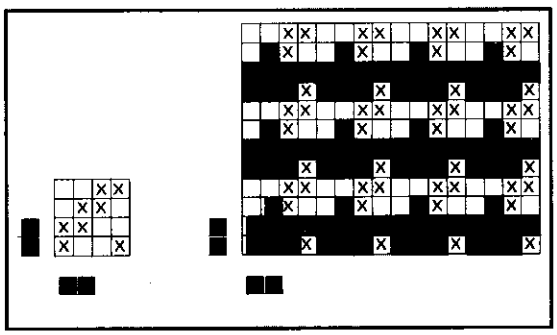
End and end colouring Pattern:

The effect of arranging the warp and weft end and end dark and light (i.e. 1 dark : 1 light) in a plain weave cloth is shown in the following figure; the shades indicate the dark yarns. The weave and colour arrangement produce the pattern, which consists of fine horizontal lines alternately dark and light.



Weave: $\frac{1}{1}$ plain

Order of colouring: 1:1 for both warping and wefting



Weave: $\frac{2}{2}$ twill

Order of colouring: 2:2 for both warping and wefting.

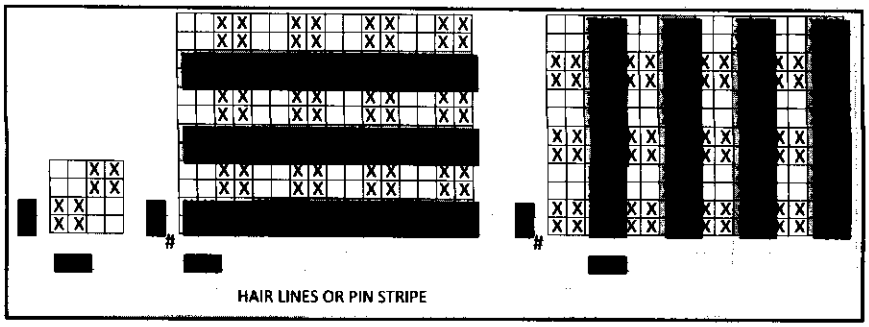
Continuous line effect:

The effect of arranging the warp and weft a 2:2 order of colouring in the $\frac{2}{2}$ twill-weave cloth is shown in the above right figure; similarly the shades indicate the dark yarns. The weave and colour arrangement produce the pattern, which consists of coarse horizontal lines alternately dark and light but it is not sharp line like previous end and end colouring pattern.

Hair lines or Pin stripe:

The effect of arranging the warp and weft a 2:2 order of colouring in the $\frac{2}{2}$ 2 matt-weave cloth is shown in the following figure; similarly the shades indicate the dark yarns. The weave and colour arrangement produce the pattern, which consists of thick or coarse horizontal lines alternately dark and light like as previous end and end colouring pattern.

In the following right side figure the weave is same as in the left one, but the warp and weft colour arrangement has been changed: the result in vertical lines. Similarly the pattern can be changed by changing the starting of the weave with same colour arrangement of both warp and weft yarn.



Weave: $\frac{2}{2}$ 2 matt

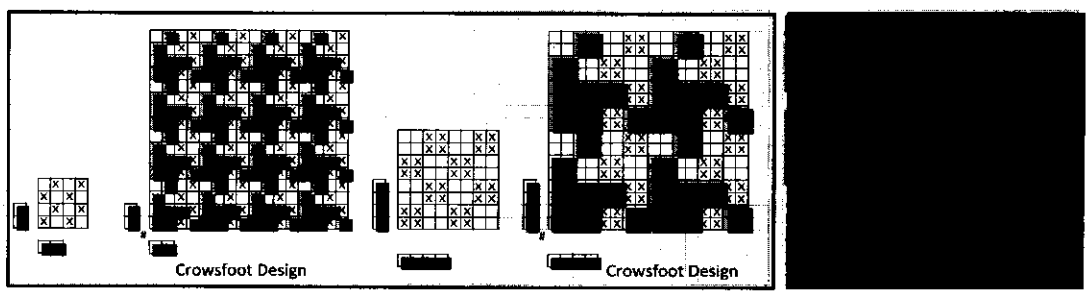
Order of colouring: 2:2 for both warping and wefting.

Crowsfoot pattern:

The effect of arranging the warp and weft 2:2 order of colouring in the $\frac{1}{1}$ plain-weave cloth is shown in the following left figure; similarly the shades indicate the dark yarns. The weave and colour arrangement produce the pattern, which is the well-known crowsfoot design.

A similar but larger crowsfoot pattern results from using a 4:4 colouring with a $\frac{2}{2}$ 2 matt-weave represent in the following middle figure. The close-up view of a fabric using this weave and colouring is shown in the following right side figure.

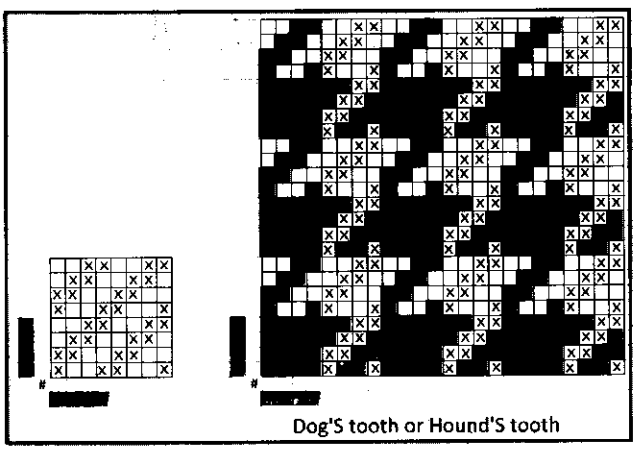
Other, less useful, patterns result if the footing i.e. the starting point of the $\frac{2}{2}$ 2 matt-weave is altered, the order of colouring remaining the same. The reader might work these out for himself.

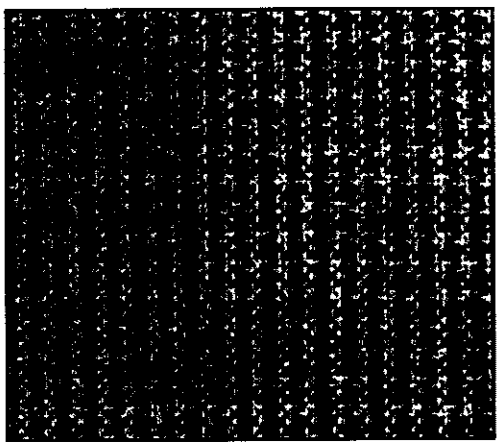


Dog's tooth or Hound's tooth Pattern:

The most popular weave for colour-and-weave effects is $\frac{2}{2}$ twill. With a 4:4 colouring, arranged as in the following figure, it gives a distinctive and decorative pattern known as dog's tooth when a relatively fine construction gives a small, and as hound's tooth when a coarser construction gives a larger pattern. A fabric made with this weave and colouring is shown actual size in the following right side figure.

Altering the footing of the weave changes the character of the effect produced, but none of the alternatives are as effective or as useful as the one shown. Here again the reader may experiment with alternative arrangements.

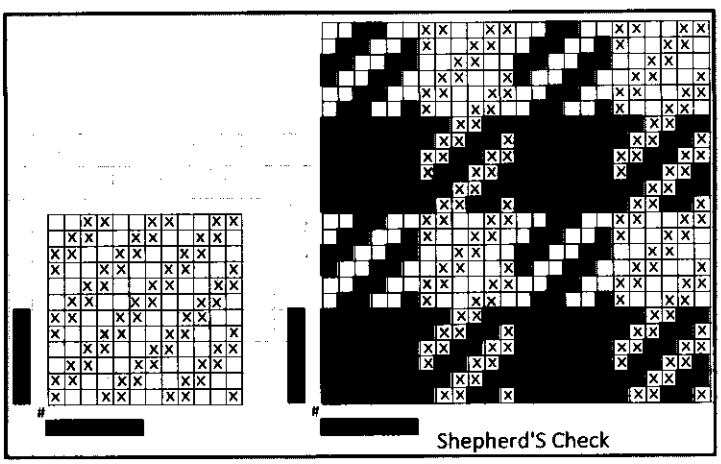


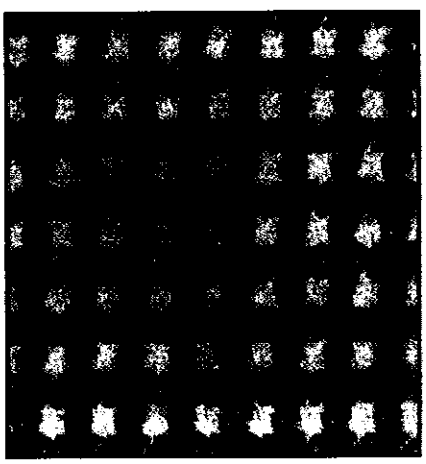


Close-up view of dog's tooth

Shepherd's Check Pattern:

A 6:6 order of colouring with a $\frac{2}{2}$ twill weave gives an effect similar to, but bolder than, dog's tooth. A woolen coating woven in this way from black and white yarns, known as shepherd's check, is shown in the following figure.

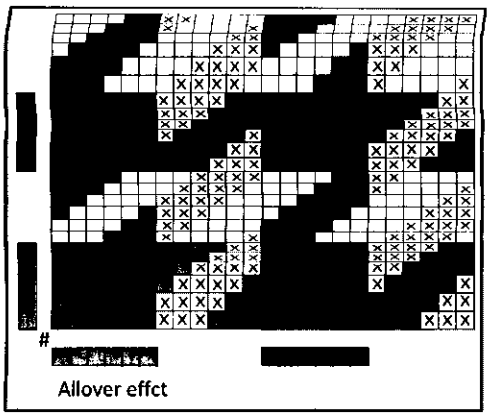


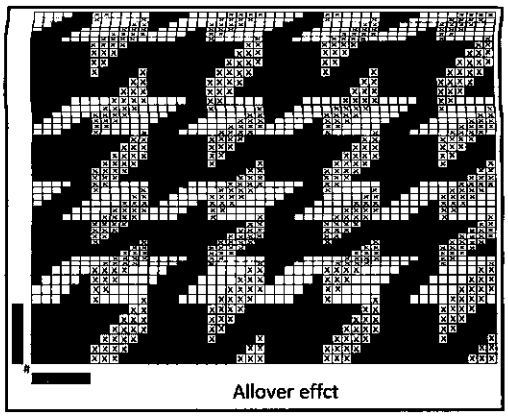


Close-up view of shepherd check

Allover effect:

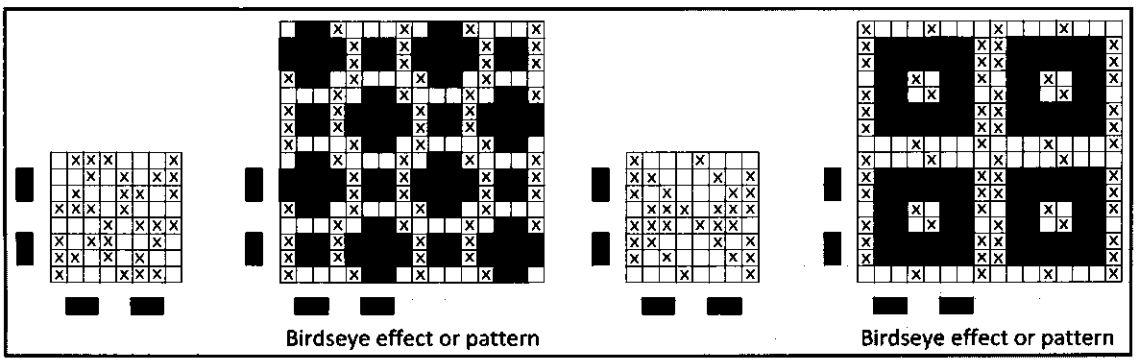
A 6:6 order of colouring with a $\frac{4}{4}$ twill weave gives an effect, known as allover efect, is shown in the following figure.





Birdseye effect:

A useful type of colour-and-weave effect is known as birdseye, defined as "a fabric having a pattern of very small and uniform spots, the result of a combination of weave and colour". The development of the pattern and of another pattern of the same type, but having larger spots, is given in the following figures. Both these patterns use simple fancy weaves. Other fancy weaves used with suitable orders of colouring provide a considerable range of patterns, some of which are distinctive enough to be useful.

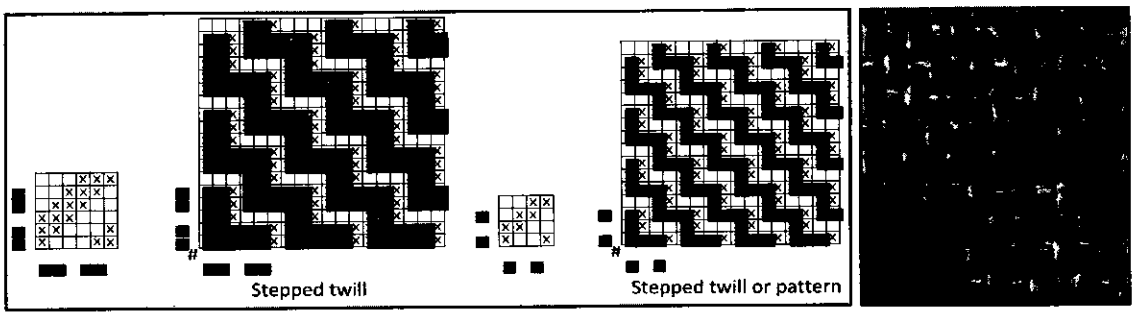


Stepped twill Pattern:

A 1:1 order of colouring with a $\frac{2}{2}$ twill weave (for finer effect) or 1:2 order of colouring with a twill weave (for finer effect)or 2:1 order of colouring with a twill $\frac{3}{3}$ weave (for coarser effect) gives a useful effect known as stepped twill. Its development is shown in the following figures. The following right side figure shows a worsted suiting fabric made with this weave and colouring.

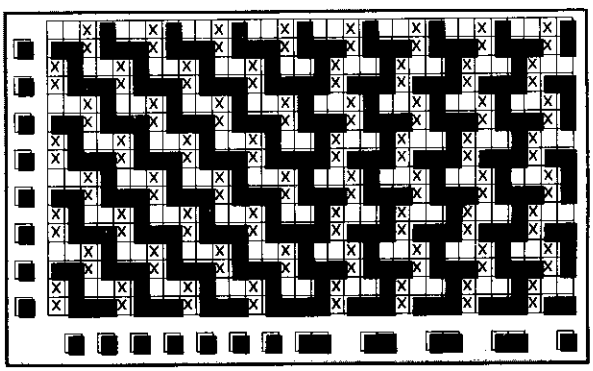
Fabrics such as this in which the warp and weft are end-and-end and pick-and-pick in contrasting colours require uniform yarns, accurately spaced. Yarn irregularities, or variations in yarn spacing,

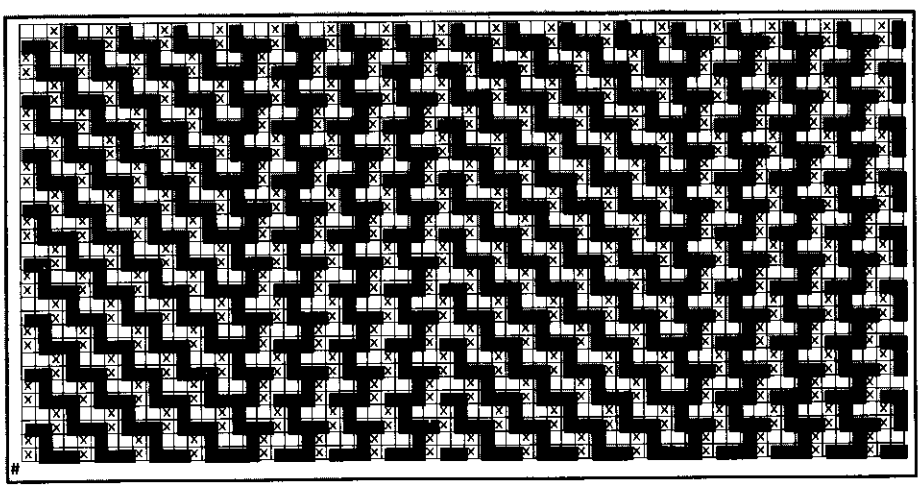
show up very markedly. Even the highest-quality fabrics of this type tend to exhibit some irregularities.



Compound colour and weave effects:

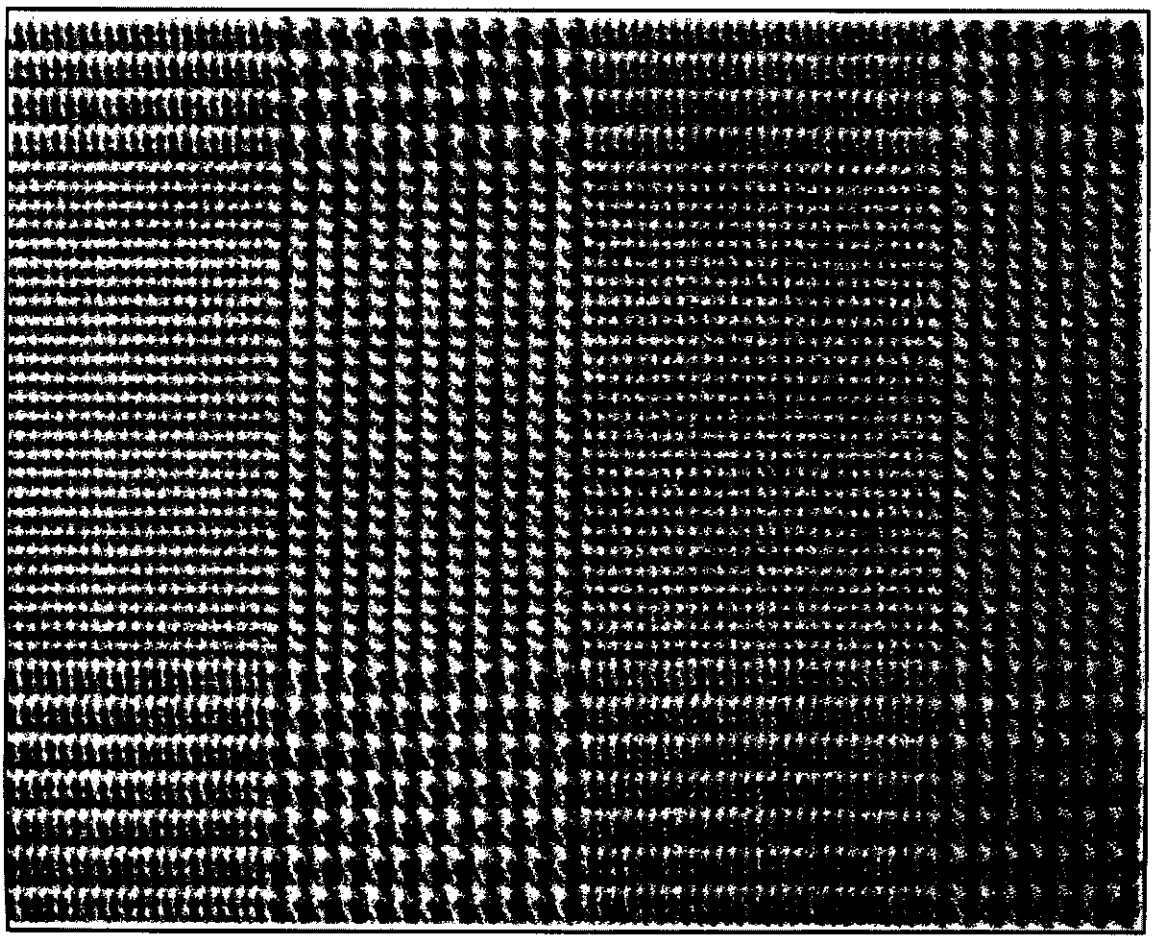
In this case different types of check and stripe patterns are produced. The following figure shows a stripe pattern, which is produced by simple weave and simple wefting with compound warping. As a weave $\frac{2}{2}$ 2 matt is used. For warp colouring 1:1 and 2:2 order of colouring and for weft colouring simple 1:1 colour arrangement are used here. The repeat size of this pattern is 32 × 16.



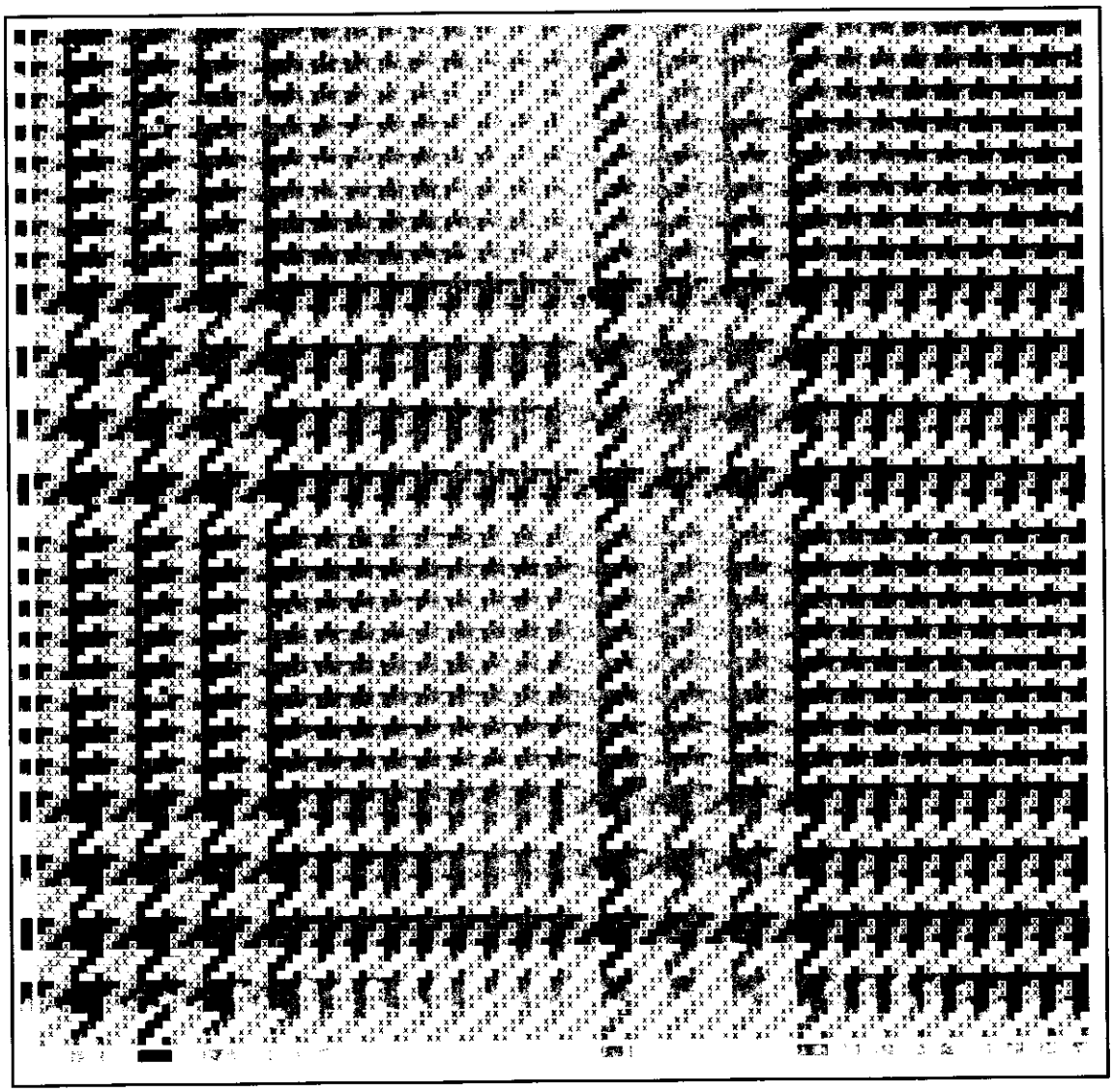


Glen check:

Distinctive patterns are often made in woolen and worsted fabrics in $\frac{2}{2}$ twill weave, with alternating blocks of ends and picks arranged 4:4 and 2:2. In those parts of the fabric where both warp and weft are coloured 4:4, we obtain a dog's tooth effect. Where both warp and weft are coloured 2:2, either vertical or horizontal lines result. Where the warp is coloured 4:4 and the weft 2:2, and vice versa, we obtain two new effects. A woolen fabric embodying these effects is illustrated actual size in the following figure. This type of design is called glen check. The warp and weft patterns are both - 4white : 4black; 4white : 4red; 4white : 4black; 4white : 4black; 2white : 2black × 8; 4white : 4green; 4white : 4black; 4white : 4black; 4white : 4green; 2white : 2black × 8. The colour and weave effect repeats on 64 ends × 64 picks, but because of the double overcheck in red and green, the design repeats on 128 ends × 128 picks. It requires only four heald shafts to produce this fabric. The following figures show the close-up view of glen check fabric with weave plan.



Close-up view of Glen check fabric



Weave plan of Glen check fabric

FIGURING WITH EXTRA THREADS

Main Features:

A distinguishing feature of fabrics in which extra materials are employed is that the withdrawal of the extra threads from the cloth leaves a complete ground structure under the figure. The formation of a figure by means of extra threads thus does not detract from the strength or wearing quality of a cloth, except so far as the extra threads are liable to fray out, whereas in ordinary fabrics, in which the figure is formed by floating the weft or warp threads loosely, the strength of the cloth is reduced somewhat in proportion to the ratio of figure and ground.

One of the advantages of figuring with extra materials is that bright colours in sharp contrast with the ground may be brought to the surface of the cloth in any desired proportion. Pleasing colour combinations may thus be conveniently obtained, since the extent of surface allotted to the figuring colour may be readily proportioned in accordance with the degree of its contrast with the ground shade, without the latter being affected.

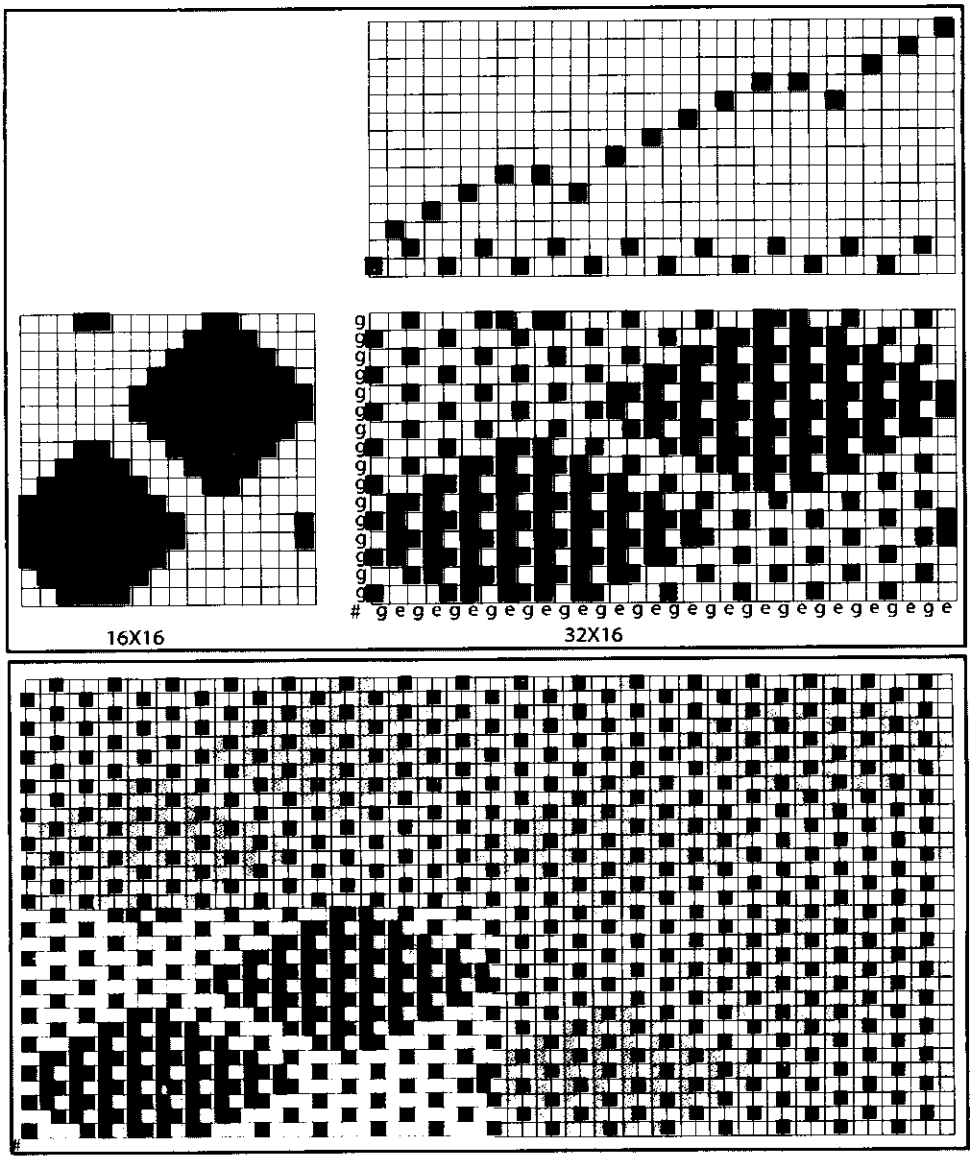
Methods of introducing extra figuring threads:

The extra threads may be introduced either as weft or warp, or the two methods may be employed in combination. When the extra material is introduced as warp then a separate beam is required for each warp on account of the different take – up rates between the extra and the ground ends. For extra weft figuring the weaving machine must have the capacity to insert more than one colour or kind of weft. The form of the design may render it necessary for the extra threads to be inserted in continuous order with the ground threads, or in intermittent order, while where they are introduced the arrangement of the figuring and ground threads may be 1-and-1, 1-and-2, 1-and-3 etc. according to the structure of the cloth and solidity of figure required. In extra weft figures, for looms with changing boxes at one side only, similar results to the 1-and-1 order may be produced by wefting 2-and-2; while the 2-and-4 order may be substituted for the 1-and-2, with, however, less satisfactory results as regards the solidity of the figure.

In this case extra warp and extra weft designs are presented by the following figures:

Comparison of extra warp with extra weft figuring:

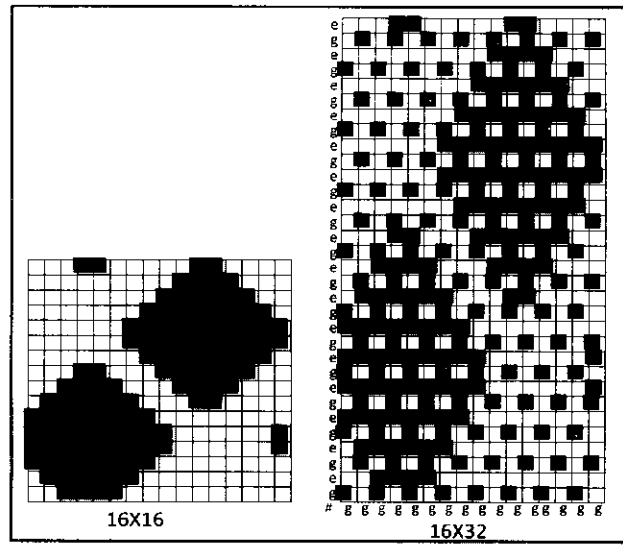
In extra warp figuring there are two or more series of warp threads to one series of weft threads, and the method has the following advantages and disadvantages, as compared with the extra weft principle.

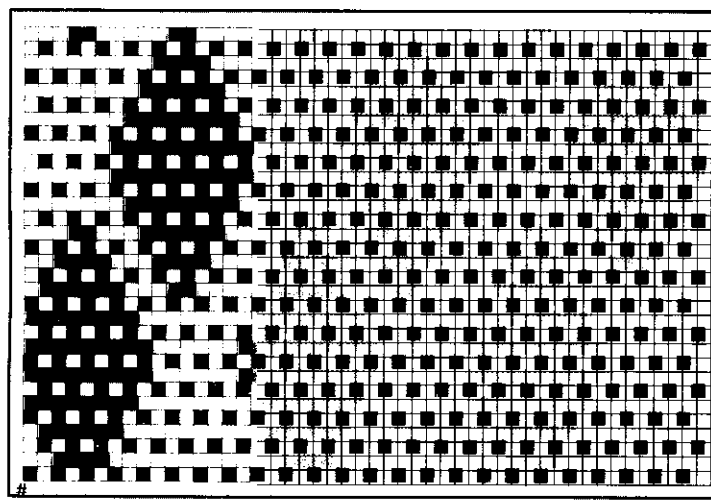


Extra warp design

Advantages:

- The productivity of a loom is greater because only one series of picks is inserted, and a faster running loom can be used.
- No special picking, box, and uptake motions are required.
- There is theoretically no limit to the number of colours that can be introduced.
- In an intermittent arrangement of the extra ends either spotted or stripe patterns can be formed, whereas a similar arrangement in the weft can only be used to form spots (except in special cases) because of the objectionable appearance of horizontal lines.





Extra weft design

Disadvantages:

- Two or more warp beams may be required instead of one.
- If an ordinary jacquard and harness are employed a smaller width of repeat is produced by a given size of machine, because the sett of the harness requires to be increased in proportion to the number of extra ends that are introduced in a design.
- In dobby weaving the drafts are usually more complicated.
- Stronger yarn is required for the figure, and the threads are not so soft, full, and lustrous; extra ends are subjected to greater tension during weaving than extra picks, and as a rule, there is less contraction in length than in width, and the result is that extra warp effects usually show less prominently than extra weft figures.
- If the extra threads have to be removed from the underside of the cloth, it is more difficult and costly to cut away extra ends than extra picks.

COMPOUND FABRICS

Some cloths are produced on the double cloth principle of construction but due to the deliberate absence of stitching between the layers become single cloths upon their removal from the loom. Two such constructions, the double width and the tubular cloth are described respectively in the following stages.

Tubular Cloth

Basic Principle:

A tubular fabric consists of two distinct face and back fabrics in which selvedges are joined, because the shuttle flies from left to right, inserting the face pick and then flies in the opposite direction, inserting the back pick. When the pick is inserted into the face fabric all the threads of the back warp should be lowered, and when the pick is inserted into the back fabric all the face warp threads should be raised.

While producing seamless bags, the shuttle inserts two face picks passing from left to right and from right to left. Then two back picks are inserted. As a result, only the left selvedges of the face and back fabrics are joined, forming the bottom of the bag. The sides of the bag are formed by making a short length of the double fabric and then again a whole width of the bag.

Uses of Tubular fabrics:

Tubular fabrics are used for making fire hoses, seamless bags and sacks, technical drying cloths, decorative and other cloths.

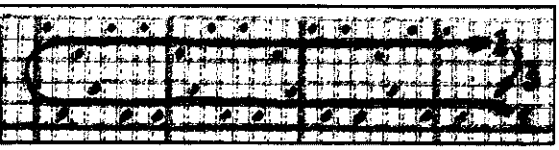
Typical weaves:

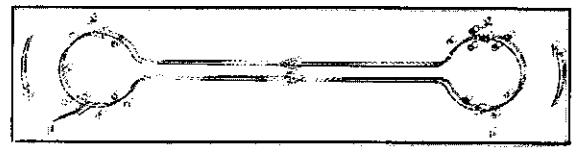
For constructing the tubular fabrics, the following weaves can be used as the bases:

Plain weave, hopsack $\frac{2}{2}2$, weft rib $\frac{2}{2}$, twill $\frac{2}{1}$ and twill $\frac{2}{2}$. The plain weave is most widely used.

Construction:

To construct this weave, two systems of warps, face and back ones, and two systems of wefts are necessary. Both warps are often wound on the same weaver's beam and the face and back picks are inserted by the same shuttle.

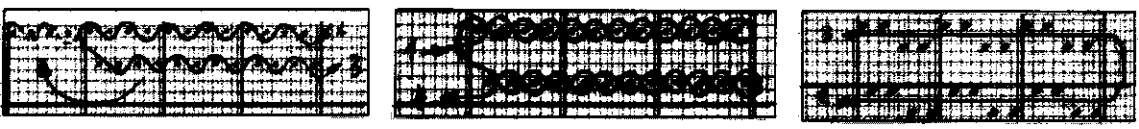




Tubular Cloth

Double width cloth:

If a tubular fabric is woven with a sequence 2 top picks – 2 bottom picks, a folded or double width fabric is produced where the two fabric layers are only joined together by the weft on one side. The other side remains open. Which is the open side depends on the pick sequence. Therefore, the point paper presentation of all folded fabrics must specify the sequence of weft insertion. At the edge where the weft passes from one fabric layer to the other, the continuity of the weave must be preserved.



Folded or Double width cloth

Multi-Ply Fabrics

Basic principle:

The multi-ply fabric consists of three or more fabrics woven one above the other and stitched together. From three to eight layers are used. A narrow eight-ply fabric is applied for making the Industrial belts.

Construction principle:

The multi-ply weave can be constructed, if either longitudinal section or cross section is given. The longitudinal section of a three ply weave is shown in the following figure. The warp repeat of this weave is 6 and the weft repeat, 12.

The sequence of warp threads at the diagram corresponds to that in the reed. The numbers of the picks correspond to the sequence of their insertion in the fabric. Thus there are three systems of warps, i.e. the face, the centre and the back, and the same number of the weft systems. The multi-ply fabric consists of three fabrics, the weave of which is plain.

Stitching system:

The stitching without using extra systems can be effected by the following five methods:

- From face to centre and from centre to back.
- From back to centre and from centre to face.
- From back to centre and from face to centre.
- From centre to face and from centre to back,
- Combination stitching.

In the example of figure A the stitching is effected from back to centre and from centre to face. The stitching of the face and centre fabrics is done by interlacing the centre warp thread 3 with the face weft thread 4, and the stitching of the centre fabric and the back one, by interlacing the back warp thread 6 with the centre weft thread 8.

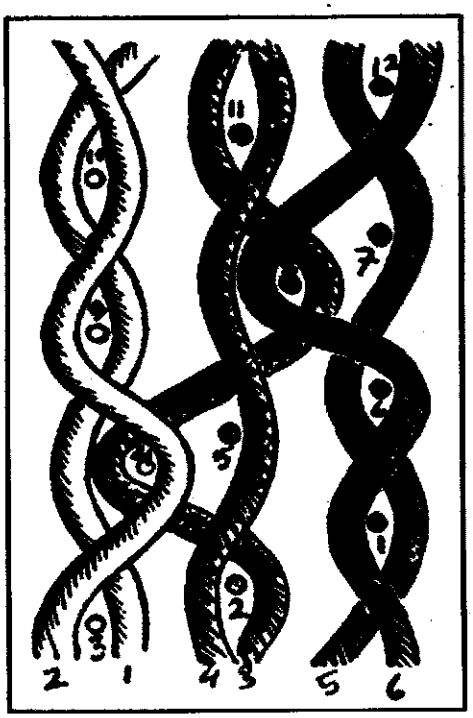


Figure - A

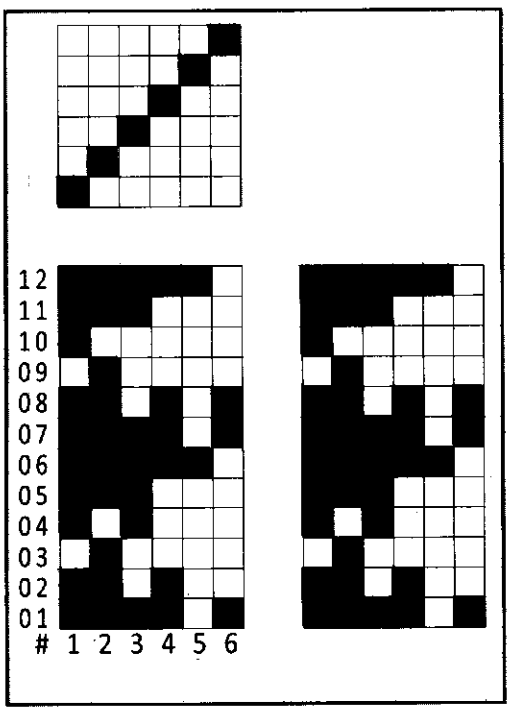


Figure - B

The diagram of weave at B is constructed by studying the position of each weft thread relatively to the warp threads. For example, the warp threads 1,2,3,4 are placed above the weft thread 1 and the warp thread 5 is placed below this weft thread at A. That is why, 5 warp overlaps are marked at B by painted squares, they are 1,2,3,4,6 and one weft overlap, by a blank square. In such a manner the diagram of weave at B has been constructed.

For producing this fabric six heald shafts are necessary with straight draft of warp threads. More often 6 threads are drawn in one dent of the reed.

STITCHED DOUBLE CLOTHS

Introduction:

Double cloths are fabrics in which there are at least two series of warp and weft threads each of which is engaged primarily in producing its own layer of cloth, thus forming a separate face cloth and a separate back cloth. The two layers may be only loosely connected together in which case each may be readily identified as a different entity or they may be so intricately stitched or tied together that they appear to form a complex single structure.

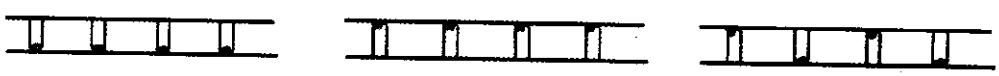
The purpose of the construction may be entirely utilitarian, such as the improvement of the thermal insulation value of a fabric in which a fine, smart face appearance is necessary; or it may be aesthetic in intention for which purpose the existence of two series of threads in each direction improves the capacity for producing intricate effects dependent upon either colour, or structural changes.

Classification of Double cloths:

Most of the double cloths can be classified under well defined headings and the following list gives the principal structural types with the simple schematic diagrams in the figure illustrating the basic principle of each construction.

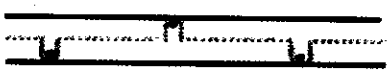
1. **Self-stitched double cloths:**

   These fabrics contain only the two series of threads in both directions and the stitching of the face cloth layer to the back layer is accomplished by occasionally dropping a face end under a back pick, or, by lifting a back end over a face pick, or, by utilizing both of the above systems in different portions of the cloth. This type of structure and the three different methods of stitching are illustrated at the following figures.



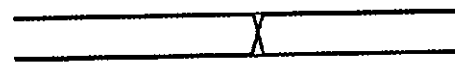
2. **Centre-stitched double cloths:**

   In these fabrics a third series of threads is introduced either in the warp or in the weft direction whose entire function is to stitch the two otherwise separate layers of cloth together. The centre threads lie between the face and the back cloth and for the purpose of stitching oscillate at regular intervals between the face and the back thus achieving the required interlayer cohesion as shown at the following figure.



3. Double cloths stitched by thread interchange:

These structures are similar to the first category in as much as they do not contain an additional series of stitching threads. However, they are distinguished from the self stitched fabrics by the fact that the stitching of the face and the back cloth is achieved by frequent and continuous interchange of some thread elements between the two cloth layers. Thus, in some portions of the cloth the face ends may be made to inter-weave with the back picks and the back ends with the face picks as illustrated schematically at the following figure. The point at which the threads interchange represents the stitch point.



4. Double cloths stitched by cloth interchange:

In this class of constructions the principle of the interchange is taken one stage further than in the third category and complete cloth layers are made to change places as shown at the following figure. As stitching between the two fabrics occurs only at the point of cloth interchange the degree of cohesion in this type of cloth depends on the frequency of the interchange.

5. Alternate single-ply and double-ply construction:

In some fabrics the constituent thread components are occasionally merged together into a heavily set single cloth and occasionally are separated into distinct layers to form figure areas of open double cloth on the firm single cloth ground. Usually, the effect depends upon a degree of distortion as the crammed single cloth areas tend to spread out, thus affecting the appearance of the double cloth 'pockets'. A cloth of this type is shown at the following figure.

Points to be considered before going to construction a double cloth as follows:

1. Relative proportions and thicknesses of the face and back threads:

These are decided mainly by the weight to be added to the face texture, but the order of arrangement of the weft threads is determined partly by the weft insertion of the loom. The most common varieties of double cloths are arranged in warp and weft 1

face, 1 back and 2 face, 1 back. For looms with boxes at one side only, and when the back weft is different from the face weft, similar effects may be obtained in many weaves by changing the wefting to 2 face, 2 back and 4 face, 2 back, respectively. Cloths which require a very fine face are sometimes arranged 3 face, 1 back in warp and weft. The threads may also be arranged in a mixed order, i.e. 1 face, 1 back in warp and 2 face, 1 back in weft and vice versa. Or 2 face, 1 back in warp and 2 face, 2 back in weft. Irregular arrangements such as 5 face to 4 back (FBFBFFBFB) and 7 face to 5 back (FBFFBFBFFBFB) are also employed, and these are occasionally useful as they admit of relative proportions of face backing threads being used which cannot be obtained in any of the regular bases.

In deciding on the relative thicknesses of the face and back yarns, a good rule to follow is to have the relative counts about proportionate to the relative numbers of the threads per unit space. In a 1 face, 1 back double cloth the back yarn should be similar to, or not much thicker than the face yarn. In 2 face to 1 back, the back yarn may be proportionately thicker, or say, from 2/3 to ½ thicker than the face yarn. If the same weave is used on both sides of the cloth the back threads may be 3 or 4 times as heavy as the face threads in the 2-and-1 arrangement, especially when centre threads are employed for stitching.

2. Selection of the face and back weaves:

When the threads are arranged in equal proportions the back weave is usually the same as the face weave, or contains about the same relative number of intersections, as, for instance, the 2-and-2 twill is suitable for backing the 3 up, 2 down, I up, 2 down twill. In other arrangements the backing weave is, as a rule, made with a relatively greater number of intersections than the face weave in order to compensate for the reduced number of threads. In the 2 face, 1 back arrangement, the plain weave is suitable for backing the 2-and-2 twill and the 2-and-2 hopsack; the 2-and-1 twill for backing the 3-and-3 twill; and the 2-and-2 twill for backing the 4-and-4 twill. In the making of cloths with a fine, smart face and soft back, the same weave may be used, in the 2-and-1 arrangement, for both the face and back textures. For a similar type of cloth in a 1-and-1 arrangement of the threads, a looser back than face weave may be employed. The most regular effect is obtained by having the repeats of the face and back weaves equal, or one a multiple of the other. For example, the 1-and-3 twill is unsuitable for backing the 2-and-3 twill unless the threads are arranged irregularly in the proportion of 5 face to 4 back threads.

3. Tying or stitching:

The stitching of the back and face fabrics of the double cloth can be effected in five ways. In the first three methods the threads of layers are used for stitching. In two other

methods the extra system either of warp or weft is introduced, which lies between the face and the back fabric, stitching them.

a. The first method which is called the stitching from face to back is carried out by lowering the face warp below the back weft. If the stitching is achieved by dropping a face end under a back pick both these elements must be away from their respective surfaces.
b. The second method is called the stitching from back to face and is carried out by raising the back warp above the face weft. When the method of stitching involves raising the back warp over the face picks then the back end can be used for tying only when it is away from the underside of the back cloth and the pick over which the tie is made must be away from the face of the top cloth. A stitch made in conformity with the above two conditions is invisible on either side of the double cloth.
c. The third method, i.e. the combination stitching, is that when the stitching from back to face and from face to back are applied simultaneously. The warp of each fabric is included in the shed of the other fabric.
d. The fourth method is called the stitching with an extra warp. It occurs when the face and back fabrics are stitched together by extra warp and there is no interlacing of the threads of the face fabric with those of the back fabric. Three systems of warp and two systems of weft are used in this case. It is necessary to distinguish the extra stitching warp from the extra stuffer warp, the threads of which can also lie between the face and back fabrics without interlacing with the weft threads.
e. The fifth method is called the stitching with an extra weft. In this case, the face and back fabrics are stitched together by extra weft which binds the face and back warps. The fabrics are held together only by extra weft threads. For increasing the mass of the fabrics, stuffing weft threads can be introduced between the fabrics. When the extra weft threads differ in count or type of fabrics, the loom should be equipped with a multi-shuttle mechanism.

4. **The construction of the point paper design:**
5. **The beaming, drafting, the construction of the pegging or lifting plans, cross-section and longitudinal section.**

Selection of suitable stitching positions:

In double cloths the stitches joining the two fabrics together, if correctly placed, have no effect on the appearance of either the face or the underside of the cloth. The method of tying which is the more suitable is, in some cases, determined by the character of the face weave. If a warp satin, or a warp-faced twill weave is employed for the face fabric, tying by lifting the back warp only is suitable; while in the case of a weft sateen or a weft-faced twill weave, it is only advantageous to tie by dropping the face ends. When there is a choice of the two methods,

other things being equal, the former method is usually preferable, as the back warp is less liable to show on the face than the back weft, which in the latter system is pulled upwards.

Using the system of tying in which the back ends are raised for stitching over the face picks it may not be possible to realize the above assumption with some weave combinations and some face to back thread ratios because for perfect placement of the tie the following four conditions must coincide:

1. The back end must be at that point away from the underside of the back cloth.
2. It must 'surface' between two long warp floats of the face weave.
3. The face pick over which the back end is raised must be absent from the surface of the face cloth.
4. It must be only pulled down at a point at which its penetration into the back cloth level is covered by two adjacent weft floats on the underside of the back fabric.

Clearly, in some circumstances it will not be possible to achieve the simultaneous coincidence of all the four conditions.

Similarly, when the face ends are lowered for stitching under the back picks:

1. The face end at that point must be absent from the surface of the face cloth.
2. It must be lowered at a point at which two long back warp floats cover it on the underside of the back cloth.
3. The back pick at the tie point must be away from the underside of the back cloth.
4. It must penetrate towards the surface at a point at which it will be covered by two adjacent face weft floats on the surface of the face cloth.

Again, the simultaneous coincidence of the conditions may not, in some cases, be possible.

If it is conceded that the conditions (1) and (3) in each system of tying are absolutely compulsory then a certain degree of freedom must be accepted with regard to the conditions (2) and (4).

Construction Principle:

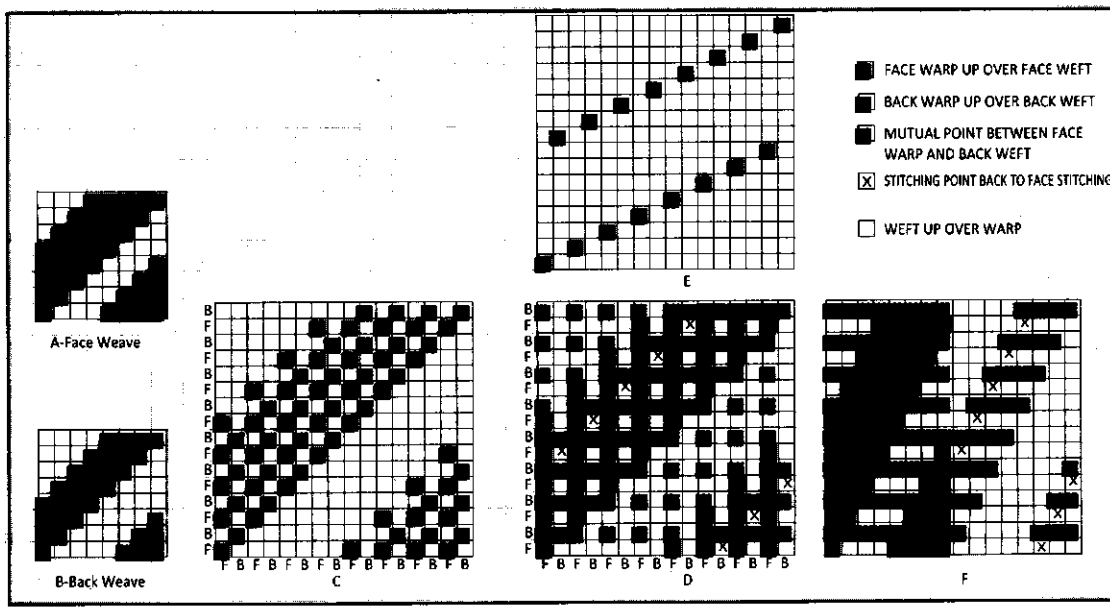
Self stitch double cloth:

There is no need to separate stitching thread. The threads of the face and back cloth are used for stitching. There are three types of self stitch double cloth, such as -

Double cloth produced by back to face stitching system:

In order to prevent confusion the different stages in working out a double cloth design should be represented by different kinds of marks, as shown in the following figures, which illustrates, step by step, the construction of a $\frac{5}{3}$ twill and $\frac{4}{4}$ twill structure in which the ends and picks are arranged 1 face, 1 back. A and B represent the face and

the back weave respectively. At C an area equal to one repeat of the double weave is marked out with the order of arrangement of the face ends and picks and the back ends and picks indicated clearly at the margins. C shows the first stage of actual double cloth construction which may be defined as: Insert the face weave on the face ends and face picks only, according to the original design. The second stage is similar except that it refers to the back weave: Insert the back weave on the back ends and picks only, according to the original design.



D shows the marks for the separating lifts which ensure that each series of yarns weaves only with its own kind and this may be stated as: Lift all face ends on back picks. Similarly, to complete the sequence, all back ends must be left down on all face picks which means an absence of marks, i.e. all back ends down on face picks. These are called mutual points.

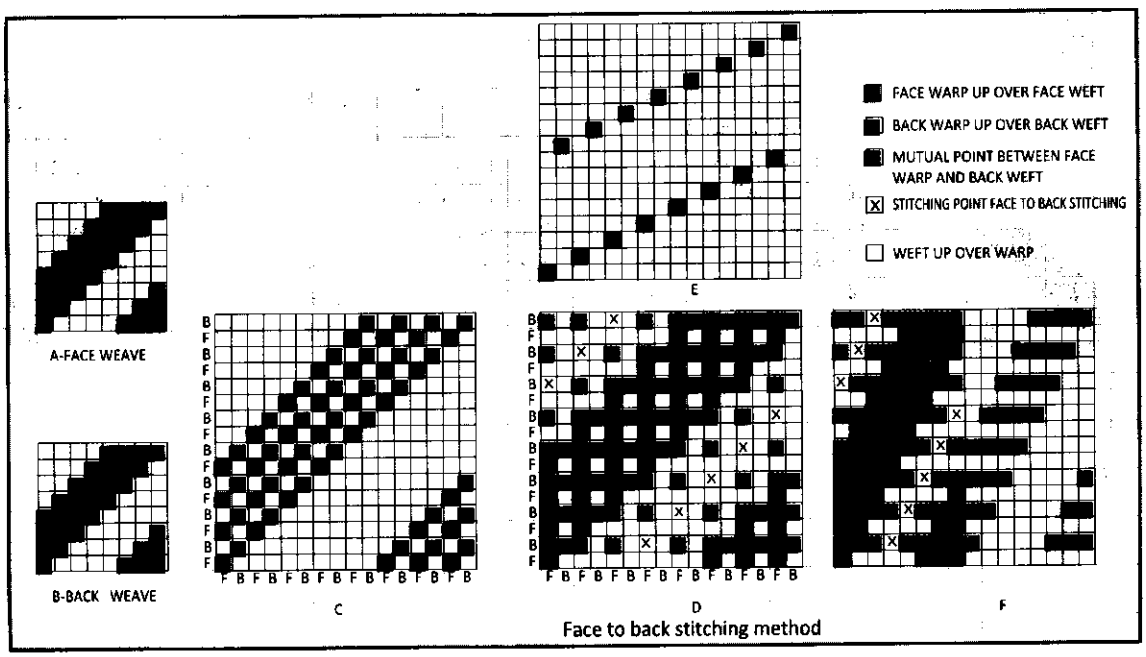
D also represents a stage in which two separate fabrics are produced one above the other. As there is no particular reason for producing two disconnected cloths in this manner, it will be realized that this stage is the intermediate point in the construction reached prior to the insertion of stitches or ties to bind the two cloths together. Before the stitch marks are inserted it must be decided which method of stitching is to be used and how frequently the cloths are to be stitched.

Assuming that it is required to stitch by lifting the back ends on the face picks and that each back end is to stitch once in the repeat, the correct positions of the ties are shown

by the crosses at figure D. The following figure D represent the final weave plan and figure E represent the drafting plan and figure F represent the lifting plan.

Double cloth produced by face to back stitching system:

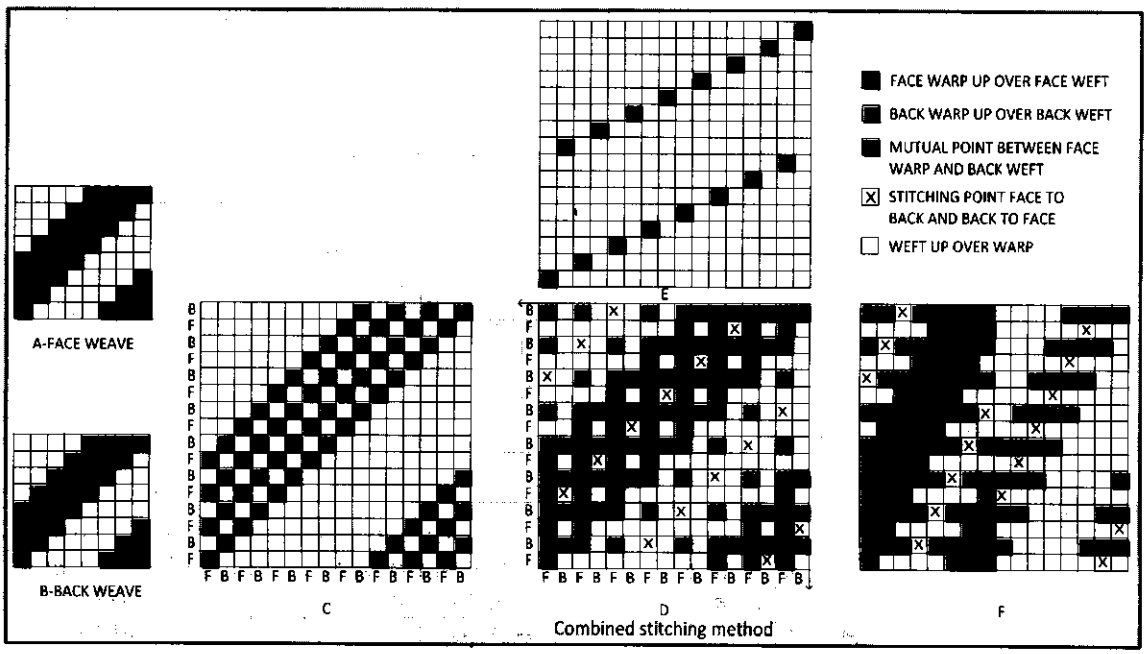
The construction principle is same like as previous one. In this case face and back weaves both are same $\frac{4}{4}$ twill weave. The second stitching method is used here, i.e. stitching by dropping the face ends on back picks. As in the previous system, one stitch per repeat is made, only in this case the face ends and not the back ends are used for the purpose. The following figure shows the weave plan (D) of a double cloth based on same two $\frac{4}{4}$ twill weaves with face to back stitching method. The figure E and F represents drafting and lifting plan of this weave respectively.



Double cloth produced by combined stitching system:

The construction principle is same like as previous one. In this case face and back weaves both are also same $\frac{4}{4}$ twill weave. The third stitching method i.e. the combined stitching system is used here. Back to face and face to back both stitching systems are used. The following figure shows the weave plan (D) of a double cloth based on same two $\frac{4}{4}$ twill weaves with combined stitching method. The figure E and F represents drafting and lifting plan of this weave respectively.

Self stitching system is used to produced the above three structures of double cloth. Only 1:1 thread arrangement is used for both face and back weave described above. It is noted that the different arrangement of threads are also used such as – face warp : back warp = 2:1, face warp : back warp = 2:2, face warp : back warp = 1:2 etc. Similarly the weft yarns are also arranged in different order. The thread arrangement may be same or different for warp and weft yarn. The repeat size of the final design is depends on this thread arrangement.



Wadded double cloth:

A wadded double cloth consists of a face and a back fabric, tied together by floating back ends on face picks, or face ends under back picks as in ordinary self-stitched double cloths, with the addition of a special series of weft or warp threads introduced independently of the face and back yarns. The warp-wadded cloths thus consist of three series of warp and two series of weft threads, while in the weft-wadded cloths there are three series of weft and two series of weft threads. The wadding threads lie between the two fabrics, and are visible neither on the face nor back; hence a thicker and cheaper yarn than that used for the face and back may be employed for wadding without the appearance of the cloth being affected.

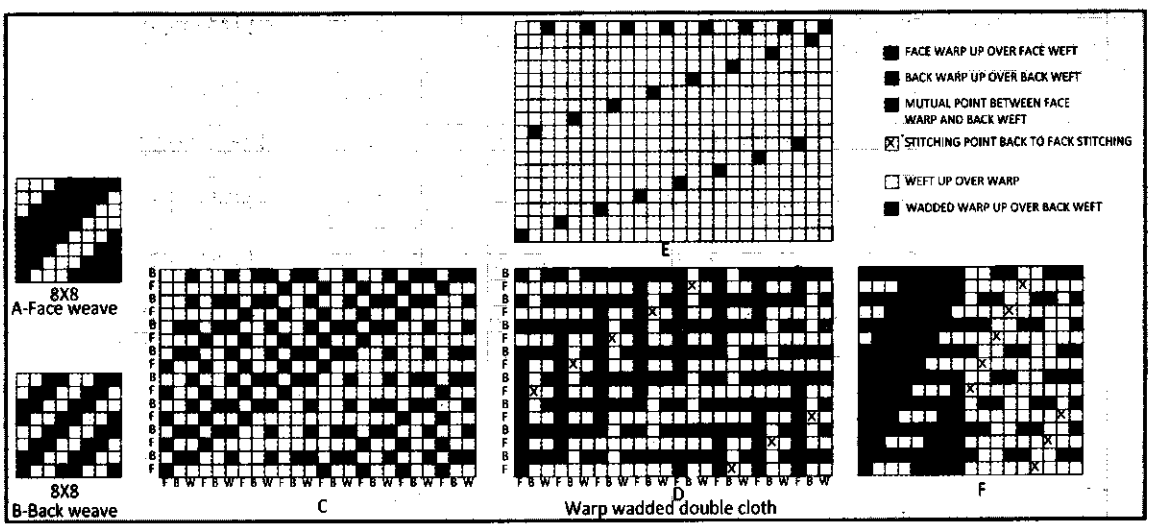
The type of construction is therefore useful in cases where increased weight and substance are required to be economically obtained in conjunction with a fine face texture. The wadding threads may be introduced into any arrangement of the face and back threads, but the

common proportions are 1 wadding to 1 face and 1 back, 2 face and 2 back, or 2 face and 1 back. The first arrangement is suitable when the wadding yarn is not so much thicker than the face yarn, and the second and third when very thick wadding is used.

Warp wadded double cloth:

The wadding yarn is more economically and conveniently introduced in the warp than in the weft but the greater strain put on the warp threads in weaving necessitates the use of a better quality of wadding material. The construction of the designs is illustrated in the following figure in which the face and back weaves are given at A and B respectively, while the complete design is given at D and the draft at E. The ends are arranged in the order of 1 face, 1 back, 1 wadding, and the picks 1 face, 1 back. The face weave is $\frac{5}{3}$ twill, the back weave is $\frac{2}{2}$ twill and a twill order for back warp tying lifts is used. In the warp wadded structures the wadding ends must be raised on all back picks and left down on all face picks.

Draft for the design D in the following figure is given at E. The wadding ends require only one heald, but in fine setts, to avoid crowding, they may be drawn on two or more healds which are then operated as one. The following figure F is the lifting plan of this weave.

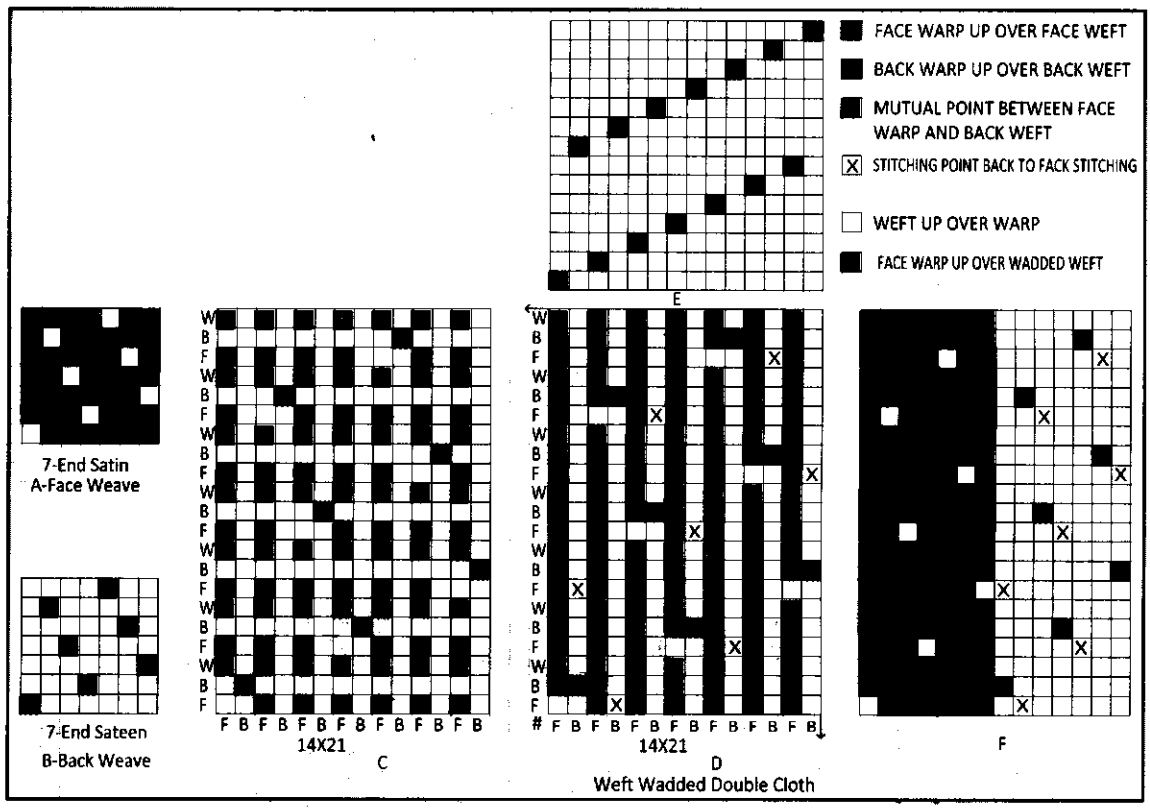


Weft wadded double cloth:

The construction of designs for these cloths is illustrated by the examples given in the following figure in which A is the plan of the face weave, and B of the back weave. Since the wadding yarn simply lies between the two fabrics without interweaving with either, the same conditions are necessary, so far as regards the face weave, the ties and the back weave, as in the construction of ordinary double cloths.

The wadded design is therefore exactly the same as the ordinary double design except for the inclusion of the wadding threads; and in order that comparisons may be made, the double weave with the wadding is given at C. In the complete design, given at D the crosses indicate the ties (back warp up on the face picks). It will be noted that in weft wadded structures all face ends are up. And all back ends are down, on wadding picks.

In the following example the picks are arranged in the order of 1 face, 1 back, 1 wadding; and the ends 1 face, 1 back. The 7-end satinette weave, warp surface on both sides of the cloth, is employed, the tying being effected by raising the backing ends in a sateen (3-move) order over the face picks. The following figure E and F represents the drafting and lifting plan respectively.



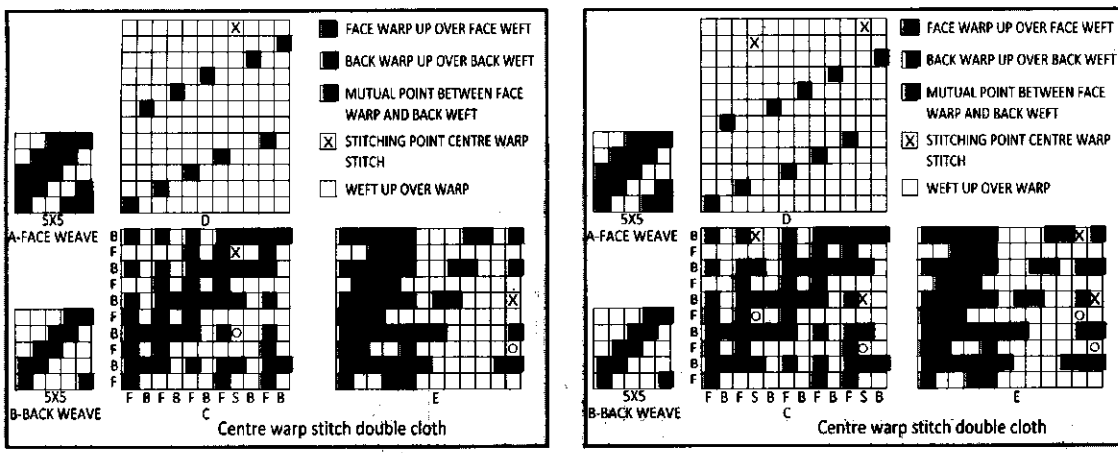
Centre stitch double cloth:

In wadding a double cloth the chief object is to get a heavy structure by introducing a yarn which is usually thicker and cheaper than the face and back yarns. In centre stitching, however, although the threads may be introduced in the same order as in wadding, and additional weight thereby be obtained, the specific purpose is to bind the two fabrics together with the centre threads, which as a rule are finer than either the face or backing threads. In this system the threads of one fabric do not interweave with those of the other fabric; the centre threads oscillate between one and the other, and lie between them when not employed for tying. The

two fabrics are less firmly united than with the self-stitching, and the cloth has a softer and fuller handle. The stitching threads may be used as warp yarn or weft yarn.

Centre warp stitch double cloth:

The plans in the following figure are illustrative of the construction of double cloths arranged 1 face, 1 back, in which the two fabrics are stitched together by means of centre warp. The design C (left side) is a double 5 × 5 twill, the face weave $\frac{3}{2}$ twill being as at A, and the back weave $\frac{2}{3}$ twill as at B, while the ends are arranged in the proportion of 5 face and 5 back to 1 stitching, as indicated at C (left side).



Centre warp stitch double cloth

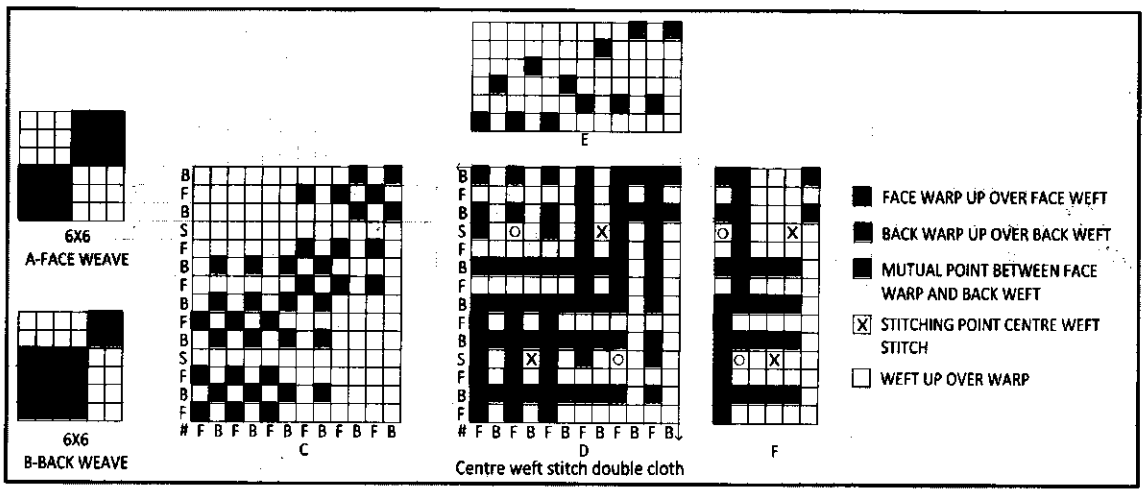
As each repeat of the double weave given at C (left side) contains only one stitching end, the ties always occur in the same line, both on the face and back of the cloth. A better arrangement is given in the design C (right side), in the above figure, in which the ends are in the proportion of 3 face and 3 back to 1 stitching; 2 face and 2 back to 1 stitching. The face weave and the back weave are the same as in the design C (left side). In this case there are two stitching ends in one repeat of the double weave, which not only causes the fabrics to be more firmly united, but enables an alternate distribution of the ties to be made. The figure D and E represents the drafting plan and lifting plan respectivelyof this weave plan.

Centre weft stitch double cloth:

This type of stitching is not very often used as it reduces the rate of cloth production. This is due to t-he fact that when the centre weft picks are introduced the take-up must be rendered inoperative and thus the picks do not contribute to the length of cloth being produced. In constructions in which the use of centre stitching threads is essential it is, therefore preferable to use the centre warp stitches. However, there are some situations which make it necessary

to use the centre weft and one reason for the use of this method occurs when all the existing jacks in a dobby are required to operate the face and the back healds and none are left to control the centre warp ends. Occasionally the centre weft is also used if the mounting of an extra beam required by the centre warp threads presents a particular difficulty in respect of the control or access to the warp yarns.

The plans A to D in the following figure illustrate the principle of stitching by means of centre weft. The double 6 × 6 matt weave is employed, the face weave $\frac{3}{3}$3 being given at A, and the back weave $\frac{4}{2}$(4+2) at B. The picks are in the proportion of 3 face and 3 back to 1 stitching as indicated at D, one repeat of the double weave thus containing two centre picks. The complete design is given at D. The following figure E and F represents the drafting plan and lifting plan respectively of this weave plan.



End uses:

Double cloths are used as different types of decorative cloth such as – sofa cover, furnishing cloth, curtain fabric, bed cover, pillow cover, and other home textile, etc. It is also used for the production of winter garments, quilts, belts, different types of industrial fabrics etc.

FABRIC USED IN APPAREL SECTOR

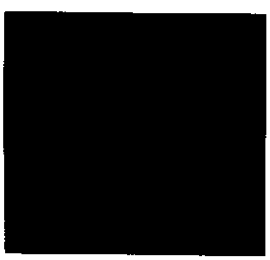
Fabric based on Plain weave:

1. **Georgette:** It is made with filament yarns. In georgette, the direction of the crepe twist (S or Z) for warp and weft yarns alternates. For example, even-numbered warp and weft yarns may be S-twist and odd-numbered yarns may be Z-twist. It can be a solid colour or printed. It is very light weight, drape well, and is used in apparel. It was originally made of silk but now often is made from manufactured filament yarns.

2. **Chiffon:** It is made from fine, highly twisted filament yarns. Because of the tightly twisted crepe yarns, chiffon has excellent drape, very light weight, and although it is delicate in appearance, it is relatively durable. It can be a solid colour or printed. It was originally made of silk but now often is made from manufactured filament yarns. Sheer evening dresses, blouses, lingerie, and other dressy apparel are constructed from the fabric.

3. **Voile:** Voile is a sheer fabric made with high twist or voile twist spun yarns that are combed or worsted. It is a soft fabric with some what lower fabric count and has a distinctive two ply warp and good drapability. It can be solid colour or printed. Voile was originally a cotton or wool fabric, but it is now available with many fibre contents.

4. **Organdy:** It is the sheerest cotton fabric that is given a temporarily or permanently stiffened finish. Combed yarns contribute to its sheer appearance. Its sheerness and crispness are the result of an acid finish on lawn gray goods. Because of its stiffness and fibre content, it is very prone to wrinkling. It is used for curtains and for summer weight apparel. It is available in solid colours or prints. Fabric construction: similar to lawn fabric.


Georgette


Chiffon


Voile

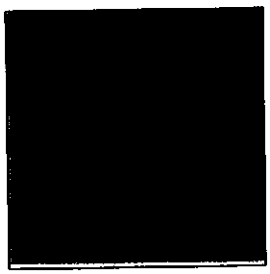

Organdy

5. **Organza:** It is the filament yarn counterpart to organdy, i.e. it is also a stiff sheer fabric made of filament yarns. It has a lot of body and a crisp hand. It is also used for curtains and for summer weight apparel. It is available in solid colours or prints.

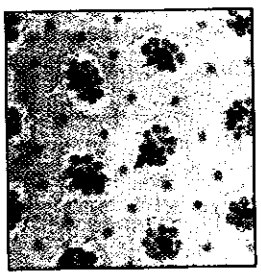
6. **Lawn:** It is a fine, opaque, light weight, plain weave fabric usually made of combed cotton or cotton-blend (cotton/polyester). The fabric may be bleached, dyed or printed. Lawn is similar to organdy fabric, but it does not receive the acid finish like as organdy and, thus, remain opaque. Fabric construction:

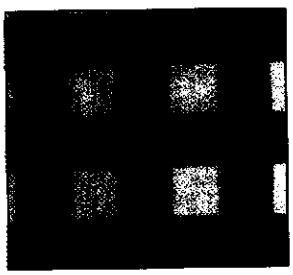
$$\frac{70' s \times 100' s}{80 \times 80}$$

7. **Batiste:** It is an opaque, light weight, spun yarn, plain weave fabric with a smooth surface. It is the softest of the light weight opaque fabrics. When made of cotton or cotton/polyester, the yarns are usually combed. It can be made of all wool, silk or rayon. Batiste also is similar to organdy fabric, but it does not receive the acid finish like as organdy and, thus, remain opaque. Fabric construction: similar to lawn.


Organza


Lawn


Batiste


Gingham

8. **Gingham:** It is a yarn dyed, plain weave fabric that is available in a variety of weights and qualities. It may be balanced or unbalanced and of combed or carded yarns. If two colours of yarns are used, the fabric is called a check or a checked gingham. If three or more colours are used, the fabric is reffered to as a plaid gingham. It is usually made of cotton or cotton blends. Better quality fabrics are made with combed yarns. When they are made of another fibre, the fibre content is included in the name; for example, silk gingham. Fabric construction:

$$\text{Carded : } \frac{28' s \times 42' s}{64 \times 60 \text{ TO } 64 \times 76}$$

$$\text{Combed: } \frac{28' s \times 42' s}{84 \times 76 \text{ TO } 88 \times 84}$$

9. **Chambray:** It is a plain weave fabric, usually of cotton, rayon, or blended with polyester. Usually chambray has white yarns in the weft direction and coloured yarns in the warp direction. Iridescent chambray is made with one colour in the warp and a second colour in the weft. It can also be made with stripes

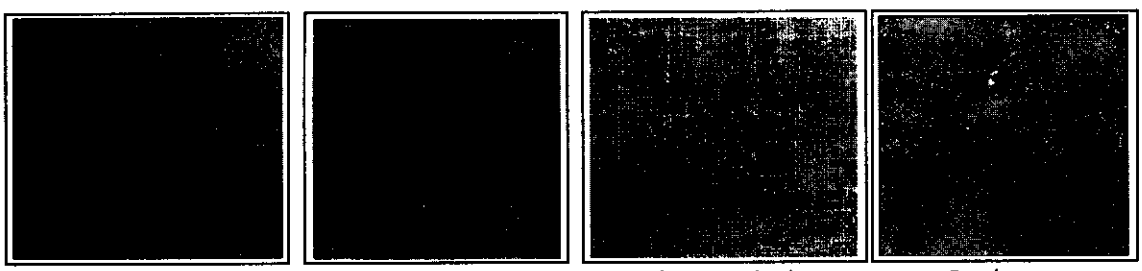
10. **Taffeta:** It is a general term that refers to any plain weave filament yarn fabric with a fine, smooth, crisp hand. Unbalanced taffeta has a fine rib made by heavier filling yarns and more warp yarns. Faille taffeta has a crosswise rib made by using many more warp yarns than weft yarns. Moir'e taffetas have an embossed water mark design. Balanced taffetas have warp and weft yarns of the same size. Iridescent taffeta has warp and weft yarns of different colours.

11. **Madras:** It is usually all cotton, and has a lower count than gingham. Madras gingham or madras shirting is a light to medium-weight, dobby weave fabric in which the pattern is usually confined to vertical stripes.

12. **Cheese cloth:** It is a light, sheer, plain woven fabric with a very soft texture and a very low count. It may be natural coloured, bleached, or dyed. If dyed, it may be called bunting and could be used for flags or banners.

13. **Crinoline:** It is a stiff, spun yarn, plain weave fabric similar to cheese cloth, used in book bindings, hats and stiffening for apparel. It is heavily sized to serve as stiffening fabrics.

14. **Buckram:** It is heavily sized to serve as stiffening fabrics. Buckram is a heavy, very stiff, spun yarn fabric converted from cheese cloth gray goods with adhesives and fillers. It is used as an interlining to stiffen pinch pleated window treatment fabrics.



Taffeta Madras Cheese cloth Buckram

15. **Gauge:** It is a sheer, light weight, low count, plain or leno weave balanced fabric made of spun yarns. It is often cotton, rayon, or a blend of these fibres. Gauge, with a higher count than cheese cloth, is used in theatrical costumes and medical dressings, as well as for blouses and dresses. Indian gauge has a crinkled look and is available in a variety of fabric weights.

16. **Ninon:** It is a sheer, slightly crisp, light weight, plain weave fabric made of filament yarns. The warp yarns are grouped in pairs, but it is not a basket weave fabric. It is widely used in sheer curtains and draperies. It is usually 100 percent polyester because of that fibre's resistance to sunlight, excellent resiliency, and easy washability. Although ninon is a plain weave, warp yarn spacing is not uniform across the fabric. Pairs of warp yarns are spaced close to each other. The space between adjacent warp yarn pairs is

greater than the space between the two yarns in the pair. Ninon has medium body and hangs well.

17. **Calico:** It is a closely woven and print cloth of cotton or cotton blend with a small busy pattern.

18. **Cambric:** It is a fine, firm, starched plain weave balanced fabric with a slight luster on one side. It is difficult to distinguish from percale.

19. **Percale:** Percale is a smooth, slightly crisp, printed or plain coloured fabric. It is a closely woven, plain weave of cotton or blended fibres, is made from yarns of moderate twist. Percale yard goods are generally carded, but percale sheets are finer and more luxurious in feel and are made of combed yarns. In percale bedsheets, counts of 160, 180, 200, and 250 yarns (warp plus weft) per inch are available. Percale is called calico if it has a small, quaint, printed design; chintz if it has a printed design; and cretonne if it has a large scale floral design. When a fabric is given a highly glazed calendar finish, it is called polished cotton. When chintz is glazed, it is called glazed chintz. Glazed chintz is made in solid colours as well as prints. These fabrics are often made with blends of cotton and polyester or rayon. They are used for shirts, dresses, blouses, pajamas, matching curtains and bedspreads, upholstery, slipcovers, draperies, and wall coverings.

20. **Muslin:** It is a firm, medium to heavy weight, plain weave cotton fabric made in a variety of qualities. It generally woven from cotton or cotton blends, is made in both heavily sized, bleached qualities and in better grades for sheets and pillow cases. Any plain woven, balanced fabric of carded yarns ranging in weight frow lawn to heavy bed sheeting may be called muslin. It is usually available in counts of 112, 128 or 140. Muslin is also a name for a medium weight fabric that is unbleached or white.

21. **Flannel:** It is a light to heavy weight, plain or twill weave fabric. Flannel is a suiting fabric of woolen yarns that is napped. It is used for women's suits, slacks, skirts, and jackets. Flannelette is a light to medium weight, plain weave cotton or cotton blend fabric lightly napped on one side. It can be found as both balanced and unbalanced fabrics. It is available in several weights ranging from 4.0 to 5.7 oz/yd^2. It is described as flannel and is used for sheets, blankets, and sleepwear. Outing flannel is heavier and stiffer than flannelette, it may be napped on one or both sides. It is used for shirts, dresses, light-weight jackets, and jacket linings. Some outing flannels are made with a twill weave. Both fabrics may be solid colour, yarn dyed or printed.

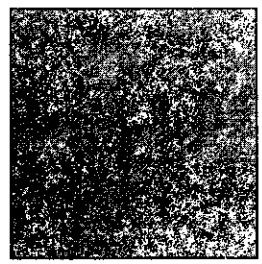
22. **Poplin:** Poplin is a bottom-weight rib weave (heavy weight ribbed fabrics) is usually made from cotton or cotton blends, polyester/cotton blends are widely used. It is a medium to heavy weight, unbalanced, plain weave, spun yarn fabric that is usually piece dyed. The weft yarns are coarser than the warp yarns. Poplin is similar to broad cloth, but the ribs are heavier and more pronounced because of larger weft yarns.

23. **Broad cloth:** It is a medium weight unbalanced plain weave with fine ribs. The rib weave makes it crisper than medium weight balanced weaves. It is often made from cotton or cotton blends.

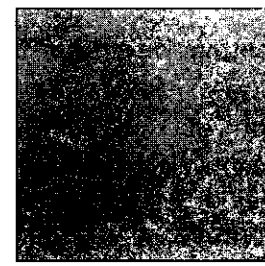
24. **Bengaline:** It is a lustrous, durable, warp faced fabric with heavy weft cords completely covered by the warp. It is heavy weight fabrics with large ribs, are used mostly in upholstery and furnishings.

25. **Bed ford cord:** It is found most often in furnishing fabrics such as bed spreads. It has spun warp yarns that are larger than the weft yarns. It is a sturdy fabric constructed with a pronounced lengthwise cord. Bed ford cord is a heavy, warp faced, unbalanced pique weave fabric with wide warp cords created by extra weft yarns floating across the back to give a raised effect.

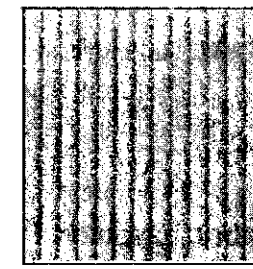
Calico



Flannel



Poplin



Bed ford cord

26. **Faille:** Failie has a prominent rib and is made with fine filament yarns in the warp and heavy spun yarns in the weft. It is usually heavy weight, although lighter weight tissue failles are also produced.

27. **Dimity:** Dimity is a sheer unbalanced fabric used for apparel and window treatments. It has heavy warp cords at intervals across the fabric. The cords may be formed by yarns larger than those used elsewhere in the fabric or by grouping yarns together in that area. Either technique produces the unique narrow band or stripe indicative of dimity. Dimity is white or printed.

28. **Oxford:** It is usually a 2×1 or 3×2 basket weave. It is most common as a 2×1 half basket weave. It may have a yarn dyed warp and white weft and be called oxford chambray. Oxford looks like a balanced fabric because the warp yarns are finer and have higher twist than the weft. Because of soft yarns and loose weave, yarn slippage may occur. Oxford fabrics are medium weight, soft, porous, and lustrous. It is often made of cotton or cotton blends, that is used for shirts. Frequently, it is made with narrow coloured stripes in the warp, or a coloured warp.

29. **Duck:** It is a strong, coarser, heavy, plain or basket weave fabric available in a variety of weights and qualities. It is similar to canvas. Duck is made with single or ply yarns. Different types of duck relate to which yarns (warp or weft) are plied and how many

plies are used in the ply yarn. Duck is used for slipcovers, boat covers, shoe fabrics, house and store awnings, tarpaulins and covers for military and industrial uses.

30. **Canvas:** It is a heavy, firm, strong fabric made of cotton or acrylic and used for awnings, slip covers, shoe fabrics, tarpaulins, and boat covers. It is produced in many grades and qualities. It may have a soft or firm hand. It is made in plain or basket weave. Canvas is smoother, more compact, and the heaviest of the three (Duck, canvas and sail cloth). It is tightly woven and very stiff plain weave fabrics made of even yarn for industrial use. They usually have an uneven weave pattern. Because of the tight weave, these fabrics are often used for outdoor purposes. It is made with single or ply yarns. Different types of canvas relate to which yarns (warp and weft) are plied and how many plies are used in the ply yarn.

31. **Sail cloth:** It is a bottom weight half basket weave (2×1), unbalanced fabric of spun or textured filament yarns that can be piece dyed or printed. Sail cloth is the lightest (among the sail cloth, duck and canvas) in weight and made of single yarns. It is used in slacks, skirts, summer weight suits, and furnishings.

Fabric based on Twill weave:

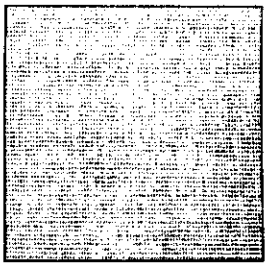
1. **Serge:** It is a popular basic twill fabric made from any number of different fibres. When serge is made from wool, it is often woven from worsted yarns. Serge will take a crease well, but wool serge tends to become shiny with wear. It tailors well. Serge is a $\frac{2}{2}$ twill with a subdued wale with combed or worsted yarns and a clear or hard finish (not napped or brushed). Serge with fine yarns, a high count, and a water-repellent finish is used for jackets, snowsuits, and raincoats. Heavier serge, with coarse yarns, is used for work pants. Serge often weighs 339.1 (10 oz/yd^2) gm/m^2 or more.

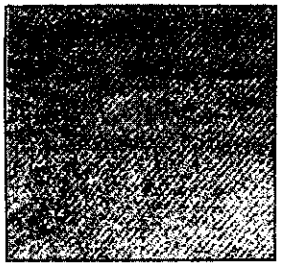
$$\text{Fabric construction: } \frac{\text{Yarn size varies with fibre content}}{\text{48X34 To 62 X58}}$$

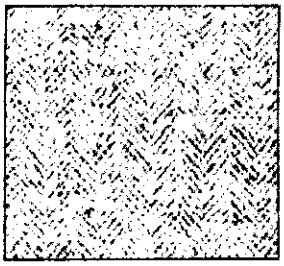
2. **Twill Flannel:** It is a $\frac{2}{2}$ twill. The weft yarns are larger low-twist woolen or worsted yarns, made especially for napping. Worsted flannels have less nap, take and hold a sharp crease better, show less wear, and sag less than woolen flannels. Even-sided flannel is used in apparel and upholstery.

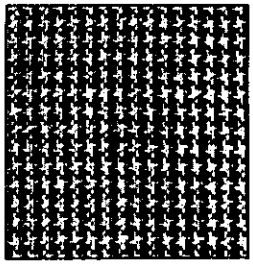
$$\text{Fabric construction: } \frac{\text{Yarn size varies with fibre content}}{\text{56X30 To 86 X52}}$$

3. **Shark skin:** It is a $\frac{2}{2}$ twill with a sleek appearance. It has a small-step pattern because both warp and weft yarns alternate one white yarn with one coloured yarns. Shark skin is used primarily for slacks and suits.


Oxford


Serge


Herring bone


Hound's tooth

4. **Herring bone:** This fabrics have the twill line reversed at regular intervals across the warp to produce a design that resembles the backbone of a fish, hence the name herring bone. Two different colour yarns may be used to accentuate the pattern. Herring bone patterns can be very subtle or very pronounced. Herring bone is used in both apparel and furnishings. These are common in suiting fabrics.

5. **Hound's tooth:** It is a $\frac{2}{2}$ twill fabric with a unique small eight-point pattern. Two yarns in contrasting colours in the warp and weft are used in groups of four to create the distinctive pattern. Hound's tooth fabrics also are used in apparel and furnishings.

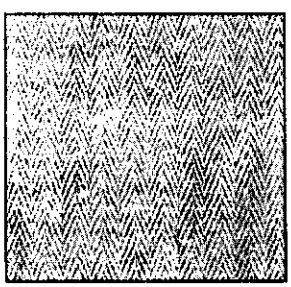
6. **Denim:** It is a cotton or cotton/polyester blend, durable heavy weight twill-weave, yarn-dyed fabric. Usually the warp is coloured and the weft is white. It is often a left-hand twill with a blue (indigo) warp and white weft for use in apparel in a variety of weights. Since it is a warp-faced twill, the coloured warp yarns predominate on the face and the white weft yarns on the back. It is available in several weights, ranging from 203.46 gm/m^2 (6 oz/yd^2) to 474.74 gm/m^2 (14 oz/yd^2) or more in a $\frac{2}{2}$ or $\frac{3}{1}$ interlacing pattern.

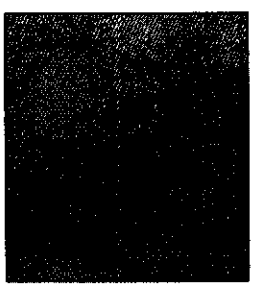
   Its long term popularity has made it a fashion fabric in casual wear. It may be napped, printed, made with spandex or other stretch yarns, or otherwise modified for fashion.

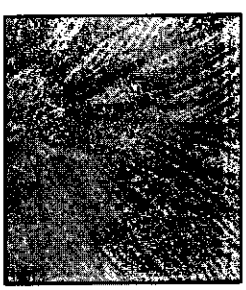
   Fabric construction: $\frac{\text{7' s to 16's X 8' s to 23's}}{\text{60X36 to 72X44}}$

7. **Drill:** It is a strong, medium-to-heavy weight, warp-faced, twill weave fabric. It is usually a $\frac{2}{2}$ or $\frac{3}{1}$ left handed twill and piece dyed (solid colour). It is usually seen in work clothing and industrial fabrics.


Denim


Drill


Gabardine


Damask

8. **Jean:** It is a warp faced twill of carded yarns. It is lighter weight than drill, and it has finer yarns but a higher warp-yarn count. It is usually with coloured warp yarns and white weft yarns. Jean is a piece-dyed also or printed medium-weight twill used for sportswear, draperies, slipcovers, and work shirts. Jean is not heavy enough for work pants.

$$\text{Fabric construction: } \frac{21\text{'s to } 24\text{'s X } 24\text{'s to } 30\text{'s}}{84\text{X}56 \text{ to } 100\text{X}64}$$

9. **Gabardine:** It is a tightly woven, medium to heavy-weight, warp-faced steep or regular-angle, twill weave fabric with a very prominent, distinct wale that is closely set together and raised. It always has many more warp than weft yarns. It can be made of carded or combed single or ply yarns. The long-wearing fabric may be heather, striped, plaid, or solid colour. The fabric can be wool, a wool blend, or synthetic fabrics that resemble wool. Gabardine can also be 100% texturized polyester or a cotton/polyester blend.

$$\text{Fabric construction: } \frac{15\text{'s to } 39/2 \text{ X } 15\text{'s to } 26\text{'s}}{\text{v}}$$

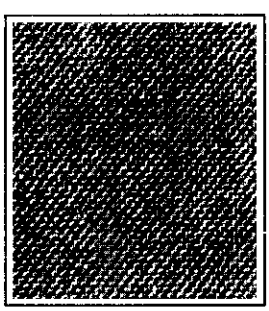
10. **Damask:** Woven fabrics made from expensive mercerized cotton for bed clothing and table cloths. The figured design often is made by interchanging satin and sateen weaves.

11. **Fil-à-fil:** $\frac{2}{2}$ twill weave fabrics in which light and dark colours alternate in both warp and weft, making a miniature staircase pattern. Used for suits and costumes.

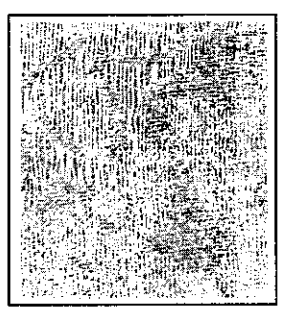
Brocade: Heavily figured jacquard fabric, often with lusture yarn effects. Used in formal wear and furnishings.

Corduroy: A cut pile cord, usually in cotton. The cords may be of various widths. Used mainly in leisure and business wear.

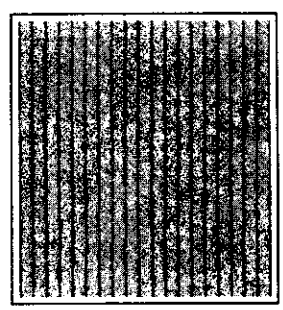
Mull: Soft, fine, open, plain weave cotton fabric with a very low thread density in both warp and weft. Used for blouses and squares.



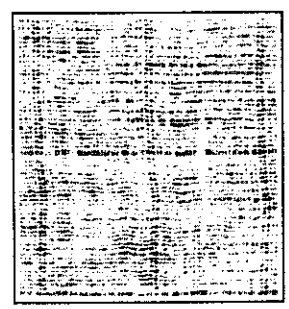
Fil-à-fil



Brocade



Corduroy



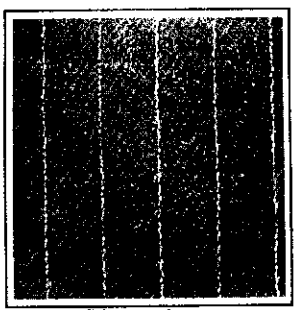
Mull

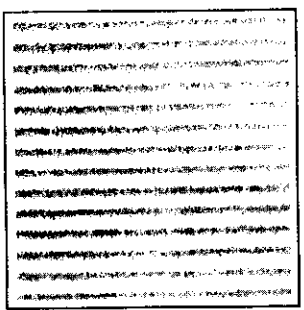
Pin stripe: Worsted woven fabric with fine light-coloured lines in the warp direction. Used for suits and costumes.

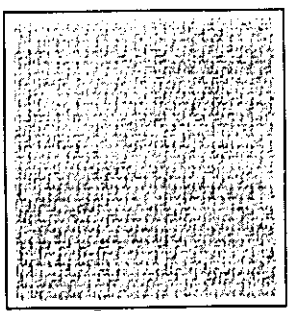
Ottoman: Warp-faced rib fabric with 3 to 10 ribs per cm for coats, jackets, and furnishings.

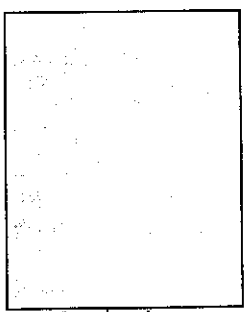
Panama: General term for a plain-based weave where two or more warp and weft yarns interlace as one, giving a chequered appearance. Made from cotton for shirts, tropical suits and leisure wear, or wool for suits and costumes.

Pocketing: Cotton plain woven fabric made smooth and dense by calendaring, for pocket linings.


Pin stripe


Ottoman


Panama


Pocketing

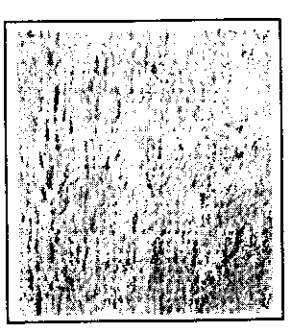
Seersucker fabric: Cotton fabric with crinkled length-way stripes caused by differential shrinkage. True seersucker is generated by differential warp tensions but finishing treatments can produce a similar effect. Used for blouses, shirts, dresses.

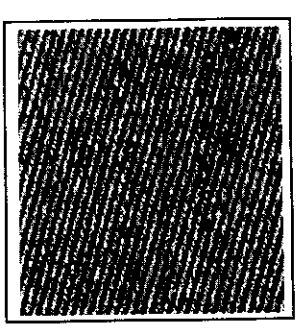
Amazon: Very fine, satin weave for business suitings with fine worsted warp yarns and woolen weft. A light milling or raising finish may be given.

Terry: A soft, voluminous, loop pile fabric. The loops are formed in a second warp sheet by a special weaving technique. Used for bath robes, towels, sports and leisure wear.


Seersucker fabric


Amazon


Terry


Whipcord

Whipcord: General term for densely woven warp-faced fabrics with a steep twill line. In worsted yarns with a clean finish for trousers, suits and coats.

Blazer cloth:
Traditionally an all-wool woven fabric for apparel, in either solid colours or stripes, that may be milled and/or raised. Imitation blazer cloths introduce cotton in the weft. The term may be used loosely for other fabrics for blazers.

Trouser:
Trouser is a long pant or full pant.

Fabric Construction or Specification:

The specification of some export oriented commercial fabrics those are produced in Bangladesh as follows:

Name of the fabric	Construction or Specification	Weight	Name of the fabric	Construction or Specification	Weight
Gabardine	$\frac{110 \times 51}{20 \times 16} \times 56"$	210 GSM	Twill fabric	$\frac{20 \times 7}{128 \times 42} \times 57\text{-}58"$	298 GSM
Gabardine	$\frac{72 \times 40}{20/2 \times 10} \times 56"$	270 GSM	Twill fabric	$\frac{7 \times 7}{72 \times 40} \times 57\text{-}58"$	380 GSM
Gabardine	$\frac{124 \times 70}{20 + 20 \times 16 + 16} \times 56"$	245 GSM	Twill fabric	$\frac{30 \times 30}{130 \times 70} \times 57\text{-}58"$	160 GSM
Gabardine	$\frac{108 \times 58}{40/2 \times 40/2} \times 56"$	200 GSM	Slub Twill	$\frac{16 \text{ (slub) } x9}{95 \times 48} \times 57\text{-}58"$	265 GSM
Gabardine	$\frac{80 \times 48}{(10+10) \times 10} \times 56"$	300 GSM	Herring bone Twill	$\frac{20 \times 20}{108 \times 58} \times 57\text{-}58"$	195 GSM
Gabardine	$\frac{116 \times 40}{20 + 20 \times 7} \times 56"$	285 GSM	Micro Twill	$\frac{150D \times 150D}{145 \times 80} \times 57\text{-}58"$	
Gabardine	$\frac{112 \times 54}{16 + 16 \times 12 + 12} \times 56"$	270 GSM	T.C. Twill	$\frac{45/2 \times 45/2}{128 \times 70} \times 57\text{-}58"$	
			Cotton y/d $\frac{2}{1}$ Twill	$\frac{80/2 \times 100/2}{142 \times 84} \times 58"/59"$	

Name of fabric	Construction or Specification	Weight	Name of fabric	Construction or Specification	Weight
Canvas	$\frac{10 \times 10}{72 \times 42}$ X 57-58"	260 GSM	Sheeting	$\frac{30 \times 30}{68 \times 68}$ X 57-58"	105 GSM
Canvas	$\frac{20 \times 16}{100 \times 50}$ X 57-58"	190 GSM	Calico	$\frac{16 \times 16}{60 \times 60}$ X 57-58"	180 GSM or 6.15 OZ
Canvas Panama	$\frac{16+16 \times 12+12}{108 \times 60}$ X 57/58"		Calico	$\frac{14 \times 14}{64 \times 58}$ X 57-58"	6.80 OZ
Slub canvas	$\frac{16(slub) \times 9}{80 \times 48}$ X 57-58"	260 GSM	Poplin	$\frac{30 \times 30}{104 \times 81}$ X 57-58"	
Light canvas	$\frac{30 \times 30}{108 \times 80}$ X 58/59"		Poplin	$\frac{40 \times 40}{133 \times 72}$ X 57-58"	
Ribstop	$\frac{20 \times 20}{108 \times 58}$ X 57-58"	195 GSM	Poplin	$\frac{40/2 \times 30}{74 \times 72}$ X 58/59"	
Ribstop	$\frac{20 \times 16}{96 \times 50}$ X 57-58"	193 GSM	Heavy poplin	$\frac{40/2 \times 40/2}{112 \times 50}$ X 58"/59"	
Nylon Fabric	$\frac{190\ T}{70D(24F) \times 70D(24F)}$ X60"		T/C(65/35) blended poplin	$\frac{45 \times 45}{133 \times 72}$ X 58"/59"	
Polyester Fabric	$\frac{95 \times 80}{70D \times 75D}$ X 60"		CVC(60/40) blended poplin	$\frac{45 \times 45}{136 \times 76}$ X 58"/59"	
Oxford	$\frac{210\ T}{70D \times 70D}$ X 58"		Premium poplin	$\frac{60 \times 50}{110 \times 76}$ X 58"/59"	
Polyester Concord	$\frac{95 \times 80}{450D \times 450D}$ X 58"		Premium poplin	$\frac{80/2 \times 80}{128 \times 98}$ X 58"/59"	
Mixed Oxford	$\frac{45sp\ X\ 16\ Cotton}{104 \times 60}$ X 57/58"		Premium poplin	$\frac{100/2 \times 100/2}{144 \times 91}$ X 58"/59"	
Micro Shirting	$\frac{75sp \times 100D}{112 \times 70}$ X 57-58"		Bedford Cord	$\frac{07 \times 07}{72 \times 42}$ X 57-58"	
Oxford (Yarn Dyed)	$\frac{72 \times 68}{30 \times 20}$ X 58/59"		Bedford Cord	$\frac{128 \times 72}{40 \times 40}$ X 58"/59"	
Cotton Oxford	$\frac{156 \times 64}{40 \times 80/2}$ X 58/59"		Flannel (Yarn Dyed)	$\frac{40 \times 40}{20 \times 10}$ X 42-43"	
Oxford	$\frac{60 \times 68}{40/2 \times 40/2}$ X 58/59"		Flannel (Printed)	$\frac{42 \times 44}{24 \times 13}$ X 42-43"	
Oxford (Yarn Dyed)	$\frac{144 \times 76}{80/2 \times 100/2}$ X 58/59"		Twill flannel(y/d)	$\frac{64 \times 54}{21 \times 21}$ X 44-45"	