

Reading Material for Diploma in Textile Technology

SUBJECT :

FABRIC STRUCTURE

Compiled By:

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Lectures available at youtube channel below:

<https://www.youtube.com/channel/UCnPu8vcBvMdV5wtPTxC4uLA>

Name of youtube Channel : Textile Technology Hisar

SUBJECT - FABRIC STRUCTURE

COURSE OUTCOMES

After undergoing the subject, students will be able to:

CO1: Identify and draw repeat, draft, peg plan and sectional view.

CO2: Compare and draw design from draft and peg plan and vice versa.

CO3: Learn the basic weaves i.e. plain weave, twill weave, satin/ sateen weave and their derivatives.

CO4: Sketch diamond, honeycomb and spot figuring design.

CO5: Calculate weight of warp, weft per square and linear yard, per square and linear meter.

CO6: Check warp, weft and fabric cover.

DETAILED CONTENTS

UNIT I

Woven Design Fundamental

Introduction, Representation of woven design- Interlacement diagram, graphical representation of woven fabric structure. Design, weave repeat unit or repeat size. Draft, types of draft-straight, pointed, skip and satin, broken, divided, group. Peg plan or lifting plan. Sectional view and denting plan. Relationship between design, draft, lifting plan and sectional view.

Plain Weave

Introduction characteristics and end use of plain weave. Derivatives of plain weave- warp rib, weft rib and hopsack weave. Derivatives of hopsack weave- Stitched, center stitched, barley corn, twilled hopsack weave. Ornamentation of plain weave. Rib and cord effect and its prominence.

UNIT II

Twill Weave

Introduction characteristics and end use of twill weave. Warp faced twill, weft face twill, right hand end and left hand end twill weave. Derivatives of twill weave- Pointed, waved, herring bone, Broken twill (By breaking at regular interval, by entering and skipping method), elongated and transposed Twill Weave. Balanced and unbalanced twill weave. Factor affecting the prominence of twill weave.

UNIT III

Satin/ sateen Weave

Introduction characteristics and end use of satin/sateen weave. Regular satin/sateen up to 12 ends. Irregular satin/sateen up to 12 ends.

Diamond and diaper

Characteristics, end use and comparison of Diamond and diaper. Diamond and diaper design upto 16 picks.

UNIT IV

Honey comb weave

Characteristics, end use and comparison. Ordinary and Brighton honey comb weave up to 16 picks. Ordinary honey comb, rectangle design example 12x14 and 14x12.

Huck-a-Back and Mock Leno

Characteristics of Huck-a – Back and mock leno. Design, end use, and comparison of Huck-a – Back and mock leno.

Feature of Different Fabric - cambric, gabardine, chiffon, denim, jeans, voile, blanket and sponge cloth.

UNIT V

Rib and Cord Structures

Welt and Pique structure - characteristics, end use and comparison of Welt and pique.

Bed ford cord - characteristics, end use and comparison with welt. Plain faced bed ford cord (Regular and alternate pick principle) Wadded bed ford cord, Twill faced bed ford cord.

RECOMMENDED BOOKS

1. Watson Textile Design & Colour Part-I & II by Z Grosicki.
- 2 Saral Vastra Sangrachna (Simple Fabric Structure – in Hindi) by S.S. Satsangi, M/S Usha Publishers, Shalimar Bagh, Delhi-88

SUGGESTED WEBSITES

1. <https://www.youtube.com/channel/UCnPu8vcBvMdV5wtPTxC4uLA>
2. <https://textilelearner.net/what-is-textile-basic-textiles/>

UNIT I

Introduction

Textile denotes fibres that can be spun into a yarn, and then into a fabric by a variety of methods including weaving, knitting, braiding, felting and twisting.

Weaving is the process in which woven fabric is manufactured by the interlacement of warp and weft according to the design.

A woven cloth is formed by the interlacement of two sets of threads, namely warp and weft thread. These threads are interlaced with one another according to the type of weave or design. The warp threads are those that run longitudinally along the length of the fabric and the weft threads are those that run transversely along the fabric. For the sake of convenience the warp threads are termed as ends and the weft as picks or fillings.

Fabric structure deals with the design formation in a woven fabric, during weaving. It tells us or deals with which of the warp is to be lifted up and which of the warp is to be brought down for insertion of any particular pick. Warp is also named as end, and weft is named as pick.

It does not deal with the mechanisms of weaving. Also, it does not deal with the designing done by dyeing and printing or after weaving.

Design or weave repeat unit indicates the interlacement of warp and weft threads in the repeat of a design. It is made up of a number of squares, which constitute the repeat size of a design. A blank in a square indicates that a warp goes below the corresponding weft and 'X' mark in the square indicates that the warp floats above the weft. Repeat unit means the smallest of the unit of design which when extended width and length wise produces the whole fabric. In repeat of design, or design warp is lengthwise and weft is widthwise.

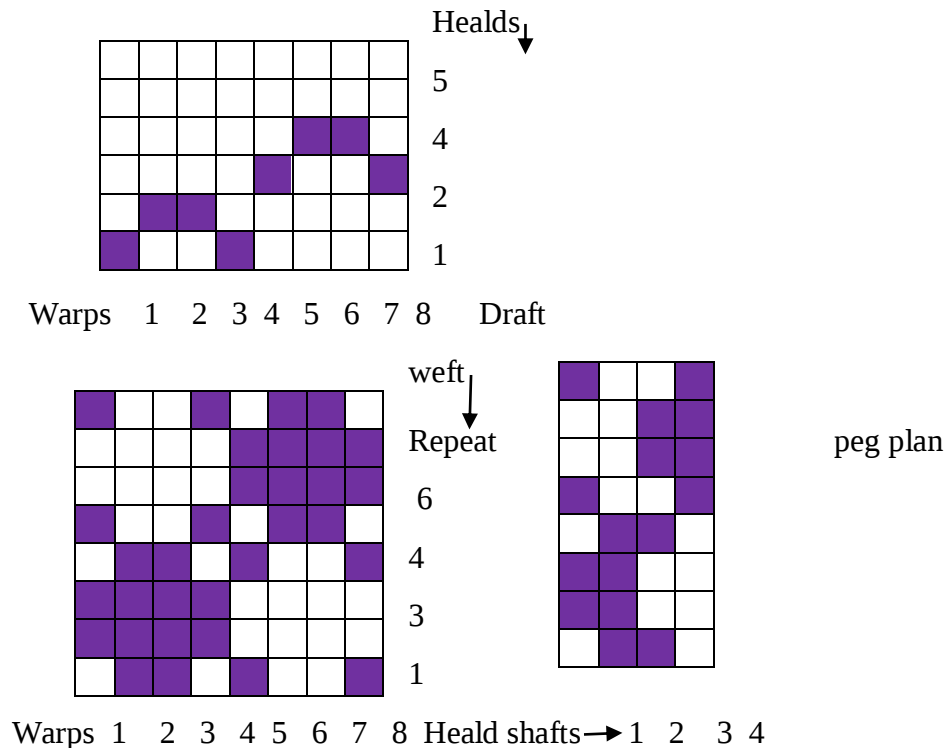
Draft indicates the number of heald shaft to be used to produce a particular design. It also indicates which of the warp is to be passed through which heald shaft.

Normally the warps which work in the same fashion will pass through the same heald shaft. The warps which function differently pass through a new heald shaft. Thus in draft lengthwise is represented by warps, and width wise by heald shaft. Filling means that warp is passing through that heald shaft. A warp can pass through a single heald shaft.

Peg plan or Lifting plan indicates which of the heald shaft are to be lifted up and which heald shaft are to be brought down while insertion of any particular pick. Lengthwise represents the held shafts and widthwise represents the weft.

Relationship between Design, Draft and Peg Plan

The relationship can be seen by the two examples given below. Students are advised to practice them

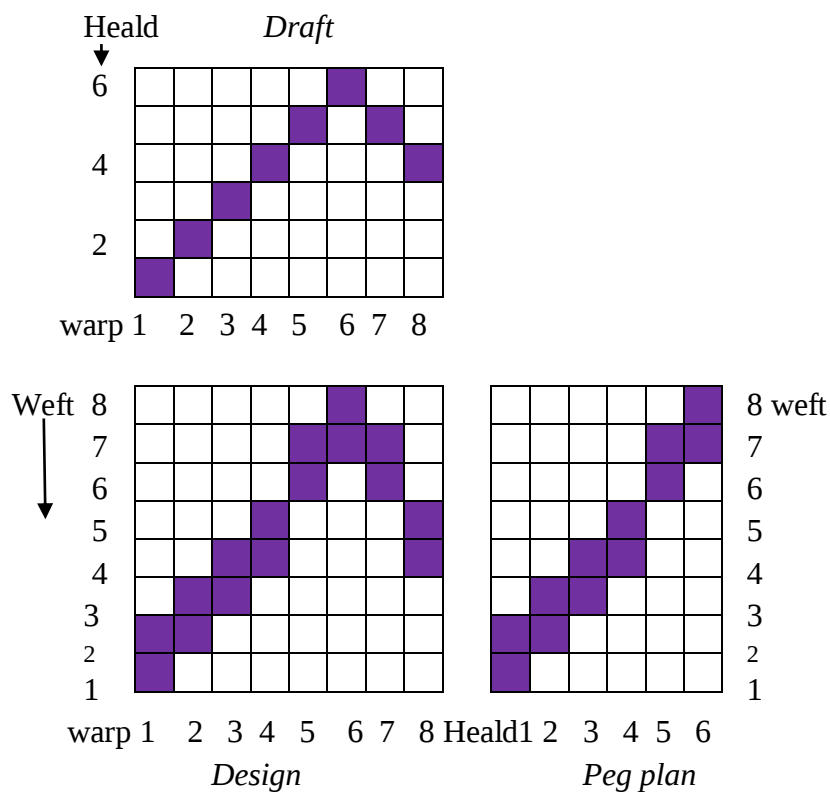


So, in the figure above, there are 8 warps and 8 wefts. Repeat size is 8x8. Above the repeat size we see the draft and on to right side is peg plan. In 1st warp/ end it is going above 2nd, 3rd, 5th, and last pick. While 2nd and 3rd warp are above first 4 wefts. 4th warp/ end is same in working as the first one. So, 1st warp pass through the first heald shaft. Working of second warp does not match the first warp, as the filled and without fill do not match. So, it will pass through the next heald shaft that is 2nd. 3rd warp working match the 2nd warp's working, so it will pass through the same that is second heald shaft. Above the repeat is the draft. In it lengthwise is the warp and widthwise is heald shafts. 4th warp matches the working of 1st heald, so it can pass through the same that is the 1st heald shaft. Further working of 5th end or warp do not match with any of the 4. So it will be taken in the next heald that is 3rd. 6th warp working do not match any one from 1 to 5. So, next heald shaft is taken which is 4th. Working of 7th warp is same as 6th so it can be in the same heald as 6th. That is 4th heald. 8th end working matches 5th do it can be in 3rd heald. So there will be 4 heald shaft in which 8 warps and the next all warps will be adjusted. These healds will be lifted up or brought down when a pick or weft is inserted. Say pick 1, the 2nd then 3rd and so on.

Which of the heald shaft is to be lifted up and which is to brought down while inserting a pick say 1st, 2nd, 3rd and so on, is shown in peg plan. Peg plan or lifting plan is made on right side of the repeat. Vertically it is showing 4 heald shafts and horizontally the wefts. Working of heald shaft will be same as the warp which passes through it. Now 1st heald shaft has the 1st end in it. So, working of 1st heald shaft will be same as 1st or 4th end. Working of 2nd heald

shaft will be same as 2nd or 3rd warp as both of them pass through the 2nd heald. Similarly, working of 3rd heald will be same as 5th or 8th warp which is 1 up then 2 down, 1 up 1 down. 2 up, 1 down. Working of 4th heald will be 6th or 7th end as both these pass through it. It is like 4 down and 4 up. 5th and 6th heald shafts are not used.

Another example is given below. There is design on 8 warps or ends, and 8 picks or wefts. So minimum size of design or repeat of design is 8x8. 1st warp goes in 1st heald. 2nd warp working is different. So next or 2nd heald shaft. Then so on, 3rd, 4th, 5th, and 6th. All ends are different and so need different heald shafts. Total of 6 heald shafts. Then working of 7th end is same as 5th end and 5th end is in 5th heald shaft, so 7th end can go to 5th heald and 8th end working is same as that of 4th end. 4th end is in 4th heald shaft. So, 8th end can go into 4th heald.



Now the peg plan. Peg plan shows the working of heald shaft. The working of heald shafts is picked from the end which is into it. So, 1st heald works same as 1st end, 2nd end as 2nd heald, 3rd end in 3rd heald, 4th in 4th. This is upto 6th. So peg plan is same as 6 ends.

The various drafts are Straight, Pointed, Skip and sateen, Broken, Divided, Grouped, Curved and Combination. For detail refer annexure 1 at the end of chapter.

Denting order

Warp ends during weaving are spaced out across the width of the warp sheet according to the desired density by the wires of the reed. Denting order gives which of warp is to pass through

which dent. The most frequent order of density is one, two, three, four ends per dent. Basic purpose is to avoid entanglement of the warps during weaving. Some fabrics, however, require an irregular order of denting.

Significance of fabric structure in fabric manufacture

Fabric or cloth has two type of threads. Warp or end, and weft or pick which are interlaced into one another. This is manufactured on machine that is loom. Cloth made also had looks or aesthetic sense. This is made by using different type, colours of warp and weft. Also which of the warp is to be lifted up or brought down for designing of in cloth. It also help in some functional properties like strength, air permeability. Fabric structure thus deals with the designing of the fabrics. Some names are like jeans, chiffon, blanket, trousers fabric, denim, damasks, towel, pile, carpets. All these fabrics have different looks and different functions.

Types of Drafts

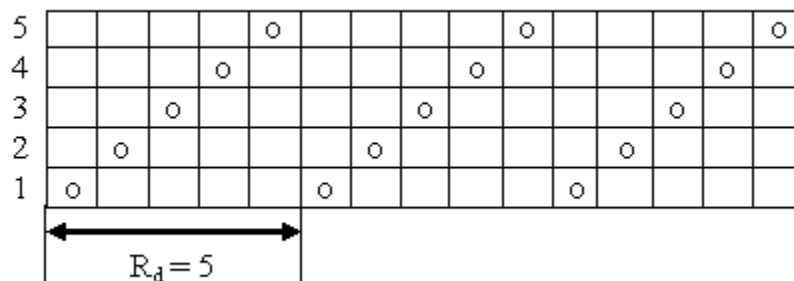
The various drafts are classified as follows:

a. Straight Draft

This is the most commonly used draft. It is the simplest of all the types of draft plans. In this kind of draft the drafting order progresses successively from first to the last heald frame. Thus the first warp end of a weave is drawn through the first heald shaft, the second warp through the second heald frame and so on.

One important feature of the straight draft that distinguishes it from other types of draft plans is that the peg or lifting plan is same as the design. Hence it is sufficient to indicate only the design.

Figure below shows the straight draft.

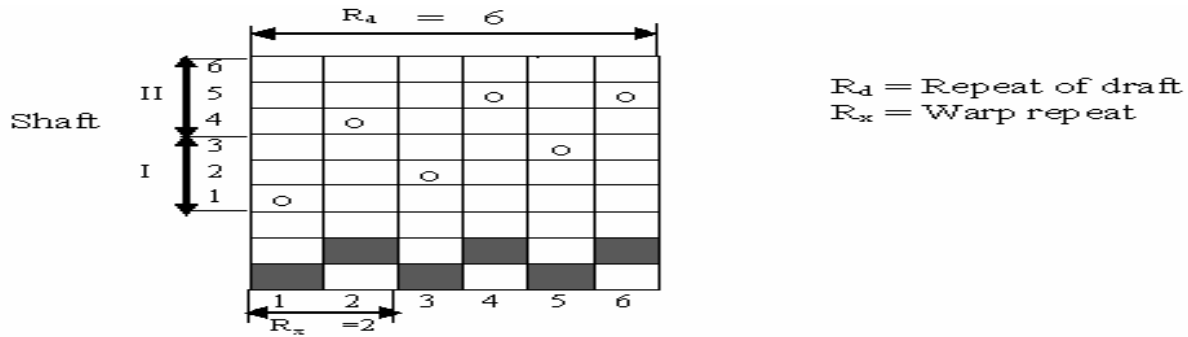


R_d = Repeat of draft

Straight draft

b. Skip Draft

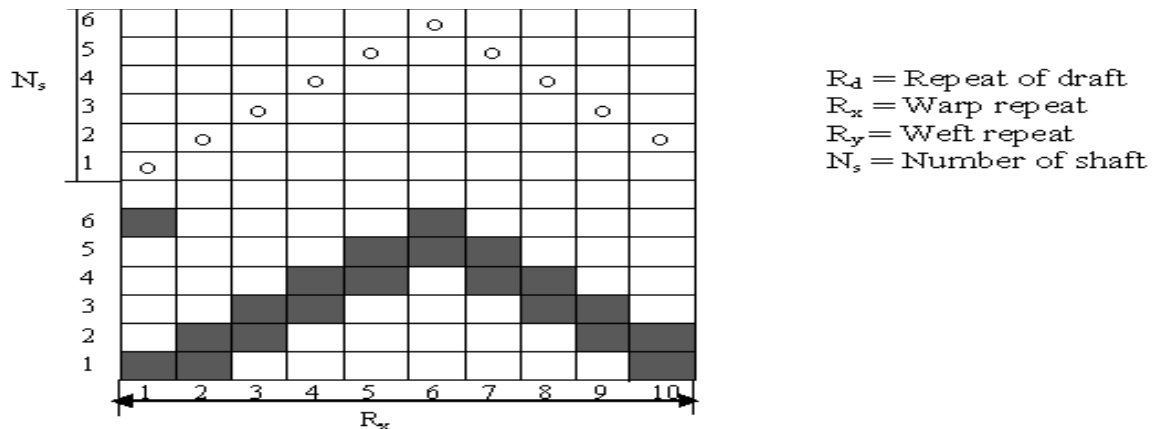
The skip draft is suitable for weaving fabrics having heavy warp thread density. In this kind of draft plan the number of heald frames may be twice or more than the minimum required for a weave. The purpose of using more heald frames than the minimum recommended is only to distribute the warp threads more uniformly so as to prevent abrasion of the threads due to overcrowding.



Skip Draft

c. Pointed Draft

This is similar to a straight draft. It is suitable for weaves such as pointed twill, diamond weaves and ordinary types of honeycombs. The straight draft is reversed after half the repeat warp way. The number of heald shafts is about half the repeat size of the weave. Figure below shows a pointed draft.



d. Skip or Sateen Draft

The sateen draft serves the same purpose as the skip draft. A skip draft is normally employed for weaves such as plain and twill upto a repeat of 4. Whereas the sateen draft is used for weaves having repeat size of more than 5.

PLAIN WEAVE

There are three basic weaves in weaving:

1. Plain weave

This is the most basic and popular weave. It is based on the basic principle of weaving. The fabric has the maximum number of interlacements with 1/1.

2. Twill weave

This is the next basic weave. This weave shows diagonal lines in the woven fabric.

3. Satin or Sateen weave

This weave has minimum number of interlacements. Due to this reason it forms the most lustrous fabric. It has long floats, and is either total warp faced or weft faced.

Characteristics of Plain Weave

1. It is first basic weave.
2. The minimum repeat size is represented on 2-ends and 2-picks. i.e. - 2x2.
3. It has maximum number of binding ends.
4. It produces the strongest fabric.
5. If warp and weft threads are balanced. i.e.- same thickness and number per unit Space, they bend equally.
6. It is most widely used fabric (80%).
7. The texture is strongest and firmer than any other ordinary cloth.
8. A wide variety of fabrics can be produced by this very heavy and course like Canvas, blanket, duck, filter, belting to very fine or light like cambric, muslin, bundage.
9. Trade names such as tabby, calico, alpaca, and talent are applied to plain cloth.
10. Ends uses: long cloth, poplin, voile, cambric, muslin, blanket, canvas, sari, dhoti, lunge, suiting, shirting.
11. Drafting is normally straight or skip type.
 - 2 H.S. are used for light fabric.
 - 4 H.S. are used for plain deep fabric.
 - 6 H.S. are used for heavy fine quality or light fabric
12. As per definition of weaving (interlacement of warp and weft), a warp should atleast go up and down, once. Thus a minimum of 2 wefts is required. similarly, if a weft is to be atleast once up and once down. Hence a minimum of 2 warps is required. Thus minimum repeat size is 2x2, and is called as plain weave.



Plain Weave

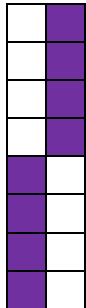
Derivatives of Plain Weave

The chart below shows the derivatives/modifications of plain weave i.e. Warp rib (regular and irregular), Weft rib (regular and irregular), and Matt rib.

1. Warp Rib

1. Vertical extension of plain weave
2. Number of ends=two.
3. Number of picks =sum of weave numbers.
4. EPI>>PPI.
5. Horizontal lines both equal or unequal size are produced.
6. Best results are produced when high warp set in which the warp ends cover the weft almost entirely.
7. Further prominence of lines can be achieved by using alternately course and fine ends or; slack and tight.
8. Working of second end is opposite to first.
9. If up and down are same then it is called as regular.
10. For e.g. 4/4 regular warp rib.

No. of picks = 4+4 = 8, No. of ends = 2



Draft is straight. So, peg plan is same as design.

4/4 Regular Warp Rib **NOTE: Use 'X' instead of filling up entire block**

The typical constructional particular for a warp rib structure is given below:

Warp - 30s cotton,
Ends/inch – 126,
Weft - 15s cotton,
Picks/inch – 38.

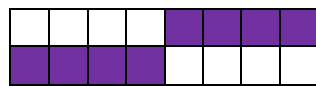
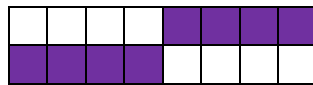
2. Weft Rib

1. It is opposite of warp rib.
2. Horizontal extension of plain weave.

3. Number of ends = sum of weave numbers.
4. Number of picks = two.
5. PPI >> EPI such that the fabric is covered entirely.
6. Lines running vertically can be enhanced as maintained above.
7. Working of second picks is opposite to first.
8. If up and down are same then it is called as regular.
9. For e.g. 4/4 regular weft rib

No. of ends = $4+4 = 8$, No. of picks = 2
Repeat size = 8×2

Draft ↓



Design



peg plan

4/4 Regular Weft Rib

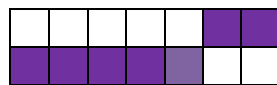
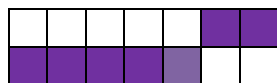
NOTE: Use 'X' instead of filling up

entire block

10. Another e.g. 5/2 irregular weft rib . it is called irregular because up and down are not same

No. of ends = $4+4 = 8$, No. of picks = 2
Repeat size = 8×2

Draft ↓



Design 1 2 3 4 5 6 7



peg plan

4/4 Regular Weft Rib

NOTE: Use 'X' instead of filling up entire

block

The typical constructional particular for a weft rib structure is given below:

Warp - 2/14s & 36s,

Ends/inch – 56,

Weft - 18s,

Picks/inch – 100.

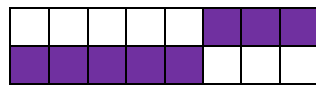
3. Hopsack, Matt or Basket Weave

1. it is Vertical and horizontal extension of plain weave.
2. Working is opposite unit wise.
3. Number of ends=Number of picks=sum of weave number.
4. For e.g. 5/3 hopsack weave

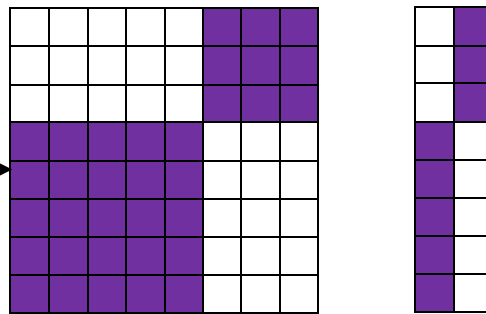
Weave number = $5+3 = 8$, Warp = Weft = 8. First fill 5 up lengthwise and widthwise extend it to 5 warps. Then in next fill the opposite that is 5 down 3 up. Since next block is of 3 so repeat same on 3 warps

R.S. = 8×8

Draft



Design



5/3 irregular Hopsack Weave **NOTE: Use 'X' instead of filling up**

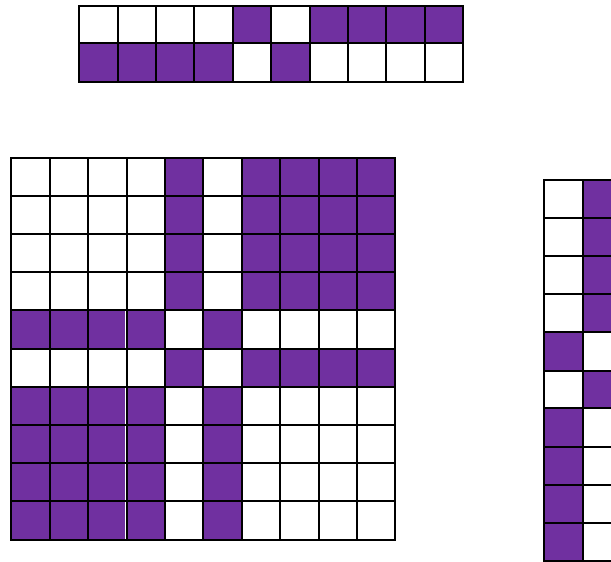
entire block

If the up and down is same then the weave is called as regular hopsack weave, e.g. 4/4. If the up and down are different then it is called as irregular hopsack weave, e.g. 5/3

Another name given to hopsack is Fancy Basket Weave or Matt weave.. A fancy basket weave is produced by taking the total of 4 up and down motions. The 3rd and 4th up and down are exactly opposite to the first and 2nd unit of up and down. For example, if the first 2 is 4/1, then the next 2 will be 1/4.

For example- 4/1 1/4 fancy basket hopsack weave

Weave number= $4+1+1+4 = 10$. So, R.S. 10×10



Design of fancy basket weave **NOTE: Use 'X' instead of filling up**

entire block

Derivatives of hopsack weave

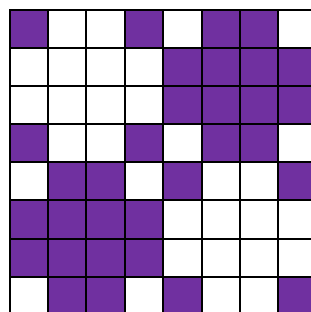
Due to large floats in hopsack, stitches are introduced. These stitches are done to introduce firmness to the cloth. The stitching may be done anywhere, at the centre, diagonally, or by introducing an extra thread.

Stitched Hopsack Weave

Stitching at certain intervals is done to provide firmness. This stitching may be in the center or in warp or weft way.

For e.g. 4/4 stitched hopsack weave

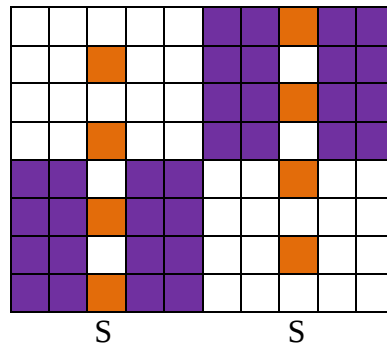
R.S. – 8x8



Centre stitched hopsack weave

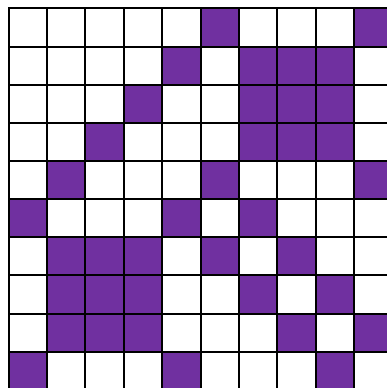
If the stitching is done at the centre than it is called as *centre stitched hopsack weave*. In it, the next stitch is exactly mirror image of the first unit.

R.S. – 10x8, S – Stitching end

*Barley Corn Hopsack*

In it, a (cross) twill like stitch that of barley corn is applied to provide firmness to the cloth.

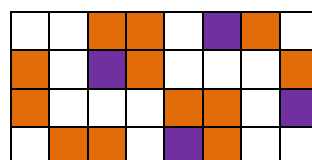
For e.g. R.S. – 10x10

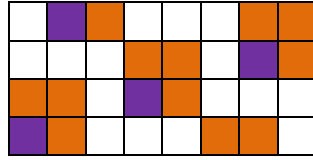
*Twilled Hopsack Weave*

In it, the small squares are formed by only one series of threads. These weave are not as stiff as ordinary hopsack and also be suitable for suiting and shirting.

For e.g.

R.S. – 8x8





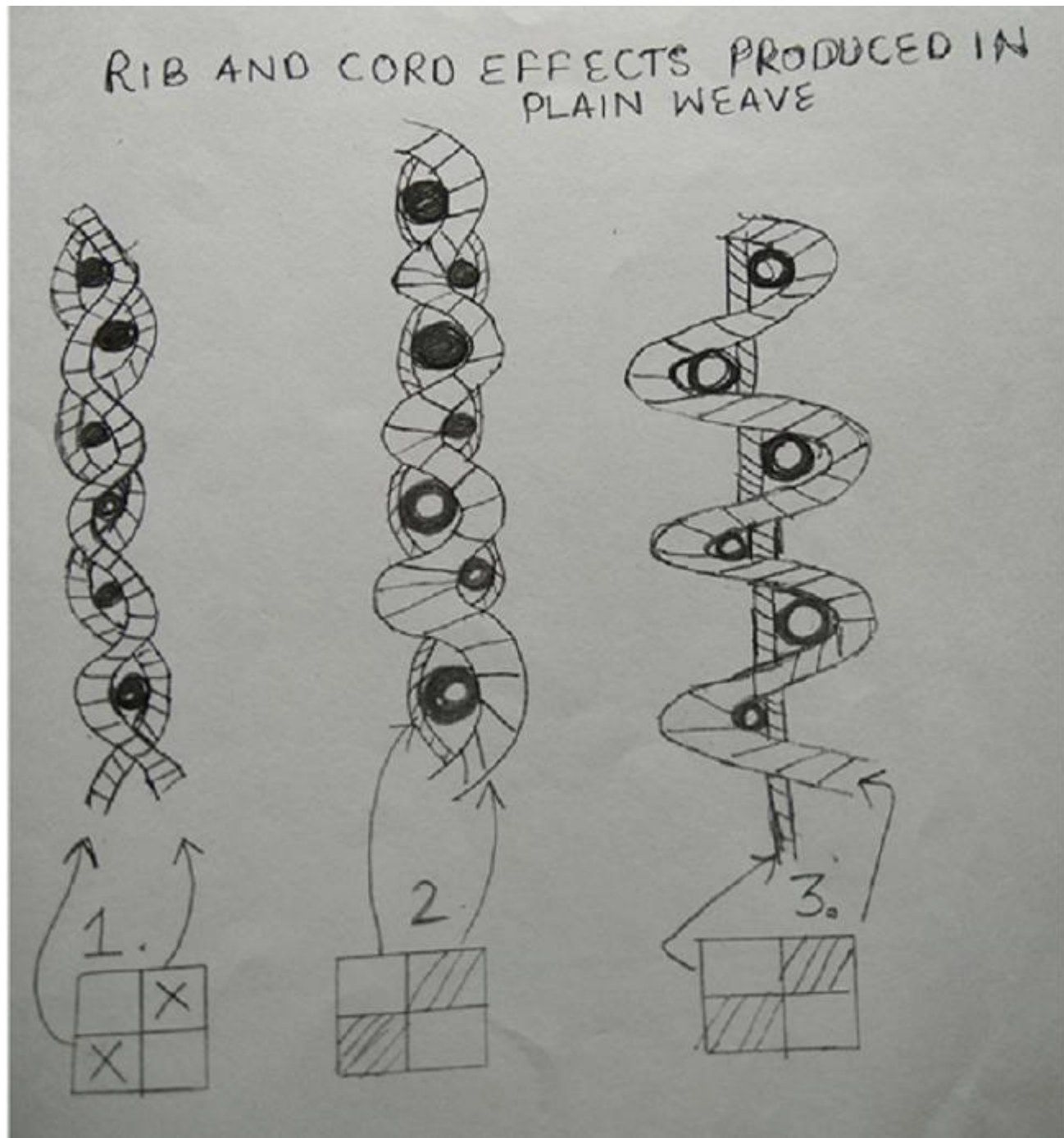
Ornamentation of Plain Weave means that we can ornament or show better type of designs. It is done using the same weave. If the different type of yarns is used warp wise or weft wise then a stripe effect will be produced. If the different type of yarns is used both warp and weft wise then a check is produced. This can be done by applying any of the methods given below:

1. Using different color thread to get stripe and check effect.
2. By using fancy slub yarn.
3. Using differently twisted yarn (S and Z twisted) to produce zig zag effect.
4. Using different count of yarn in warp and weft.
5. Using a varied stock of reed.
6. Using specialized take up and let off motion.
7. By using different tensions between the warp threads.

Rib and Cord Effects Produced in Plain Weave

If the difference in thickness, number of threads per unit space between the warp and weft, then rib and cord effects is produced. This effect can be enhanced by use of differently tensioned beams/threads as given below. Cord effects normally mean the lengthwise or widthwise line effect. A different method of enhancing this effect is as under:

1. If the $EPI \gg PPI$, then the former (ends) tend to bend around, the later. The effect is warp rib structure. If $EPI \gg PPI$ and of some thickness, than picks bend around the warp and form a weft rib.
2. This prominence can be increased if thick and thin warp and weft are employed alternately in warp and weft. The thick warp end is over the thick pick and the thin end over thin pick. This develops prominence as the gap is more visible. In warp rib $EPI \gg PPI$, and in weft rib, $PPI \gg EPI$.
3. The permanency can be further enchanted, by using differently tensioned warp beams. The odd numbered finer warp threads are heavily tensioned and lie straight in the fabric.



Questions

- Q. Machine used for weaving is called as.
a. Tappet b. Dobby c. Jacquard d. Loom
- Q. Tappet is adevice.
a. Shedding b. Picking c. Let off d. Take up
- Q. By whom we know how many heald shafts are to be used.
a. Tappet b. Dobby c. Draft d. peg plan
- Q. Repeat size of 4/2 warp rib is?
a. 2/4 b. 4/2 c. 6/6 d. 2/6
- Q. Repeat size of 3/1 warp rib is?
a. 2/4 b. 4/2 c. 3/3 d. 2/6
- Q. Give repeat size of 3/3 weft rib.
a. 6x6 b. 2x6 c. 6x2 d. 3x6
- Q. Give repeat size of 3/3 weft rib.
a. 6x6 b. 2x6 c. 6x2 d. 3x6
- Q. Fancy basket weave is part of
a. Plain weave b. twill weave c. Satin d. Diamond
- Q. How are woven fabrics classified?
- Q. What are the basic elements of woven design?
- Q. Define the term 'weave'.
- Q. Mention the practical methods of weave representation? Which one is preferred?
- Q. What is repeat of weave?
- Q. Mention the importance of design, draft and peg plan?
- Q. Mention the various types of drafts.
- Q. How does straight draft differ from other types of drafts?
- Q. When are skip and 'sateen' drafts used?
- Q. Mention the weaves which use pointed draft.
- Q. Mention the weaves which employ broken draft.
- Q. Give examples of weaves which use divided draft.
- Q. Where are grouped drafts used?
- Q. Under what circumstances are curved drafts used?
- Q. What is denting plan?
- Q. Construct a draft and peg plan of the following design

8	■	□	□	□	□	■	□	□
7	■	■	□	□	■	■	□	□
6	□	□	□	■	□	□	■	□
5	□	□	■	■	□	□	■	■
4	□	■	□	□	■	□	□	□
3	■	■	□	□	■	■	□	□
2	□	□	■	□	□	□	□	■
1	□	□	■	■	□	□	■	■
	1	2	3	4	5	6	7	8

After reading student should be able to answer:

- Q. Give the other names of plain weave.
- Q. Mention the basic characteristics of a plain weave.
- Q. Define the term 'texture'.
- Q. Mention the end uses of plain weave.
- Q. Classify the plain weave
- Q. Define warp rib, weft rib, and matt rib.
- Q. Give the standard quality particulars for a weft rib cloth.
- Q. Give the other names of matt weave.
- Q. Give the typical constructional particulars for a warp rib structure.
- Q. Mention the end uses of rib weaves.
- Q. Give the end uses of matt weaves.
- Q. Give the design, draft and peg plan for the following :
 - (a) 2/3 warp rib
 - (b) 5/5 warp rib
 - (c) 4/2 weft rib
 - (d) 6/3 weft rib
 - (e) 4/4 matt rib
 - (f) 2/4 matt rib
 - (g) 4/3 matt rib

Also indicate the denting order for the above weaves.

UNIT II

Twill Weave

Characteristics and end use of twill weave

1. It is second basic weave.
2. This weave produced diagonal effects.
3. In normal twill, angle of inclination, 45° .
4. It produces a smoother and lustrous fabric when compared to a plain fabric.
5. This weave are employed for the purpose of ornamentation to increase cloth weight, closer setting, better drape quality to plain fabric when both are produced by similar particular.
6. Draft is straight.
7. Normal twill weave is constructed on a square.
8. Uses of twill are many in trouser fabrics e.g. jeans, gabardine. The weave is employed for the purpose of ornamentation, increase cloth weight, close settings. It has better drape quality.
9. Minimum repeat size is 3×3 .

Derivatives of Twill Weave

1. Pointed Twill Weave

- a) It is a combination of right hand and left hand twill.
- b) Normally used for decorative purpose.
- c) It can be further divided into two types-
 - i) Simple Pointed Twill
 - ii) Broken Pointed Twill

- i) *Simple Pointed Twill* – In simple pointed twill, number of ends = $2n-2$;
 where n = no. of heald shaft;
 number of picks = n = sum of weave number.
 The base marks on any pointed twill starts from first pick and ends on second pick.

For e.g. 3/5 pointed twill

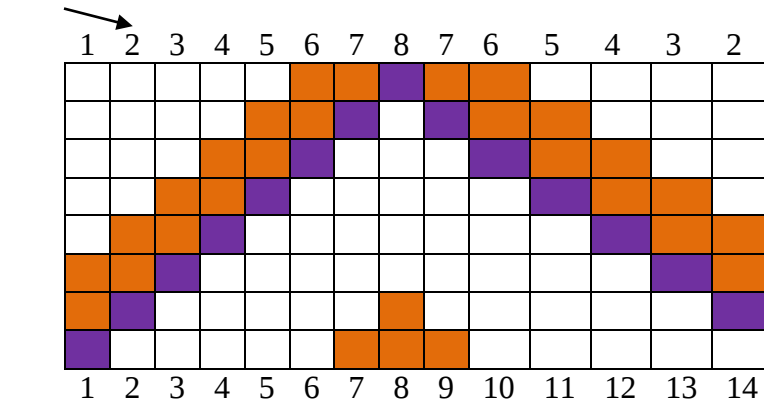
$$n = 3 + 5 = 8$$

Base marks = 1 2 3 4 5 6 7 8 7 6 5 4 3 2

End = 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Repeat Size = 14×8

Working in heald shafts



Ends

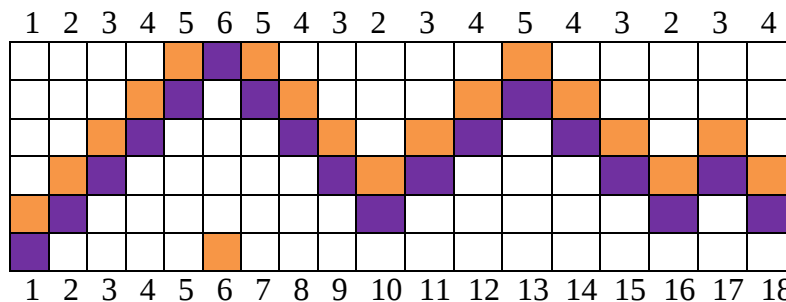
Draft is same as Base marks. Peg plan is same as first n ends of repeat.

2. Waved or Zigzag Twill

It is one of the simplest derivatives of twill and can be produced just by reversing at suitable interval. This twill should once touch the last pick and ended second last pick to maintain continuity. The base marks in between are in continuation. Then the extensions are filled. The draft is same as the base marks, and peg plan same as first n ends of repeat. Designs can be numerous at the same number of ends and picks.

For e.g. 3/3 waved or zigzag twill on 18 ends

Repeat size= 18x6



Ends:

3. Herring bone Twill

The twill direction change is done in a different manner. The reversed direction is cut into half. The lower half is first drawn. The base marks starts from the first pick and end on the last pic. Then the base marks are drawn in reverse order from $n/2$ pick, and end on the first pick. After that the base marks are started from the last pick with ending on to next to the $n/2$ pick. A distinct vertical line zigzag sort of effect is produced with a sort of cut of effect. Repeat size is equal to $2n \times n$ and draft is same as base marks, n should be an even number so as to break from the middle.

Uses are mostly in furnishing fabrics, bed covers, toweling fabrics.

Youtube channel : . <https://www.youtube.com/channel/UCnPu8vcBvMdV5wtPTxC4uLA>

For e.g. 2/2 herring bone twill

$$n=2+2=4$$

Repeat size= $2n \times n$

$$2(4) \times 4$$

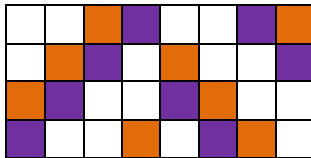
$$8 \times 4$$

Base marks= 1 2 3 4 2 1 4 3

No. of ends= 1 2 3 4 5 6 7 8

Repeat size= 8×4

Draft (Same as Base marks)



4. Broken Twill

In his case the twill lines are produced in such a fashion that they are visible as broken after certain interval at diagonal lines. This break of twill lines at regular intervals is produced by various methods.

By breaking at regular interval

There factor “k” is taken as break unit factor.

K can be = 2, 3, 4, 5....

For example, the ordinary twill the base marks are;

a) If K = 2, Base marks= 1 2 3 4 5 6 7 8;

1 2 4 3 5 6 8 7

b) If K= 3, Base marks= 1 2 3 4 5 6 7 8 1 2 3 4 5 6 7 8 1 2 3 4 5 6 7 8 1 2 3;

1 2 3 6 5 4 7 8 1 4 3 2 5 6 7 2 1 8 3 4 5 8 7 6 1 2 3 (no. of ends=24)

c) If K= 4, Base marks= 1 2 3 4 5 6 7 8;

1 2 3 4 8 7 6 5 (no. of ends=8)

For e.g. 2/6 broken twill ;

$$n= 2+6=8$$

if k=2. Here break unit is a factor of repeat of original weaves than

Repeat size= 8×8

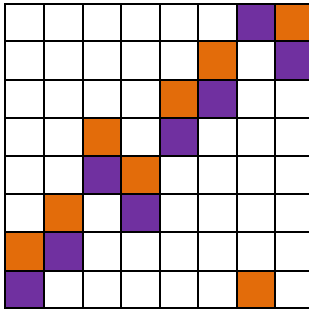
Base marks= 1 2 3 4 5 6 7 8

1 2 4 3 5 6 8 7

Draft is straight. So, Peg Plan is same as design

Working:

Ends:



Draw yourself for practice

Draw $\frac{3}{5}$ broken twill with $k=3$ as breaking factor

5. Transposed or Rearranged Twill

This twill produced inter potation in the continuity of the twill line by rearranged or changing its direction, after a certain breaking factor (k). Either all the broken lines are rearranged (*fully transposed*) or alternately they are rearranged (*half transposed*). Like in earlier case (broken twill); if the factor is a repeat of unit design, then the repeat will be same as original. If k is not a factor of original design the end = (L.C.M. of k and n) and picks = n

i) *Half Transposed*: same as broken twill, by reversing at regular interval.

ii) *Full Transposed*: For e.g. $\frac{3}{5}$ fully transposed twill; with $k=3$

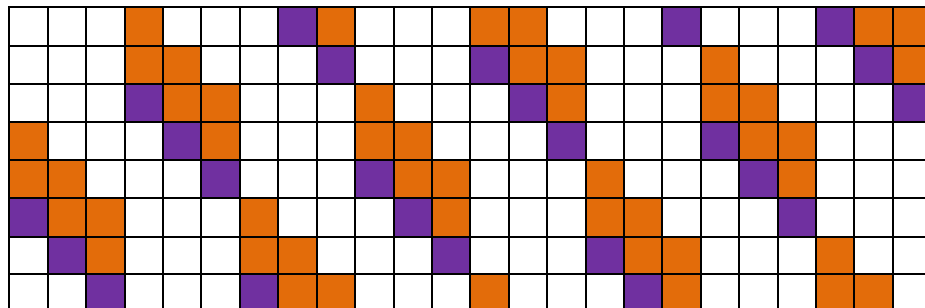
$$n = 3 + 5 = 8$$

No. of ends = L.C.M. of 8 and 3 = 24

Repeat size = 24×8

Base marks = 123 456 781 234 567 812 345 678

321 654 187 432 765 218 543 876



$\frac{3}{5}$ Fully transposed twill

6. Elongated Twill

In the normal twill weave, angle of inclination $\alpha = 45^\circ$. If the twill angle is more than 45° then it is called as *steep twill*, and if the angle is less than 45° , then it is called as *low twill*. These twill weave are called as elongated twill weave. The angle α of the twill depends upon,

- i) The relative ratio of number of ends per unit (inch) and the number of picks per unit (inch) space.
- ii) The rate of advancement of the interlacing.

Formula is,

$$\alpha = \frac{\text{step upward } (^) \times \text{EPI}}{\text{step outward } (>) \text{ PPI}}$$

if $\text{epi} = \text{ppi}$, and steps are also equal then $\alpha = 45^\circ$.

If $\alpha =$

Value	$\alpha =$
2	63
3	Fill yourself
4	76
5	89
$\frac{1}{2}$	$90 - 63 = 27^\circ$
$\frac{1}{3}$	Fill yourself
$\frac{1}{4}$	Fill yourself
$\frac{1}{5}$	Fill yourself

e.g. : Given $\text{epi} = 40$, $\text{ppi} = 80$,

Step upward = 4, step outward = 1. Calculate twill angle.

Factor affecting the prominence of twill weave

The twist of yarn, used to bind yarn affects the handle, strength, wearing properties of cloth and appearance of cloth. More twist is required in yarn prepared with short staple, finer yarn and warp yarns. The normal twist given is Twist/cotton worsted. Following factors affect the prominence in twill.

- i. Nature of the yarn A coarse yarn with low twist, and a double yarn or plied yarn produces stronger twist effect in a twill.
- ii. Nature of weave Twill having longer floats will give more effect. A $4/2$ twill will give better effect than $3/3$ twill.
- iii. EPI and PPI with increase in EPI or PPI, the effect increases.
- iv. Relative direction of twill and yarn twist If the direction of the twist underside of the top thread is opposite to that of the upper side of the lower thread, the thread do not rapidly bed into each other, but tend to stand off from each other. This help in showing up the weave and the structure of the cloth distantly.

If these thread are in the same direction than condition are favorable for the threads to bed into each other and form a compact cloth. If the direction of the yarn twist is same as the twill direction, the prominence is reduced. If ti is opposite then the prominence is increased. For example if the twill is Z type and then the S-twist yarn will give more prominence. If the twill is S-type then the yarn twist with Z-type will show more prominence, and S-type will show less prominence.

After reading student should be able to answer:

- Q. Name weave that produce diagonal effects.
 a. Satin b. Spot figure c. Plain d. Twill
- Q. Repeat size of 1/2 Twill weave is?
 a. 2x3 b. 3x3 c. 3x2 d. 2x2
- Q. In Jeans fabric twill angle degree is?
 a. 45 b. 63 c. 72 d. 27
- Q. Repeat size of 3/3 Herringbone twill weave is.
 a. 12x12 b. 6x12 c. 12x6 d. 6x6
- Q. Twill angle given that EPI=PPI, step upward= 1, step outward= 2.
 a. 27 b. 45 c. 63 d. 72
- Q. Repeat size of 2/3 Twill weave is
- Q. Weave produces diagonal effects.
- Q. Minimum repeat size of twill weave is
- Q. diagonal lines are produced in weave produces.
- Q. Gaberdine is Weave.
- Q. What are the factors affecting prominence of Twill weave?
- Q. draw design, draft and peg plan of 3/2 pointed Twill weave.
- Q. Draw 3/2 Pointed Twill weave.
- Q. Draw 4/4 Herring bone twill weave.
- Q. Draw zig-zag twill weave on 16x6 repeat size.
- Q. Draw half and full transpose twill weave.

UNIT III

SATIN/SATEEN WEAVE

Characteristics of satin/ sateen

1. It is the third basic weave.
2. Satin is warp faced weave, while sateen is weft faced weave.
3. It produced the smoothest and lustrous fabric out of all the three weaves.
4. It is also called as floating weave and can be used for producing large floral design like bed cover, curtain etc.
5. These weave is also used to produce high quality dress material especially for ladies.
6. Draft is straight. Denting is 4 or more.
7. Minimum repeat size= 4x4 irregular satin/ sateen
5x5 regular satin/ sateen

To produce satin/sateen first the base marks are drawn. Then, the extension is marked. The base marks are drawn in steps and the steps for regular satin/sateen should be any number between 1 and (n-1), with the exception that the number does not have any factor common with the repeat (no. of thread, n) of the weave.

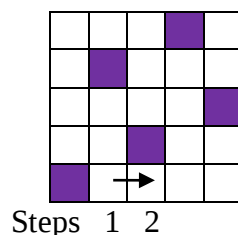
For example for 8-end regular satin steps can be between 1 to (8-1) = 7. Since 2, 4 and 6 have a factor 2 common with 8, they cannot be step. Hence the final steps are 3 and 5 only, vertically or horizontally.

Thus the minimum repeat= 5x5.

Sateen/ satin size	Steps in regular
5-end	2,3
7-end	2,3,4,5
8-end	3,5
9-end	2,4,5,7
10-end	3,7
11-end	5,6
12-end	5,7

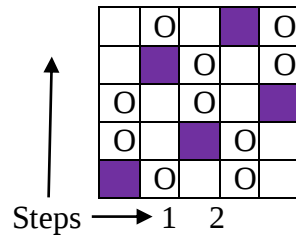
For e.g. 5x5 Regular sateen (it is weft faced. So less warps are up)

$\frac{1}{4}$ is sateen as drawn below. Steps= 2 or 3



If it is more warps up then it is called as Satin. In case of 5 ends, it is 4/1 or 3/2. In both cases more warps are up. We shall be drawing 3/2 satin

Base marks are same as the earlier one. Now 2 more ups are filled



Steps $\rightarrow$ 1 2 steps are either 3 upwards or 2 horizontally. Since steps are regular or same till end, these are called regular Sateen or Satin.

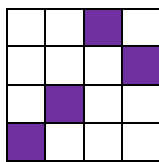
Irregular Satin/Sateen

For irregular sateen, the total numbers of ends or picks are even. The steps are:

Steps up to $n/2$ picks, $n/2-1$

Irregular Sateen/Satin	Up to $n/2$ picks Step ($n/2 - 1$), direction $\rightarrow$	Next ($n/2 - 1$), direction	Rest Same as first, direction $\leftarrow$
4-end	1	2	1
6-end	2	3	2
8-end	3	4	3
10-end	3	5	3
12-end	3 & 5 alternately		3 & 5 alternately

SATINETTE (4x4 irregular satin)



For e.g. 12- end Irregular Satin

$$\begin{array}{r} 5 \quad 5 \\ \hline 1 \quad 1 \end{array}$$

Repeat size= 12x12

Up to 6 picks, Step 3 & 5 alternately $\rightarrow$;

Next 6 $\rightarrow$;

Rest 3 & 5 alternately $\leftarrow$

X = BASE MARKS O = EXTENSIONS. We have taken 3/9 so it is Sateen. One 'X' and 2 'O' extensions.

X

		O				X			O		
		O			O				X		
		X			O					O	
	O				X					O	
	O				5	4	O	2	1	X	
1	X			O			O			3	2
5	6			O			X	1	2	3	O
				X				O			O
1	2	3	O	5				O			X
O			O					X	1	2	3
O			X	1	2	O	4	5			
X	1	2	3			O			O		

DIAMOND and DIAPER

Diamond is an extension of twill weave. It is mainly used for ornamentation of fabrics like curtains, sofa cover, fancy dress material, and decorative purpose.

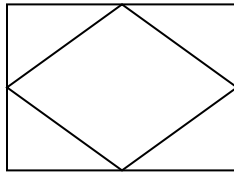
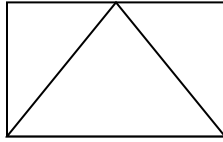
Diamond can be prepared by 3 different methods :

TYPE OF DIAMOND	DRAFT	PEG PLAN
1. Ordinary or Pointed Diamond	Pointed Twill	Pointed Twill
2. Cut Diamond and Diaper	Herring bone Twill	Herring bone Twill
3. Combined Diamond	Pointed twill or vice verse	H.B.T or Pointed T.W

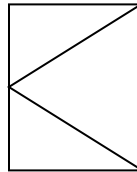
Ordinary or Pointed Diamond

Draft & Peg Plan is Pointed Twill or Zig- Zag twill. Lets take 10 & 16 End. Diamond can best be prepared directly, or by first drawing the draft and peg plan and then developing the design.

Draft



Design



Peg plan

Method 1

Let us take example of 10x10 Diamond. First we will draw pointed TWILL on draft and peg plan. It will be 10x6 in draft, and 6x 10 in peg plan. Fill the peg plan as per the diamond required. Then from the draft and peg plan draw design.

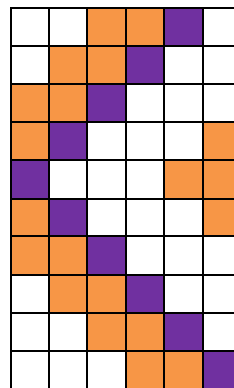
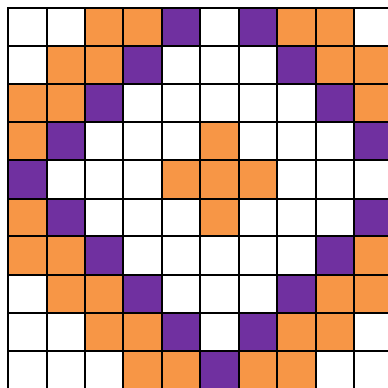
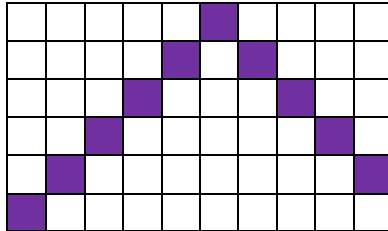
Youtube channel : . <https://www.youtube.com/channel/UCnPu8vcBvMdV5wtPTxC4uLA>

Repeat size – 10x10

End - 1 2 3 4 5 6 7 8 9 10

Base mark – 1 2 3 4 5 6 5 4 3 2

6- picks



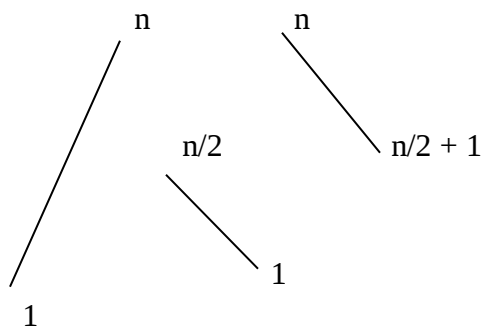
Starting point of peg plan

Cut Diamond or Diaper

Cut diamond or diaper is made by first making a draft and then peg plan from herring bone twill.

Extension are then filled in the peg plan. After that using draft and peg plan, design is made.

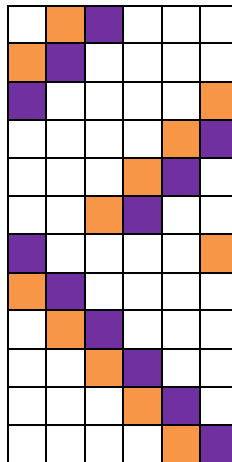
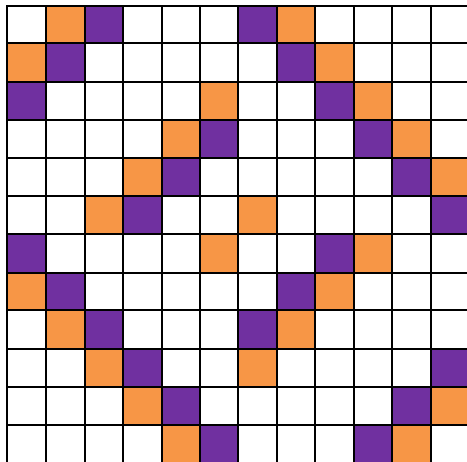
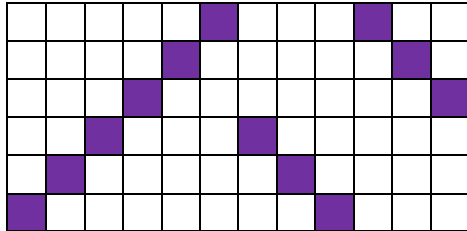
Draft and peg plan is herring bone twill as shown here:



Repeat size – 12x12 diaper

End - 1 2 3 4 5 6 7 8 9 10 11 12

Base marks - 1 2 3 4 5 6 3 2 1 6 5 4



After reading student should be able to answer:

Q. Name third basic weave.

- a. Satin b. Twill c. Diamond d. Honeycomb

Q. Fabric that gives most shining.

- a. Plain b. Twill c. Satin d. Spot figuring

Q. Give repeat size of satinette weave.

- a. 10x10 b. 8x8 c. 6x6 d. 4x4

Q. Minimum repeat size of regular satin weave is

- a. 3x3 b. 4x4 c. 5x5 d. 6x6

Q. Satin is the basic weave.

Q. is third basic weave.

Q. Draw 10 end irregular Satin.

Q. Draw 2/8 regular Sateen.

Q. Draw 10x10 OR 12x12.Diamond

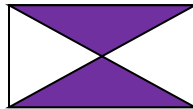
UNIT IV

HONEYCOMB WEAVE

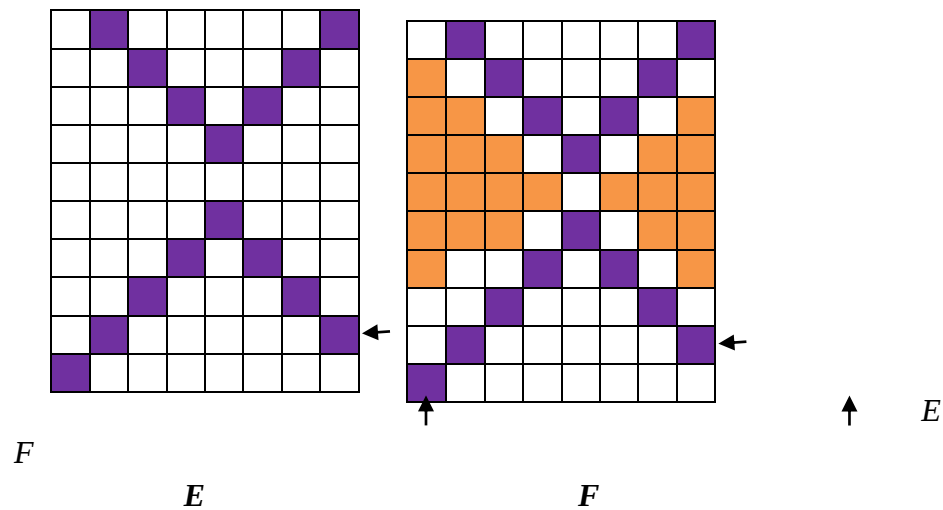
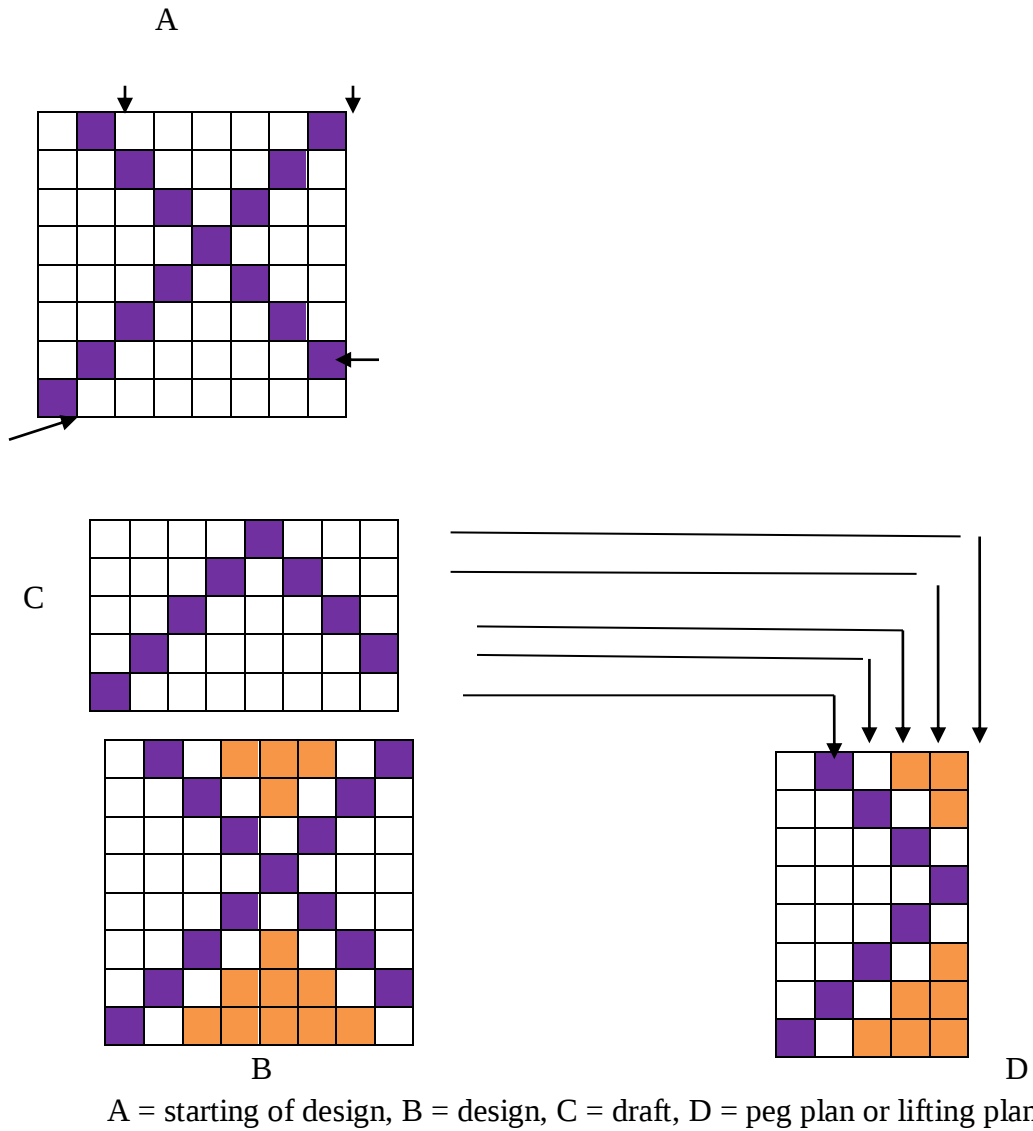
This weave forms ridges and hollow, a cell type appearance texture (with ridges and hollows). The fabric is mainly used for absorbency purpose, like towels, and various forms of bed covers and quilts when used in combination with other weaves. There are two types of honeycomb weaves. Ordinary honeycomb weave and Brighton honeycomb weave.

Ordinary Honey Comb Weave

1. Pictorial view

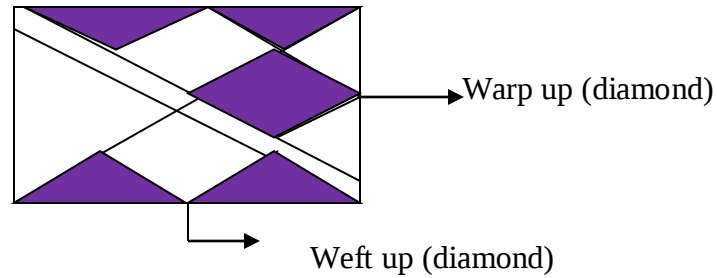


2. It is mostly used for absorbency purposes like toweling.
3. There is one warp diamond and one weft diamond in the repeat.
4. Draft is pointed.
5. Minimum repeat size is 6X6.
6. it can be made on both even and odd number of ends, and on square and rectangle. Example is 8x8, 6x6, 14x12.
7. Drawing of Ordinary Honey comb weave



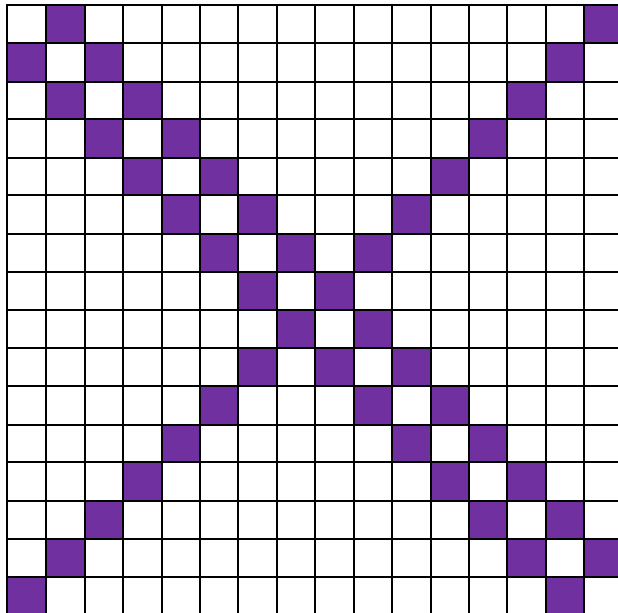
Brighton Honey Comb Weave

1. Pictorial view

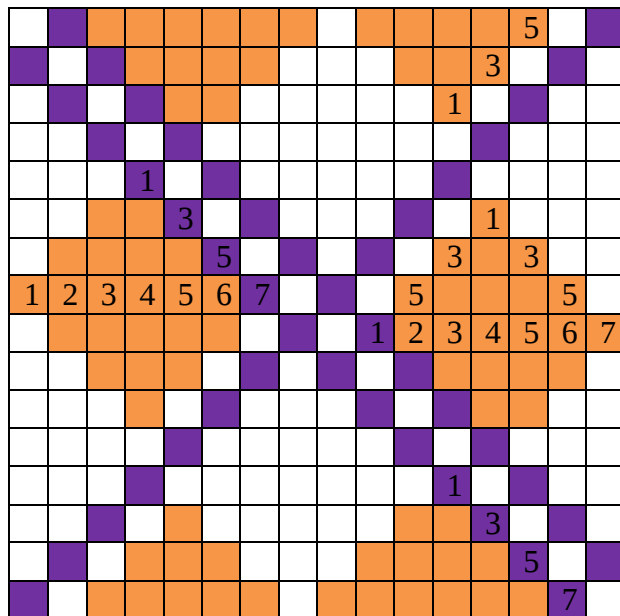


2. This weave is usually used for decorative purpose like bed covers, curtains clothes.
3. There are 4 warp diamonds (2 full and 4 half), and 4 weft diamonds (2 full and 4 half).
4. Minimum repeat size possible is 8x8.
5. Draft is straight, so the peg plan is same as design.
6. It can be made on square with repeat size divisible by 4. Example is 8x8, 12x12, 16x16.

A



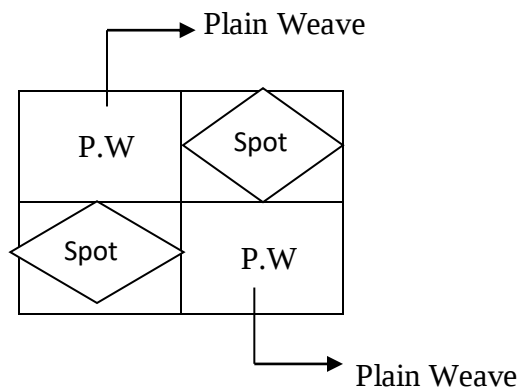
B



HUCK-A-BACK and MOCKLENO

Huck-a-Back

1. Pictorial diagram

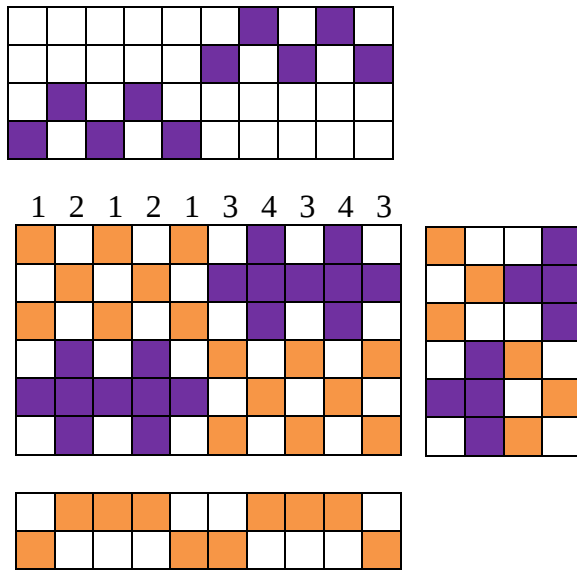


2. The weave is normally used for linen and cotton towels, glass clothes etc.
3. The spot is used for absorbency and the plain weave is used for firmness.
4. Draft: normally odd ends are taken in first two heald shafts and even ends on back heald shafts so that coupling of 1 & 2, 3 & 4 can be done together.

Youtube channel : . <https://www.youtube.com/channel/UCnPu8vcBvMdV5wtPTxC4uLA>

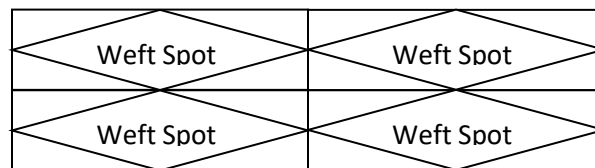
5. Denting: it is customary to place last end of the first group and the first end of the next group in one split.
6. Hack-a-back spot is normally odd sized. Example 3x3, 5x5, 5x3.

Spot Size= 5X 3, Repeat Size= 10X 6.



Mock Leno

1. Pictorial diagram.



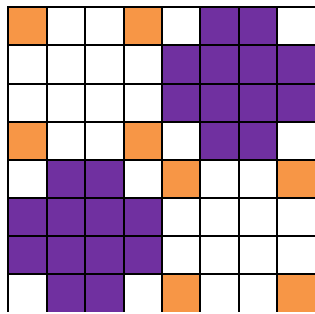
2. The fabric prepared is used for decoration, embroidery work. It can also be used for suiting, shirting and dress materials.
3. This fabric has perforations, and is used for decorations.
4. The other uses are canvas fabrics, cheap fabrics for window curtains, light dress fabrics, blouses, apron etc. this weave is generally employed in combination with other weaves.
5. The weaves are in sections, and tend to oppose each other.
6. Denting order: All the threads in the group are to be taken in one dent and next dent is skipped so as to maintain regularity.

7. Mockleno is normally even sized. Example 4x4.

This has a guaze and leno type appearance in the fabric. In this, instead of plain weave the mirror image (i.e. opposite of warp spot) is there. Figure 6(d) and 6(e) shows the example. Figure 6(d) represent with a spot of 6(a) in which the huck-a-back and mock leno are designed with the use of a 5x3 spot. The figure also shows the denting order.

Spot Size = 4X4,

Repeat Size= 8X8.



Feature of Different Fabric –

cambric original name of a fine linen cloth made of cambric in Belgium and is now applied also to a fine bleached cotton texture which is usually given a rather stiff, bright finish and used for summer dresses. A class of cambric used for dress linings is finished soft and is termed kid finished cambric 60s to 80s cotton warp 80s to 120s cotton weft. 96 ends and 80 to 144 picks per inch [ppi].

gabardine is a Warp faced cloth mostly woven in 2 and 2 twill which produce a fine steep twill effect on account of the predominance of the warp over the weft, but lower qualities are sometimes made in 2 and 1 twill. Largely used for rain proof over coating and made at first with botany worsted warp and cotton weft, but the warp is now more frequently composed of cotton or a mixture of wool and cotton 2/60s botany warp. 2/60s or 2/80s cotton weft, 108 ends and 88 picks per inch.

The cotton weft is yarn dyed but the wool warp may be dyed in the piece.

Chiffon is a very soft and filmy plain woven silk texture, consisting of the finest singles, which are hard twisted and woven in the gum condition and the cloth being after ward degummed 1.7 tex warp and weft, 40 ends and picks per cm. The terms chiffon is also used in conjunction with certain silk fabrics which are finished with a soft pliable feel. E.g.: chiffon velour chiffon taffeta.

denim is a strong warp faced cotton cloth used for overall jeans, skirts etc largely made in 3 and 1 twill weave. The cloth is sometimes piece dyed, but generally the warp is yarn dyed brown or blue and crossed with white weft. The colour should be fast to washing. 18s warp and weft of 14s, 90 ends and 60 picks per inch.

jeans is 2 and 1 twill cotton cloth made warp or weft faced. When woven with a warp face in strong yarns a drill structure is formed. 20s warp and weft used and 90 ends and 64 picks per inch. The weft face cloth is made higher tend is used for linings. 28s warp, 32s weft, 60 ends and 100 picks per inch.

voile is a plain woven, open fabric made from hard twisted warp and weft yarn which is combed and gassed in order that the thread will be smooth and produce a clear, crisp fabric. Made in both worsted and cotton yarns which vary extremely in thickness in different makes.

A cotton voile 2/50s warp and weft, 34 ends and 36 picks per inch or 2/100s warp and weft, 58 ends and 50 picks per inch.

blanket is a heavy fabric produced from wool or a admixture of wool and cotton. Sometimes cotton, acrylic and polypropylene are also used.

After reading student should be able to answer:

Q. Voile is an example of

- a. Plain weave b. twill weave c. Satin d. Diamond

Q. Gabardine fabric is an example of.

- a. Plain weave b. twill weave c. Satin d. Diamond

Q. Gaberdine is Weave.

Q. derivatives of Honeycomb weave are ordinary and

Q. Compare Huck-a-back with Mock Leno.

Q. Draw 12x12 ordinary honey comb.

UNIT V

Rib and Cord Structures

Welt and Pique structure

These structures are characterized by pronounced ridges with lines of the ribs or cords visible weft wise. The structure consists of a plain face fabric composed of two series of warp (face ends) placed on a moderate (normal) tension beam; and a series of back or stitching warp threads placed on a separate heavily tensioned beam. These are woven with one series of weft. These tight ends are stitched woven at a fixed interval in the plain face texture. Due to result of which these are pulled down and an indentation is formed.

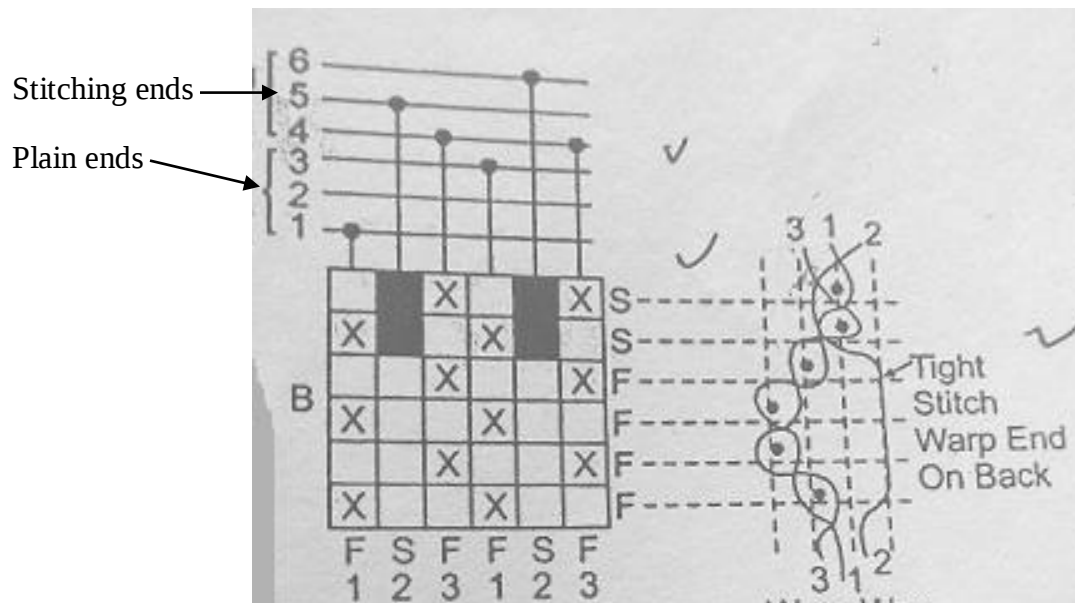
If the indentation is of continuous sunken lines that run horizontally in a single line, it is called a *welt structure*. But, it is scattered horizontally (not in a horizontal line but arranged in alternate group), then it is a *pique*. Following are the derivatives.

welt structure

1. It is in 1Face 1Welt & 1Face (1F1W1F) Combination. .
2. The welt end has just warp over two picks for stitching. However, the maximum length of consecutive stitched picks cannot be more than 12.
3. The draft is prepared with plain ends on front heald shafts.

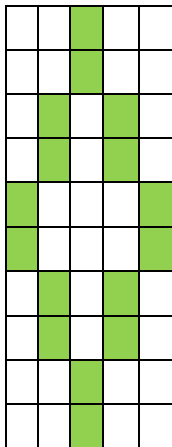
e.g. —6 pick welt.

R.S=6x6

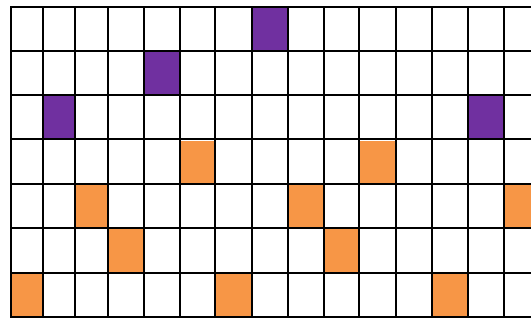


Waved pique

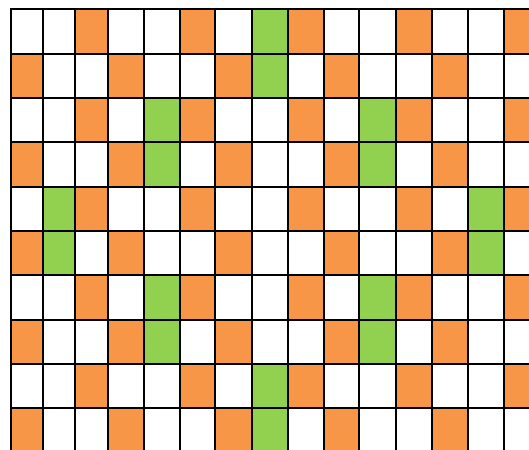
The indentations are not in horizontal line. However, group of mark do not overlap each other. The mark in design indicates the lifts of stitching ends. Following example first shows the design in 8x20. This same design is put in between two plain weave ends. Thus the ends are $8 \times 3 = 24$, and the picks remain the same i.e. 20.



SPOT: 5x 10



Draft



15x 10 Design

comparison with welt. Plain faced bed ford cord (Regular and alternate pick principle) Wadded bed ford cord, Twill faced bed ford cord.

Bedford cord

This type of weave produces longitudinal (length wise) lines (bulginess) in the cloth, with sunken lines (grooves) in between. These weave are used for toweling purposes. They can also be used for shirting and other types of dress material. In it, it is also used in heavier texture in worsted, and in cotton in lighter texture. The cord effect is done in solid colour effects. It is also used for furnishing fabrics. Wadded threads are used to enhance the effect. There are two groups. The first one constitutes the cord effect, where it weaves face thread as plain. The second group of these threads is called as cutting ends. They weave in a pair or on alternate picks. Following type of Bedford cords are there:

1. Plain-Face Bedford cord.
2. Wadded Bedford cord.
3. Bedford cord on alternate picks.
4. Twill Bedford cord.
5. Crepe Bedford cord.

Cords ends are responsible for producing bulginess, and two plain weave ends are used to produce sunken lines. The *draft* is with the binding ends on the front heald shaft.

Plain faced Bedford cord

1. The number of ends between the pairs of plain ends can be varied, as per the width of cord required.
2. Insert the plain weave after the interval of cords; in 4 ends (sunken lines).
3. Inserting cord ends:
 - i) Insert first end second pick of one cord with all warps up.
 - ii) Insert third end fourth pick of other cord with all warp up.
4. Insert plain weave on the other part of cord i.e. on two picks alternately.
5. Draft is prepared with plain ends taken (sunken lines) on front heald shafts.
6. Lifting plan is a combination of plain and twill weave.
7. To develop sunken lines prominently, plain weave should be separated by the splits of the reed. Sometimes, the pair of plain ends is dented together. Number of ends are passed through each split as Per fineness of the cloth (2, 3 or 4).



Wadded Bedford cord

1. The basic structure of this Bedford cord is same as the plain faced Bedford cord.
2. In this extra wadded ends are inserted.
3. These ends do not weave. They lie between the weft floats and the cord warp ends.
4. The wadded ends is used to : (i) increase weight of the fabric (made waste material) that lower cost of material; and (ii) increase prominence of cord without disturbance.
5. The wadded end in design are up all picks with the cord and down all picks in the other (plain weave) interweaving portion.
6. *Draft* is made with wadded ends are filled after sunken plain weave heald shaft, and before cord ends.
7. The denting order is adjusted along with the corded end, in the split.
Eg. let us take a float of 6 ends. Plain weave ends = 2. Wadded ends= 2. Then total ends is $(6+2 \text{ plain} + 2 \text{ wadded}) \times 2 = 20$. The picks is fixed at 4.
So, R.S. = 20×4 .

Bedford cord on alternate picks

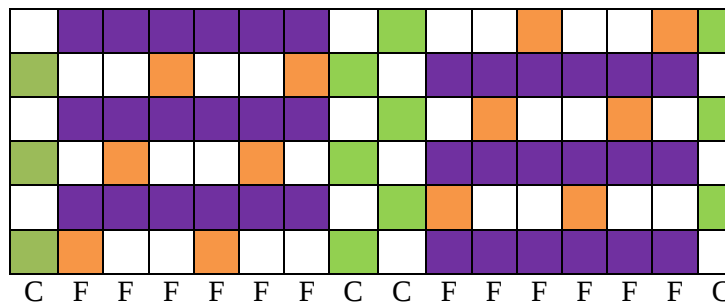
1. The basic structure of this Bedford cord is same as the plain faced Bedford cord.
2. Instead of the two cords running simultaneously, in this alternate picks are floating at the back.
3. The marks of plain ends are also changed accordingly. So, the plain end and the marks of the cord end up and down not join.
4. If wadded threads are introduced then wadded warp are up only at corded picks.

Twill faced Bedford cord

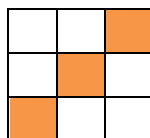
1. The basic structure of this Bedford cord is same as the plain faced Bedford cord.
2. Instead of plain weave that was filled up with the cord picks, now twill faced is being used.
e.g. Face weaves: 2\1 twill. So, cord on : $(3/6/9+2)$ i.e. 5, 8, 11 etc.... Ends will be 10/ 16/ 20 as explained below. And number of picks now required = $3+3=6$, instead of 4, as in plain face bedford cord.

E.g. $(6+2) \times 2 = 16$, R.S. = 16×6

A



B



After reading student should be able to answer:

Q. Bedford cord does not has which of the following derivatives

a. Plain weave b. twill weave c. Satin d. alternate picks

Q. In pique the indent is

Q. Give an example of 10 pick welt.

Q. Draw pique.

Q. Draw wedded Bedford cord weave.

Q. explain Bedford cord weave with derivatives.