A Comprehensive Guide to Woven Fabric Design, Structure, and Industrial Applications

STRUCTURE & TECHNOLOGY
of
Single Layered Woven Fabrics

Structural Engineering and Technological Innovations in Woven Fabrics

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Dedicated to my Parents, wife

Dr. M. Vanitha and

lovely son

Jamakhandi Arvind

CONTENTS

CHAPTER 1
Introduction to Woven Fabric Structure

Fabric structure and design is a part of weaving which deals with production of fabric on an equipment called loom. Fabric structure deals with the construction of fabric (material data and manufacturing data) based on the specific end use. To understand Fabric structure, it is necessary to consider certain aspects related to weaving or Fabric Formation. Weaving is a process in which the cloth or fabric is produced on loom. Each loom is specified in terms of Reed space expressed in inches or cms and is related to width of fabric to be produced or under consideration. In other words, particular loom equipment is selected based on the nature of Fabric to be produced with respect to width, category, nature, type of warp and weft etc.Fabric is defined as a structure characterized by length, width, thickness and weight and is the Interlacement of warp and weft. Fabric comprises longitudinal threads known as warp (individual threads are called as ends) and horizontal threads known as weft (Individual threads are called as picks). Warp is delivered from weavers beam and passes through drop wise, healds (heald eyes), Reed and finally culminates at Fell. Similarly, the weft is supplied from a package known as pirn, accommodated in a moving boat called shuttle and the later traverses from one side of the loom to other side. The number of threads are expressed per unit area like per inch or per cm and is represented by n_1 x n_2 (ends and picks per cm or inch).Whenever shuttle traverse from one side to other side, it lay a pick or single weft. Lifting of warp over the weft or lowering of warp under the weft forms interlacement or fabric.The warp threads are drawn through heald eyes of heald shaft (which are selected based on the total number of ends, drawing order i.e. number of ends drawn per each heald eye) and through dents of Reed (which may be pitch baulk or all metal type and generally two ends are drawn per dent) and finally converges to fell. It is the heald shafts which may be lifted as per the order (lifting or peg plan) over a pick (which is inserted by shuttle as it passes through shed which inturn formed by separation of warp into layers) to form a specific interlacement or design. This is how a fabric is formed on loom. During weaving rate of delivery warp is being controlled by let-off motion and fabric formed is wound onto cloth roller by takeup motion and it is to be noted that both will be working in unison. Fabrics differ on various grounds like count of warp and weft, nature of yarns, type of yarns, weaving method or order of interlacement, width, type of selvedge required etc. To know the details of weaving motion, the reader is suggested to refer any weaving book[1].

Elements of Fabric:

Each fabric is characterized by the following:

a) Body and Selvedge
b) Face and back
c) Warp and weft
d) Width and weight (GSM)
e) Weave (warp faced / weft faced / equi faced)
f) Threads/unit area – cover factor

Body Vs Selvedge:

Selvedge is the end point for a fabric and between the selvedges the fabric width is specified. The selvedge is characterized by

a) Width – which may be from 0.5″ to 1.5″ each side.
b) Weave – normally weave used in selvedge will be different from that of body.
c) Type of yarn – Selvedge uses always double yarns and are drawn 2 per heald eye in heald shaft and 4 per dent in Reed.
d) Additional selvedge – which carry the name of the fabric or name of manufacturing company etc.

The main purpose of selvedge is to impart strength to fabric and in finishing machines (stenter) the fabric is finished by holding the selvedges either by pins or clips. Total number of selvedges will be equal to : 2 x number of selvedges on a side. On the other hand body represents the main part or area of fabric which may be dyed/bleached/printed or woven. If woven or printed the prints or designs will differ from selvedge. Body may also contain certain extra designs at some places across width (eg.Butta style in saris).Total number of ends in body is given by: ends/inch x body width in inches. Body and selvedge can be very easily distinguished specially in case of weaves like sateen, twill, toweling etc.

Face Vs Back:

Every fabric is characterized by face and back sides. It depends on the condition or state of fabric. For example: in the case of dyed or bleached / mercerised goods both face and back are same, if printing is one side, then face is the side where print is observed. It is necessary to identify face as fabric analysis is normally done on face side only. Face and back are easily distinguished in case of warp faced or weft faced weaves. Eg. 3/1 or 1/3 or 5-end sateen etc. face and back can also be distinguished in complex structures like extra thread figuring (ex warp or extra weft), backed cloth, double cloth, tile fabrics, Bedford cods/piques, velveteen's/velvets etc. But face and back cannot be identified in plain weave (1/1), gauge and leno, equifaced weaves (2/2 or 3/3 etc.)

Warp and weft:

Warp differs from weft in fabric with respect to its position. Warp and weft do differ on many grounds like twist multiplier, tension during fabric formation, preparation of warp and weft for weaving etc. However, from fabric structure point of view we look for count of threads (linear density). Majority of the cases warp and weft counts are same (nominal) even through actual count differ. It should be noted specially in plain weave or fabrics the counts are retained same to get approximately square set fabrics and all the commercial plain sorts belong to category (sort: In industry each type of fabric is called as sort and is given a number known as sort number for its identification).

Width and Weight:

In the olden days, fabrics were sold on weight basis and even now silk fabrics are selected by consumers on weight basis only. However all fabrics are identified or specified by 'width' expressed generally in inches. All fabrics are classified into various classes based on width like narrow, medium, wider and broad width cloths. Today in market we have ribbons, tapes, honey comb towels (28″-32″) Terry towels (30"-35″), shirting (nearly 44"-46″), suiting (58″-60″) bed spreads (58″-64″), widths of bed spreads for double caught, sheeting's up to 330 cm etc.It's well known fact that fabric width reduce as it passes through various wet processing stages. Today in chemical processing a pre shrunk process (zero-zero finish or sanfrorising) is available to prevent fabric from further shrinkage during use.Width refers to the distance between two selvedges of a fabric, which may be unfinished (grey loom state) or finished. Hence if it is necessary to produce or plan for production of a fabric, calculations are made from finished state in reverse direction. It should also be mentioned here that indeed fabric width has made is mandatory to manufacture loom of a specific Reed space and this is true in shuttless weaving and even in non woven also (needle loom).

Weight

Weight is an important measure for a fabric plain cloths are classified (into light weight, medium weight and heavy weight) based on weight. Fabric weight can be estimated by different routes like

a) Direct method or Arial density (it measure the length, width and weight(Figure A 1.1)

$$\text{Weight (g/m}^2\text{)} = \frac{\text{weight in grams}}{\text{Area in m}^2}$$

b) Template method (using GSM cutter) or quadrant balance method – fabric of specified area is cut and hung on to the hook of the instrument, which reads the weight (03/yd^2 or g/m^2).(Figure A 1.2)

c) Empirical method

d) W (g/m^2) = 0.1 [n_1 x N_1 (1 + C_1) + n_2N_2 (1 + C_2)] where n_1, n_2 are ends and picks per cm, N_1 and N_2 yarn count in Tex, C_1 and C_2 crimp of warp and weft in percentages

$$W_{(oz.yd^2)} = 0.6857\left[\frac{n_1}{N_1}(1+C_1)+\frac{n_2}{N_2}(1+C_2)\right]$$

Where n_1, n_2 are ends/inch, picks/inch, N_1, N_2 – English count , C_1, C_2 – yarn crimp (%)

Weight is also a measure to specify quality in weaving and processing units (eg 6 kg quality – 100% polyester dress material).

Fig. A 1.1

Fig. A 1.2

Weight of fabric is governed by a number of factors like:

i) Type of fibre
ii) Nature of fibre
iii) Type of yarn
iv) Count
v) Threads / cm

Weave:

Weave is defined as interlacement of warp and weft and can be represented by m/n, where m=number of up and 'n' number of down. If m=n it is equifaced weave (eg. 2/2/, 3/3, 4/4) m > n warp faced weave (3/1 or 2/1) and m <n it is weft faced weave (1/2 or 2/3 or 1/3).Warp faced weave and weft faced weaves are used in respective constructions. Weaves can be used to represent either single layered structure or multi layered structure. Combination of two or more weaves can be used as modification of basic weave (eg. Crepe weaves by super imposing, double cloth – using face and back weave etc.).Weave always represents the minimum or repeat size of interlacements.

Threads/unit area (Reed x pick) and cover:

Cover factor of a fabric greatly depend on count and threads / cm or inch. Let 'n_1' be the ends/unit area and 'n_2' be the picks/unit area then n_1 x n_2 is (pronounced as ends/unit area and picks/unit area) threads / unit area or thread count. If $n_1 > n_2$ – it is a warp faced construction (eg. Poplin of plain sort 112 x 72, sheeting of plain sort – 52 x 44) $n_1 < n_2$ – it is a weft faced construction (eg. Casement of plain sort 58 picks and 48 ends), and $n_1 = n_2$equifaced construction (eg. 80 ends and 80 picks of long cloth – plain sort) etc. It should be noted very clearly that majority of fabric constructions are warp faced in weaving (Reed count higher than pick wheel) and if Reed count is lower than pick wheel bumping conditions present (a method to improve the cover factor). In weaving threads/cm or unit area is generally represented by REED x PICK (pronounced as Reed and pick)Cover factor is defined as the factor which expresses the extent to which the threads are covered in a fabric. Thus low cover indicate open structure, medium cover indicate moderate structure and close set or high cover indicate a very close construction like 125 ends x 92 (silk saree) picks or even 190 ends x 100 picks (sateen construction). It should be noted that based on cover some of the fabric applications are observed (eg. Curtain cloth – open set).

Let us analyse the construction particulars of following fabrics

Sl. No.	Threads/ icnh		Count	
	n_1	n_2	N_1	N_2
1	102	75	40's	40's
2	92	88	60's	60's
3	80	80	30's	30's
4	42	58	10's	10's

In the above table it is seen that sample no. 1 & 2 are warp faced fabrics and 3 is equi faced fabric and sample 4 is weft faced fabric .

Fabric shrinkage:

Any fabric shrinks in different states, from loom state on wards. It can be recalled that width of warp on beam (weavers beam) is different from width in Reed, width of fabric on front rest differs from width in Reed, width on cloth roller differs from relaxed width and finished width is smaller than grey width. Answer for all these changes is 'shrinkage', of cloth width wise and length wise. In some cases fabric shrinkage is high and noticeable eg. 10^s warp sized with 10%, 34^s or 40^s Reed, 8 or 10 pick wheel using 2^s Roving as weft to produce "chaddars" or thick bed sheets.When grey fabric subjected to preparatory process like desizing, scouring, bleaching or mercerizing, fabric undergo shrinkage. Thus if a cloth is finished, we need to calculate from reverse side to arrive at width of warp on beam.

Example 1: The finished width of a suiting fabric was found to be 58.45″ and shrinkage at different stages was as follows from dyeing to finishing 0.8%, from preparatory to dyeing – 1.0% and from gray to preparatory – 1.5% suggest suitable Reed space for the sort.

Solution: The width is calculated from finished stage.

W_1 = cloth width $(1 + C_2)$
(considering the weft crimp as nearly equal to shrinkage in weft direction)

$$= 58.45\left(1+\frac{0.8}{100}\right)$$

$$= 58.91''$$

$$W_2 = 58.91\left(1+\frac{1.0}{100}\right)$$

$$= 59.49''$$

$$W_3 = 59.49''\left(1+\frac{1.5}{100}\right)$$

$$= 60.38''$$

The suitable Reed space is 64″ RS

Method of Notation of Structure or Design:

Design or interlacement order can be represented through various means like cross-sections, thread interlacement diagram or universal notation X – indicates warp up and (blank) indicates weft up or warp down. Figure 1.1a shows the details

		X	X
	X	X	
X	X		
X			X

Figure 1.1 a – universal cross-blank system of notation.

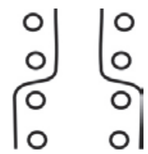


Figure1.1 b – weft cross-sectional views of 1^{st} and 3^{rd} ends.

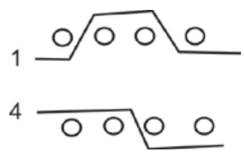


Figure 1.1 c – warp cross-sectional views of 1^{st} and 4^{th} picks.

b	b	a	a
b	a	a	b
a	a	b	b
a	b	b	a

a – warp up, b – weft up

Figure 1.1 d – ‘a’ and ‘b’ system of fabric notation.

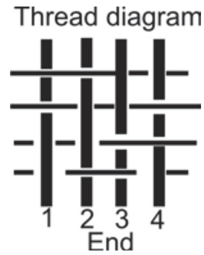


Figure 1.1 e – Interlacement or thread diagram for figure a.

If a warp or weft appears more than two times, it is referred as 'float'. The firmness of any fabric do depend on float. Generally more the number of intersections like in plain weave (1/1), the firmer is the fabric. On the other hand floating weaves like sateen or satin are not firmer. However, in certain cases like in toweling fabrics, it is desired to have floats for better moisture absorption. In advanced or complex woven fabrics like double or treble cloth, it is necessary to have floats, as the binding points or stitching points are selected in between floats.

Selection of Reed and its importance:

Reed is an important element in weaving irrespective of type of fabric formation technique. Reed is a part of beat up mechanism in loom and is selected in relation to ends/inch desired in fabric and width of the fabric. Normally Reed count is defined (stock port system) as number of dents per 2 inches. With 2 ends/dent order, Reed count is equal to ends/inches in Reed. Reeds are selected basically on warp count and number of ends/inch of the finished fabric.

Reed count is given by $= \dfrac{n_1}{1+C_2}$ where n_1=ends/inch, C_2 – weft crimp (%)

while applying the above formulae, sometimes it is practically impossible to use the Reed count obtained through calculation. In such situations, it is the trend to select the half the number of Reed count with 4 ends/dent. For eg. Warp count = 34^s , ends/inch = 98, picks/inch–85, weft count – 30^s, weft crimp 8%, as per formulae Reed count is given by

$$\text{Reed Count } = \frac{98}{1+\frac{8}{100}} = 90^s \text{ (approximate)}$$

But 34^s yarn cannot be woven using 90^s Reed (finer Reed) even though if an attempt is made, end breakages, selvedge breakages may be more. Therefore it is better to recommend $4/44^s$ reed. Similar is the case of poplin (40^s K x 40^s C), (112 x 78), (8% x 6.5%) formulae give 104^s Reed, but in weaving we use $4/52^s$ Reed. Another example is commonly sateen cloth using filament warp and filament weft has (194 x 100) where the weft crimp is minimum, it is better to use 94^s or 98^s Reed with 4 ends per dent. Reed count is available with maximum value as 120^s or 128^s, as normally 60% air space is considered, while designing a Reed. Reed also control the fabric texture and by using 4 ends/dent, Reed marks are observed in Grey fabric. These marks can be eliminated if fabric is subjected to chemical processing.

ELEMENTS OF FABRIC STRUCTURE

Design – is defined as the plan of interlacement of warp and weft (if it is referred to woven design) or the coloured arrangement of motifs on a suitable basis (if it is referred to a printed or painted design).

Draft – Defined as the order of drawing ends through heald eyes of the heald shaft. (Normally one end is drawn/eye only in case of weft rib/matt (2 ends are drawn).

Denting – It is a plan showing the order of drawing of warp ends through the dent of Reed (Normally we draw 2 ends / dent or 2 or one dent 3 in other dent or group dent as case may be)

Lifting: It is defined as the plan of order of lifting of heald shafts on each pick based on warp 'up' in design.

Types of relation among elements of fabric structure:

There exists linear and non-linear type of relations between design, Draft and peg plan. If the draft is straight, peg plan is same as design – This is linear relation. If the draft is pointed, peg plan is half of the design (partial relation with design). If the draft for plain weave is skip, peg plan is weft rib (Non-linear).

Construction of Elements of Fabric Structure

<u>Construction of Draft from Design:</u>

Draft for each design is constructed by observing following rules:

1. First end is drawn through first heald shaft (unless it is a special case)
2. Draw the ends working similarly in the same heald shaft.
3. Draw ends working separately in different heald shafts.

Notation for Draft : calculation of number of heald shafts and methods of draft indication

Generally 'X' (cross mark or 'up' mark) in any horizontal line (Heald shaft) in Drafting plan (Drawing-in-Draft or DID) indicates (Fig.1.2 a, 1.2 b, 1.2 c) that particular end is drawn through that heald shaft. The number of heald shafts required depends on the repeat size and type of weave. Generally with in a repeat all the ends will be working differently with exception of some cases like wavy twill or herring bore twill. In some cases there exists a relation between maximum float length and number of heald shafts (eg. Brighten Honeycomb. Number of Heald Shafts = $\frac{\text{Float length}}{2} - 1$) or repeat size with number of heald shafts (eg. Ordinary honey combs number of heald shafts = one more than half the number of threads in repeat).

There are two methods of draft indication like conventional and leno drafting is shown in Figures.

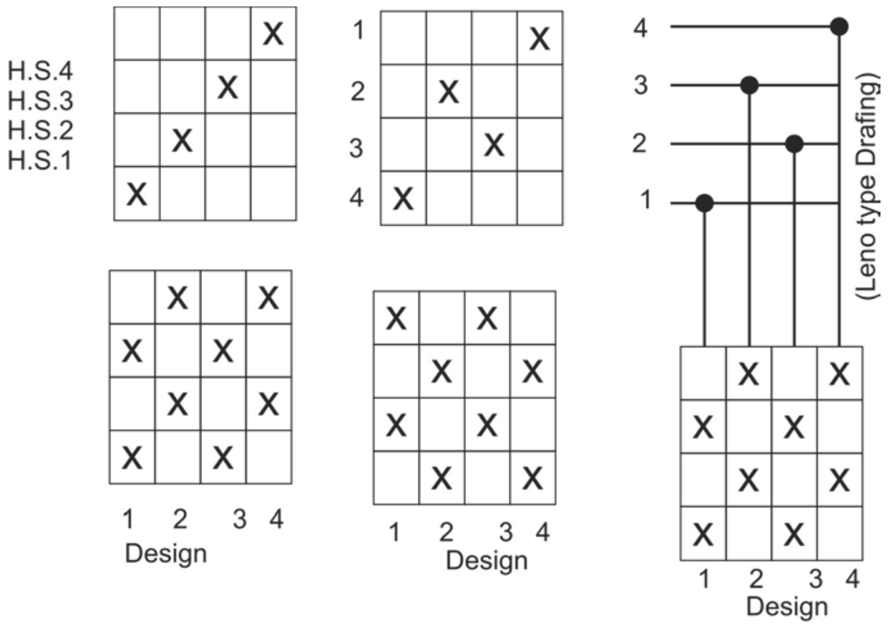


Fig 1.2 a Fig 1.2 b Fig 1.2 c

Fig. 1.2 Method of Draft notation (construction)

Construction of Design from Draft and peg plan:

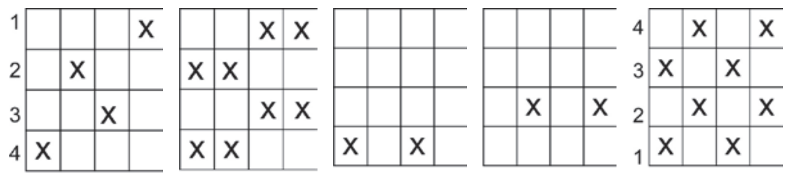


Fig 1.3 a Fig 1.3b Fig 1.3 c Fig 1.3 d Fig 1.3 e

In some cases design can be obtained from constructing draft first (eg. Skip and broken twill- skip and broken drafts are constructed first and then converted to design) (Fig.1.3 a to d)and subsequently design is obtained by cross reference of peg lifting plan (peg plan or lifting plan – In dobby pegging the lifting plan is used for pegging and hence the name peg plan with draft. The procedure is as follows:

Step – 1: Consider first pick (Fig. 1.3a lifting plan and refer the draft through which the end is drawn. (Note that the design will have vertical lines or ends equal to ends in draft and horizontal lines or picks equal to picks in peg plan and accordingly the size of the repeat is marked for design). Mark ‘X’ in the end on that pick in design.

Step – 2: Consider the next cross mark (if exists) on the same pick and refer back the heald shaft, mark the particular end on the 1^{st} pick by ‘X’ in design.

Step – 3: Consider next pick and repeat the above steps.

Construction of peg plan from Design and Draft:

This is normally practiced by weaver as and when a new design is to be produced on loom either by Dobby (pegging) or Jacquard (card punching). Following is the procedure:

Step – 1: Consider the size of rectangle (vertical and horizontal squares) equal to number of ends in draft and number of picks in design. For example design like 2/2 wavy twill on 8 ends drawn through 4 heald shafts for a point or ‘v’ draft, 4 picks of basic design repeat giving 4x4 for lifting or peg plan.

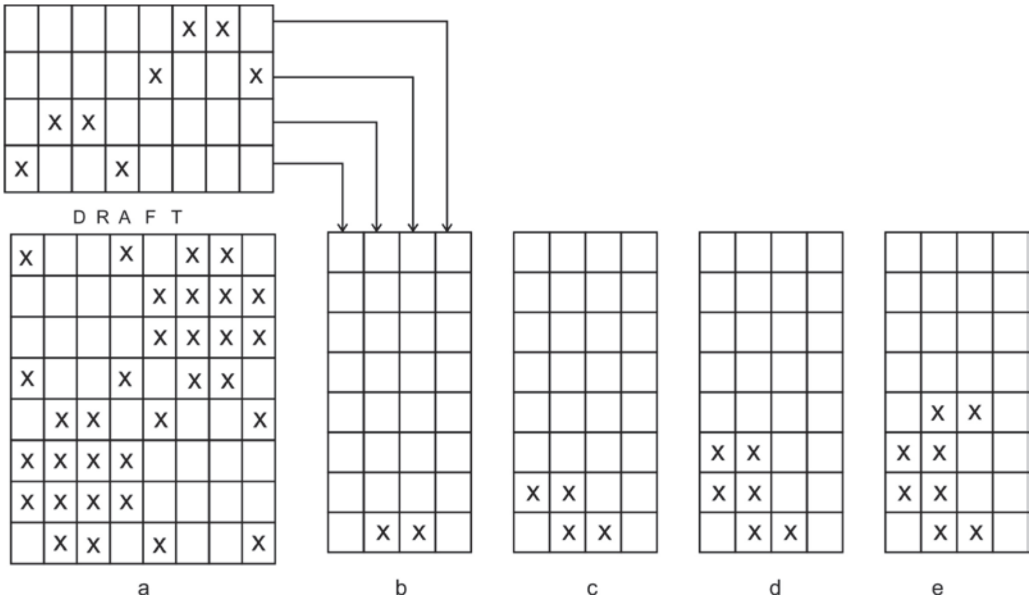


Fig. 1.4 Construction of lifting or peg plan

Example 2: Sateen on 5 ends and 5 picks – 5 heald shafts as it will be straight draft, 5 picks of repeat design and hence the size of peg plan is 5x5.

Step – 2: While constructing peg or lifting plan consider pick by pick. Refer a cross mark on the first pick and observe the heald shaft through which it is drawn, mark that heald shaft in peg plan by ‘X’ mark where a particular heald crosses the first pick.

Step – 3: Blanks are not considered while constructing peg plan.

Step – 4: Consider the next cross mark on the first pick and repeat the act of step 2. Repeat this until all the cross marks on the first pick are duly represented in peg plan.

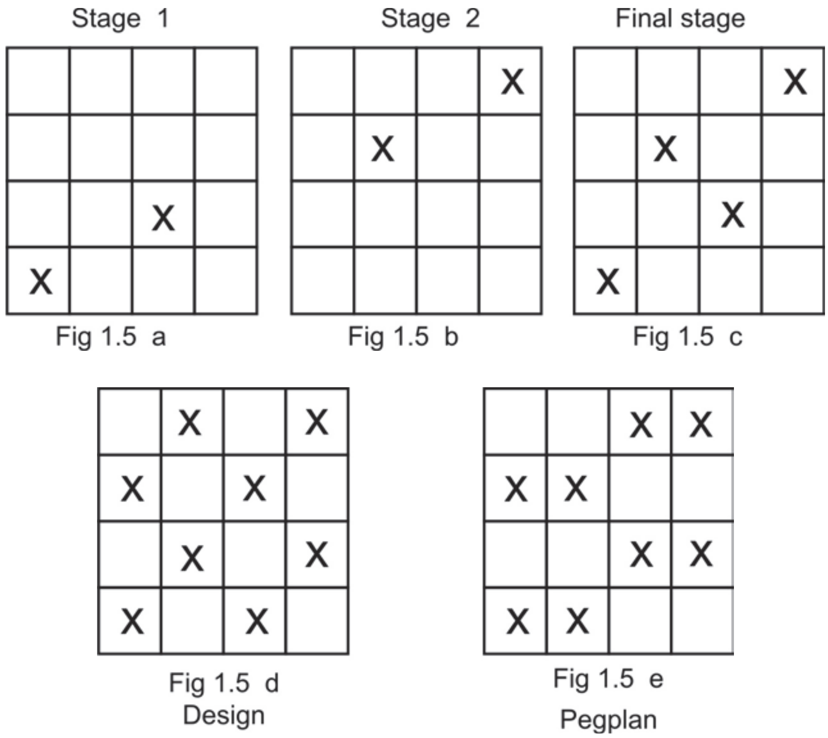
Step – 5: Consider the second pick and repeat step 2.

Step – 6: Repeat the steps until all the picks are completed (Note: Once the heald shaft is lifted on a pick, all the ends drawn through are lifted at a time).

Step – 7: Observe the peg plan for linear or non linear relation with design and draft.

Construction of Draft from Design and peg plan:

Normally Draft is constructed from design itself. But some times, the drawing order is selected specially to suit specific need in fabric production. In such situations, draft is constructed from peg plan and design. For example a plain weave (Fig.1.5) on 4 ends x 4 picks basically require only 2 heald shafts as per theory. But practical application use skip draft with 4 healds. Even a straight draft with 4 healds can be used for a design of 4x4 (which is not preferred generally) but use of skip draft assists weaving process. It should be noted here that certain toweling fabric like Huck – A Back on 6 picks 10 ends (Devon Huck) uses only 4 healds with special drawing arrangement like in the first half of the design, odd ends are drawn through front heald shafts and even ends through back healds (i.e. 1 and 3) and in the second half of design healds 2 and 4 are used. In other words, the basic rules of draft construction is not followed here.



TYPES OF DRAFT in weaving:

Depending on design, various types of drafts are used in weaving. Point paper show all these drafts(Fig. 1.6 ato e)

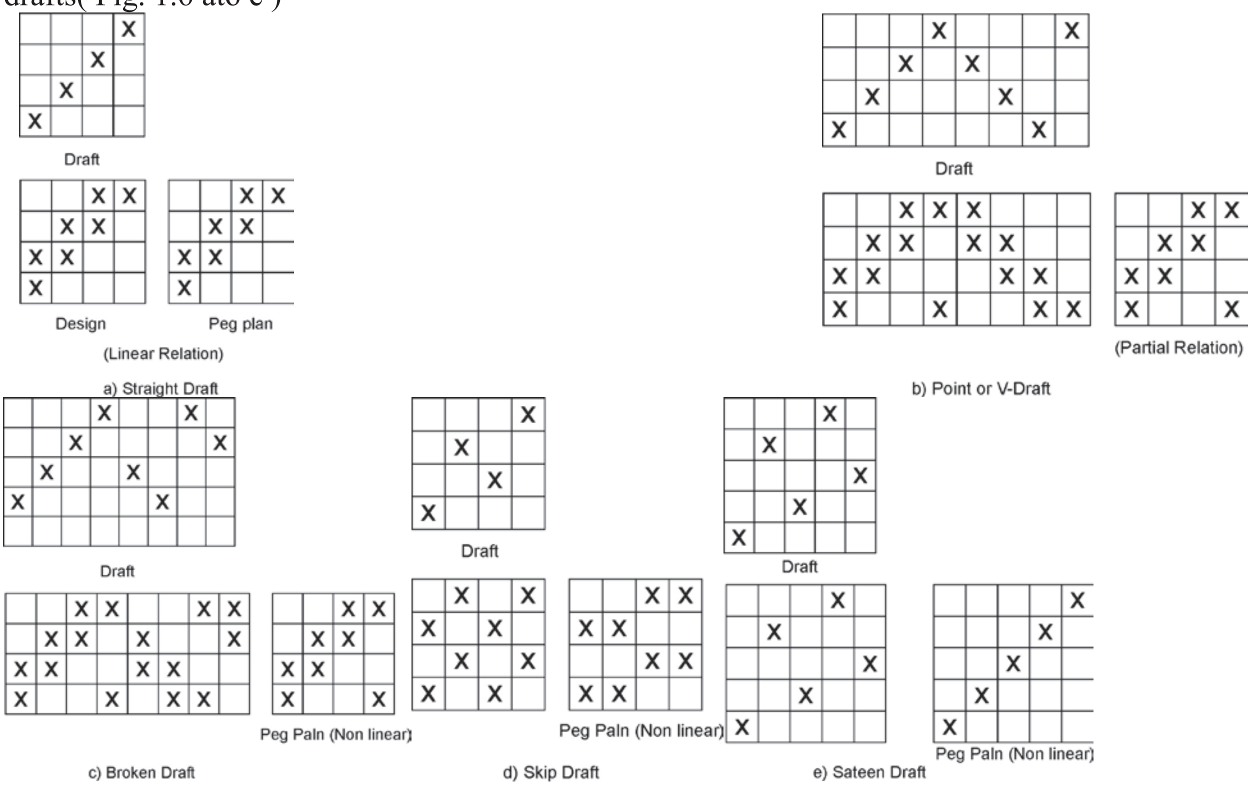


Fig. 1.6 : Different types of Drafts.

1. Straight Draft:

Non symmetrical motifs or figures need straight draft. Within a repeat all the ends work differently, straight draft is used. For example: Twill weave – 2/2 'z' need 4 heald shafts as four basic ends in repeat work differently. 5 – end sateen/satin are also examples of straight draft. If one consider compound fabrics like double and treble cloths, straight draft is used. Disadvantage from weaving point is that, more number of heald shaft demand larger figuring capacity loom and larger strain on warp, leading to low loom efficiency due to end breaks (Refer figure on point paper for straight draft). (Fig. 1.6 a)

2. Point Draft:

The main advantage of point or 'v' draft is increase in figuring capacity. In other words, the symmetry of motif or design results in double the number of threads per repeat. This also reduce the strain on warp, leading to improved quality and efficiency of loom shed. In point draft, each end is drawn in separate healdupto half of the design, and reversed there of(Fig. 1.6 b) Eg. Pointed or wavy twill, Honey comb (ordinary).

3. Skip Draft:

There are two types of skip drafts viz. 1. Skip draft used for plain loom 2. Skip draft used for skip twill. In plain weave to prevent end breaks due to over crowding, it is customary to use 4 healds instead of 2 and allow skip in drawing order i.e. (1,3), (2,4). However the healds are operated as two (by tyeing) using two tappets on bottom shaft. (Fig. 1.6 d)

Skip for 4 healds = (1,3) (2,4) ; Skip for 6 healds = (1,4) (2,5) (3,6) { Refer Figure 1.7}

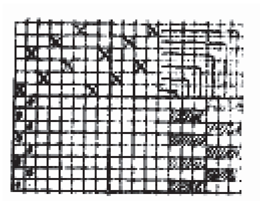


Fig.1.7

If it is necessary to know the skip order, consider or plain on m x n (Even number of threads) and draw the corressing m/n weft rib. Deduce the draft, using peg plan and design. For example consider plain on 6 ends x 6 picks. Draw peg plan on 6x6, introduce 3/3 weft rib. Rework draft from peg plan and design to know the exact skip order.

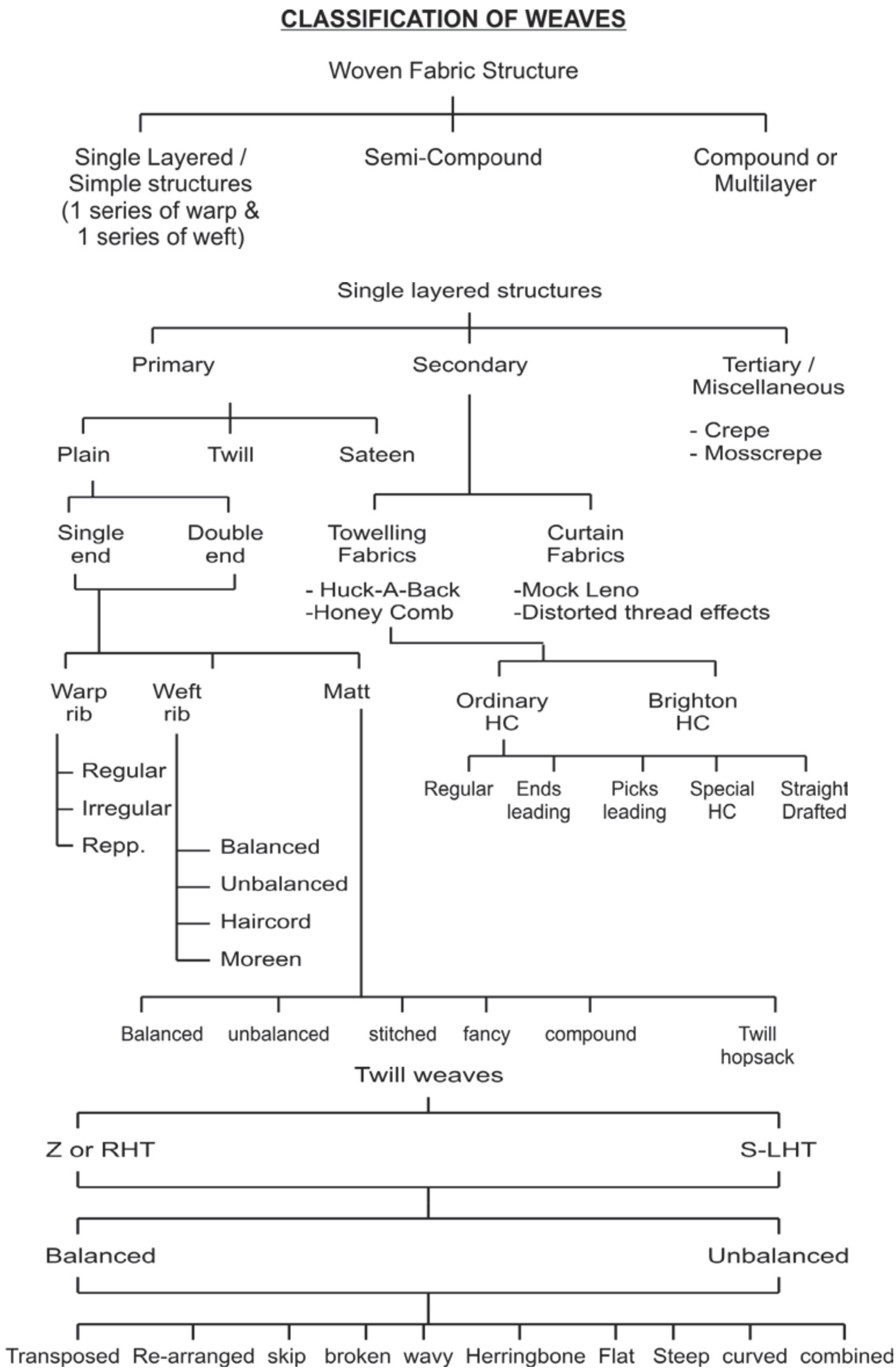
(Note: Here skip related to plain is discussed and skip draft related to twill will be discussed in twill chapter).

4. Broken Draft:

This is another special type of draft found for herring bore twill, sateen on 4x4, Broken twill, and transposed twill (if the weave number is divided into 2 groups of even size and introducing 'z' in one block and 's' in other block, we get broken draft also).Broken draft is obtained when the drawing order is straight upto half the threads and then reversed with break in order.(Fig. 1.6 c)

5. Sateen Draft:

This is a special draft associated with sateen or satin only. Here the draft is arranged as design. But, practically this may be tough to handle end breaks and mending there of as the drawing order is different to understand.(Fig. 1.6 e)



Continuous Twills

- Diamond
- Diaper

Commercial Twills

- 3 - End
  - Jeans 2/1
  - Denim 2/1
  - Graberdene 1/2
- 4 - End
  - 3/1 Drill
  - 1/3
  - 2/2 Gaberdene
- 5 - End (3/2)

Sateen / Satin

- Sateen / Satin Stripe & Check
- Warp Faced
- Weft faced
  - (Warp Faced and Weft faced): Regular & Irregular
- Modifications
  - Venitian
  - Lambsdon
  - Buckskein

Sem-compound Fabrics

- Bedford Lords
  - Simple BC
  - On Alternate picks BC
  - Wadded BC
  - Twill Back BC
  - Crepen BC
  - Backed BC
- Piques or welts (PIQUES)
  - Simple / Loose back
  - half fast back
  - Fast back
  - Wadded
  - Backed
  - Waved

Extra Thead Figuring

- Ex-Warp
  - Simple (1:1) continuous
  - Combined (2:1, 2:2, 1:2)
  - Modified ground
  - Dobby clipped spot
  - Jacquard spot
  - Cut away
  - Planting
  - Multicolour
  - by using special picks
  - Intermittent
  - Butta effects
- Ex-Weft
  - Simple (1:1) continuous
  - Combined (1:2, 2:1, 2:2, 3:1)
  - Cut away
  - Intermittent
  - Two colour
  - Butta
  - Special ends
- Immitation Effects
- Ex-Warp & Ex-weft

CLASSFICATION OF WEAVES

All fabrics are classified into three classes

i. Single layered or Simple Structures
ii. Semi Compound Structures
iii. Compound or Multi layered Structures.

Simple Structures of following types

i. Primary weaves
ii Secondary weaves
iii Tertiary or Miscellaneous weaves

Primary weaves are divided into

i. Plain weave
ii. Twill weave
iii. Sateen weave

Classification of Plain Weaves

i. Single end plain
ii. Double end Plain
iii. Warp Rib iv. Weft Rib v. Repp
vi. Seersucker
vii. Hair cord
viii. Matt or Basket or Hopsack weaves

Warp Rib & Weft Rib

i. Regular or Balanced
ii. Irregular or Un balanced

Matt Weaves

i. Regular or Balanced
ii. Irregular or Un balanced
iii. Fancy Matty
iv. Stitched Hopsack
v. Twill Hopsack
vi. Compound Matty

Classification of Twill weave

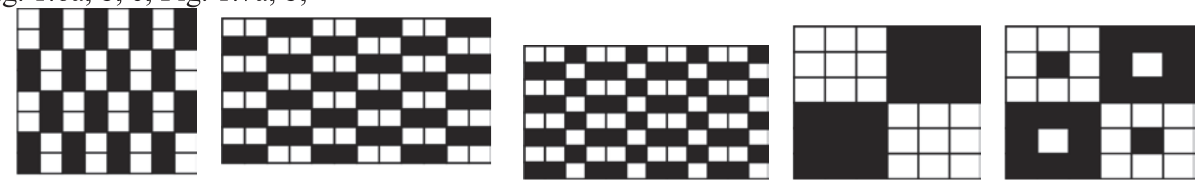
i. Balanced or Regular
ii. Unbalanced or irregular
iii. Z twill or Right hand twill
iv. S or Left hand twill

Z or S twill

i. Warp faced ,ii. Weft faced ,iii. Equi faced

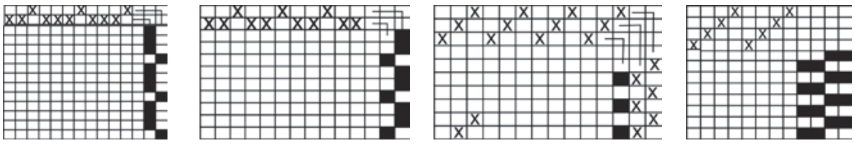
EXERCISES

1.. Develop Draft and peg plan for the designs shown in Fig E 1.1; Fig 1.3d; Fig. 1.4c;Fig.1.5a,b; Fig. 1.6a, b, c; Fig. 1.7a, b;



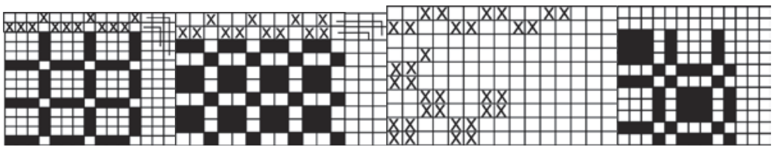
a b c d e

Fig. E-1.1



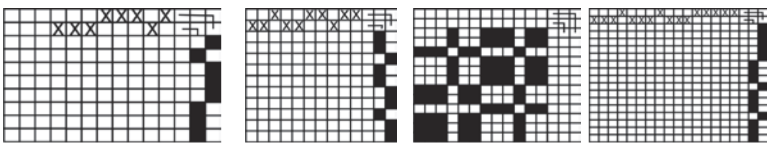
a b c d

Fig. E-1.2



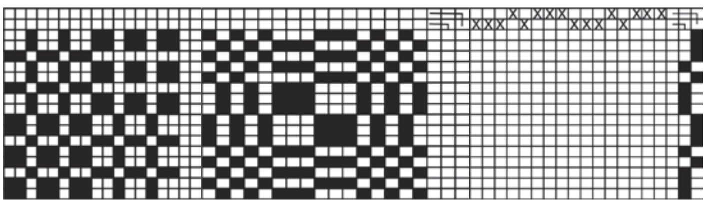
a b c d

Fig. E-1.3



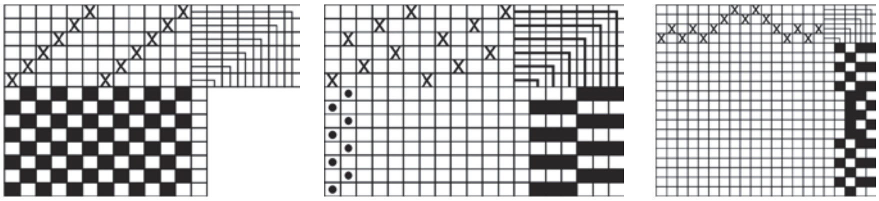
a b c d

Fig. E-1.4



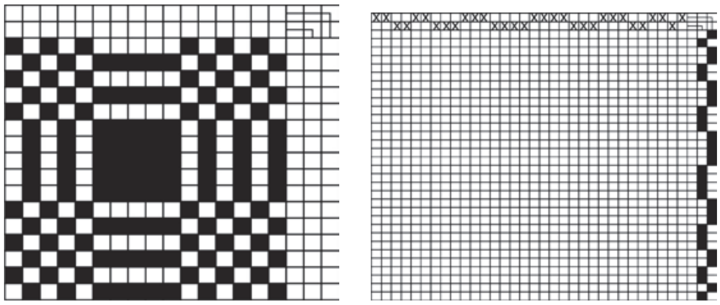
a b c

Fig. E-1.5



a b c

Fig. E-1.6

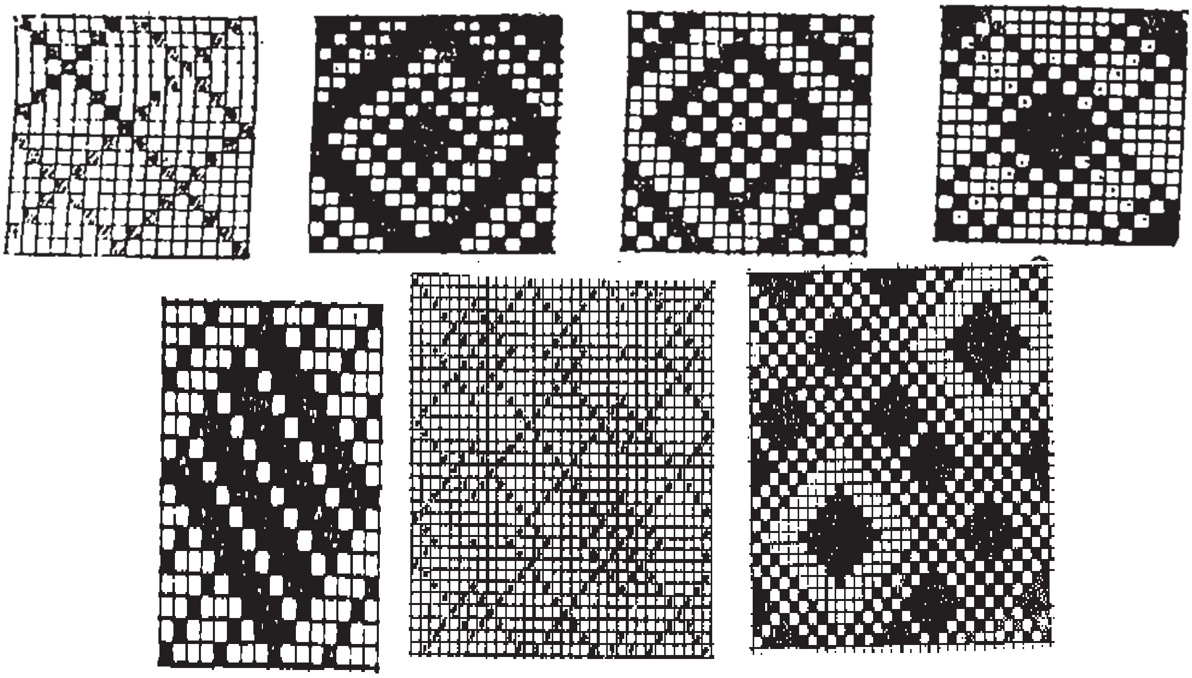


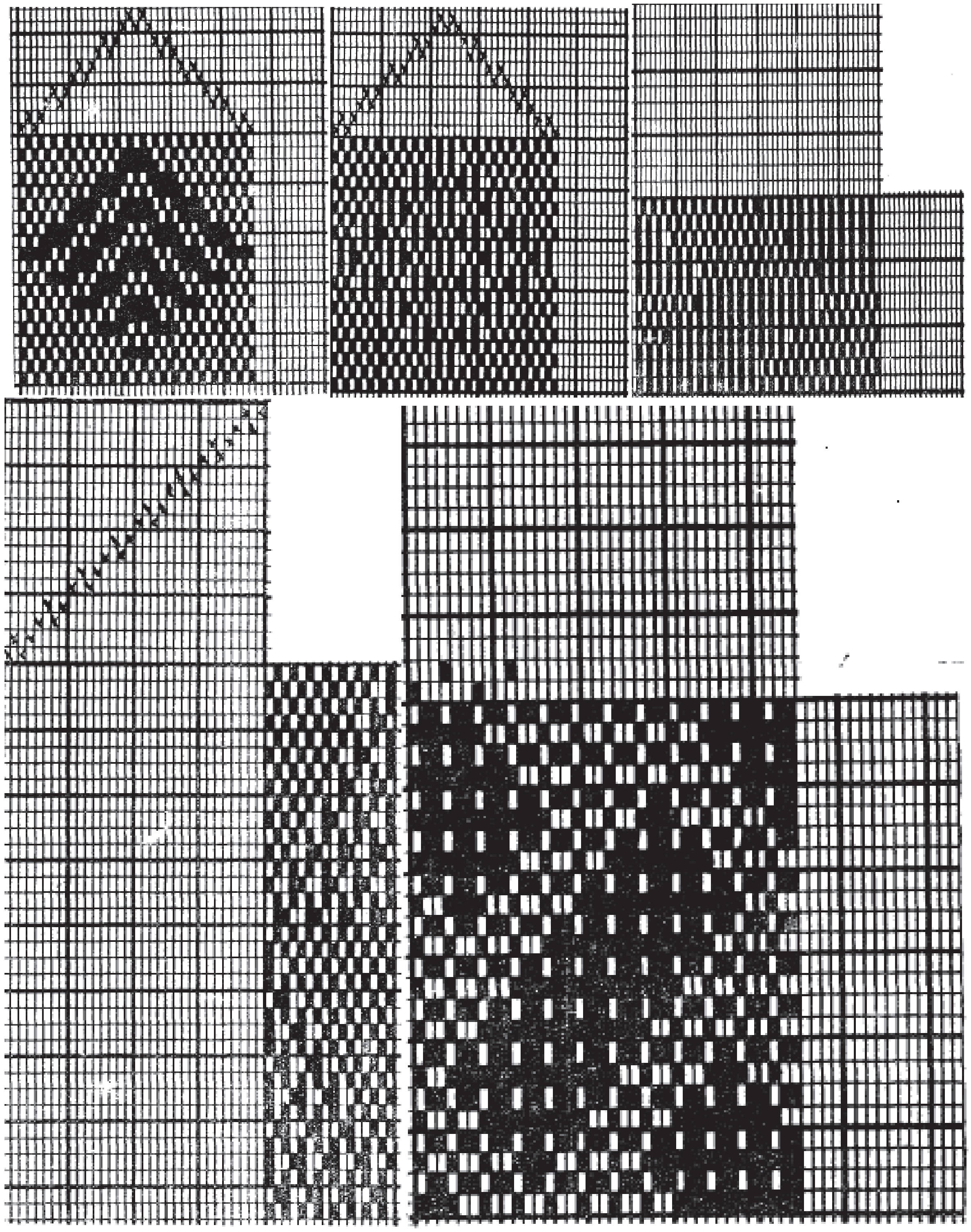
a b

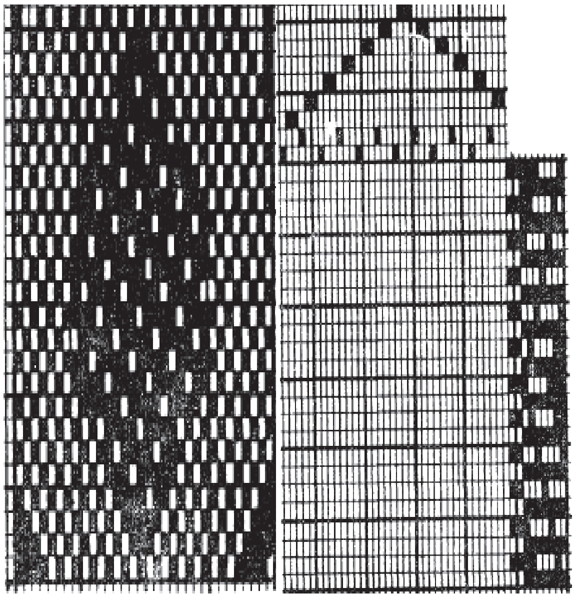
Fig. E-1.7

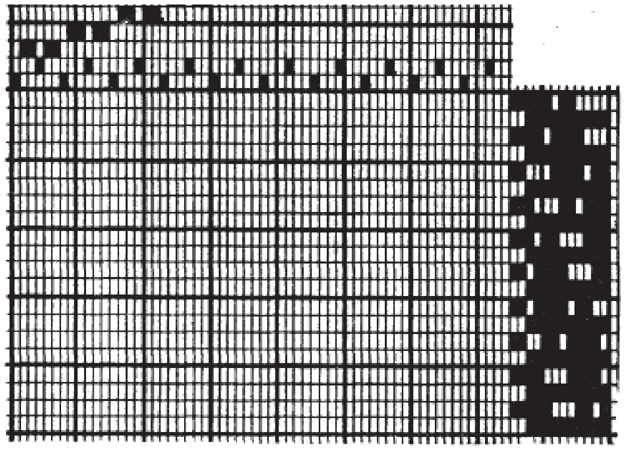
2. Develop design from draft from peg plan. Refer Fig. E 1.2 ato d, Fig. 1.3 c,d ; Fig. 1.4 a ,b,d, ;Fig.1.5 c, ; Fig. 1.6a, b, c; Fig. 1.7a, b;

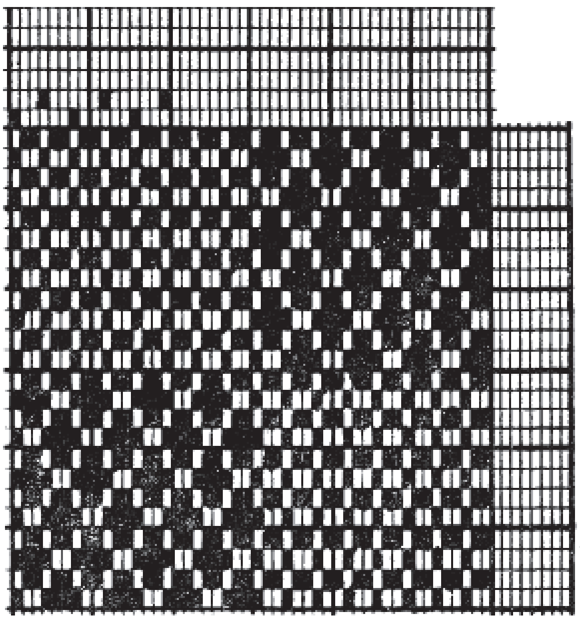
3.Develop all weavers plans for the following examples











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CHAPTER 2
Plain Weave & Its Modification

Among the primary weaves , Plain is very popular weave as it ensures maximum comfort due to its excellent dimensional stability as each thread support it adjacent thread. Interlacement order with one up and one down or the minimum number of ends and picks is two ends and two picks. Plain is known by various names like tabby, calico, alpaca, taffeta etc., Plain or calico as is familiar is most widely used structures among all the weaves of fabric structure. The equipment used is called as Plain loom and is characterized by various inputs like RS, type of Picking mechanism, Patterning type etc., In Plain weave the threads interlace in alternate order and if the warp and weft threads are balanced (i.e count and sett) the two series threads bend equally .

Characteristics of Plain weave.

- In this class each thread give the maximum support to the adjacent thread thus ensuring the maximum firmness among all the weaves. This is one of the strong reason why plain cloths are more popular than other type of weaves. Due to this characteristic feature, plain is used as ground weave in advanced, semi compound structures.
- As it is simplest form of interlacing, is used to a greater extent any other weave and diverse methods of ornamenting and of varying the structure are employed.
- By using different types of count or twist as warp and weft varied structures can be produced .
- Plain can be coloured in different ways to get beautiful effects on the concept of mixing weave and colour
- Plain indicates the closest possible order of interlacing two sets of threads
- Plain can be produced in widest range of materials and yarns like cotton, wool, silk, jute, viscose, Synthetics, glass etc.
- Popular constructions of plain like Muslin, voile, lawn, limbric, poplin, crepe, etc are produced on plain loom without much modification
- Even though weave is same the wide range of structures produced in plain differ mainly because of type and qualities of yarns used along with relative settings, depending on the end use of the cloth.
- Plain is the largest weave employed in Industrial fabrics or Technical fabrics.
- Even though plain weave is commercially produced in different varieties, all are represented by single type of structure.
- Plain weave can be modified either in warp way or weft way or both ways resulting different structures .
- Keeping the plain interlacement, using differently tensioned yarns (warp) ornamental effects are produced.
- Plain weave responds in a unique way for all the testing properties as compared to twill and sateen weaves.
- Plain can be produced in lightest voile to heaviest canvas or blankets.

- Plain is the only one weave where in wide range of textures can be produced by dyeing , printing, finished ,raising , cropping etc., with the same interlacement .
- Plain is used along with other complex weaves like Gauze or Leno for some special class of furnishing fabrics.
- Plain is ornamented in multi colours with stripe or check patterns meant for wide range of applications.
- Plain weave can be produced using different types of drafts like straight and skip

Rib and cord Effects in Plain weave (without weave modification)

By varying the thickness and threads per unit space rib and cord effects can be produced in plain weave. Term 'cord' represents the effects which run in length and where as rib runs in width direction .When ends /inch is more than picks per inch, the later tend to lie straight and warp bend around weft resulting in warp rib .On the other hand if picks per inch is more than ends per inch , the ends tend to lie straight and picks bend around warp threads resulting in weft rib .In any case the prominence of the rib is high if the straight threads are thicker than those which bend. In one of the method two warp beams are used with one heavily tensioned and the other slack tensioned so that heavily tensioned ends lie almost straight in the cloth and force the picks into two lines. The lightly tensioned ends are therefore compelled to bend round the picks so that horizontal ridges and depressions are formed in the cloth. The prominence of the ribs can be increased further using thicker ends with light tension than others. A method also include with equal thickness of threads and ends per inch more than picks per inch so as to form rib effect .i.e the rib appears on both sides of the cloth. Using a thick and fine threads alternately rib effects can also be produced .

Modifications of Plain weave

Necessity

Modifications of any basic structure is necessary to produce varied or ornamental effects by changing the number of interlacements ether in warp way or weft way or both way simultaneously. The modifications of the basic structure is also necessary to suit the specific end use . It should be noted that extension of basic plain need only two heald shafts. A group of structures are produced when a several picks are inserted in the same shed forming Warp rib or several ends are lifted on single pick forming Weft rib or both forming Matt weaves

Modification of Plain in Warp way – Warp Rib (Fig. 2.1 a to k)

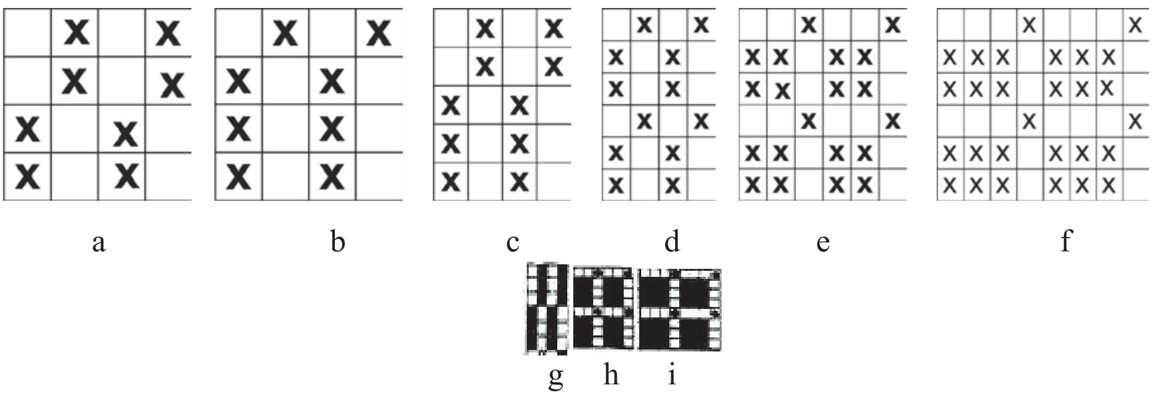


Fig. 2.1 Warp rib weaves

The details of Figure 2.1 are as follows

a..- 2/2 Regular rib, b..- 3/1 Irregular rib, c- 3/2 Irregular rib , d- 2/1 Irregular rib e- special warp rib on 2/1 with ply of 2 and one ends, f- Similar to 'e' but with ply of 3 ends and one end , g- 3/3 Regular rib, h &i. reader has to analyse

When the number of intersections in warp is increased, Warp rib is obtained. By increasing the number of intersections in warp direction, the effects will be running in weft side direction. This is indeed the basic principle of so called semi compound fabrics like "Bed ford Cords". In Warp rib the warp thread change positions on every second or third or fourth picks or on every second or one or third as the case may be. In other words warp ribs are produced either in regular or irregular concept. The pairs of picks or pair of pick may be of similar count of warp or different, accordingly the effects are produced. For example, use of two finer and one coarser picks or two coarser and one finer pick can be employed to produce warp ribs. In warp ribs warp threads change position one very second or third or fourth pick as the case be when two or three or four picks are introduced in the same shed . To improve the ornamentation sometimes irregular number of picks like two picks in the first shed, one pick in the next shed or three pick in the first shed followed by one pick in the next shed etc., may be employed . This type of structure in which more than two picks are inserted in the same shed call for higher warp density i.emore number of ends per inch in loom. But it is not common practice to weave a fabric with 2 picks in the same shed ,because by using one thick pick in place of the two finer picks almost the same effect is obtained at much less cost (The same mentioned later on in this discussion). However ornamentation in warp rib be obtained further when two picks used are of different color or different materials. Different cases of warp rib is shown on the point paper .Reader is directed to work out additional designs given as practice. Warp rib weaves are normally used in warp-faced constructions. The warp cover factor and the warp crimp are substantially higher than the weft cover and the weft crimp. The intention is to produce fabrics with prominent weft-way ribs formed by the crowns of the warp threads. For a given width of rib, therefore, warp rib weave gives a lighter-weight, thinner and more flexible cloth than plain weave. Note, however, that the ribs are necessarily less rounded. The weft will be thicker than the warp in order to emphasize the ribs .A cotton furnishing fabric in which ribs of varying width produced by varying the number of picks in the same shed. The ribs consist of 1,2 or 3 picks in a shed, arranged to produce a random effect. Suitable construction details are:

16s x 4s cotton (37x148 tex); 96x25; 8.5x1.0percent; 24 mils; 7.9 oz.; K_c = 24+12=36

Warp ribs can be produced by grouping together several ends which work like and raising them over a number of coarse picks and then passing them under one fine pick. This method give more prominent ribs than using alternate fine and coarse pikcs.

Weaving Arrangement

By inserting two or more picks in the same shed , Warp ribs are obtained. For this purpose in pirn winding machine two or three cones or cheeses or tubes are placed and yarns from the packages are plied and wound onto the pirn and the building motion of the pirn winder is set accordingly. But the only one major disadvantage in this arrangement is pirn exhaustion at earliest which results in frequent reshuttlings and thus the loom production will be low . In other cases using coarser weft rib effects are obtained . for example using 2 's roving and 10's warp blankets are produced. Depending on the structure like regular or irregular, box motions are used to produce warp ribs. The effects are also produced using quality material for odd ends and cheaper material for even ends ,cloth can be produced economically. Ribs are also emphasized using combination of coarse and fine , tight and slack and thick and fine picks .

Applications of Warp rib

Warp rib are used in warp face constructions .Basically these are used for furnishing fabrics and as ground weave for terry towels .They are also used along with other class of weaves like gauze or fancy weaves etc.,

Commercial significance of ribs production

Commercially ribs are produced using 2's roving as weft and 10's warp sized with 10 % add on with over pick loom of 60 inches reed space. These are called as " blankets" . The only problem of weaving 2's weft is the quick exhaustion of the weft .Of course the pick spacing will be very low as the thickness of roving is sufficient to get placed in an inch .

Production of Weft rib or Moreen(Fig. 2.2 a to d')

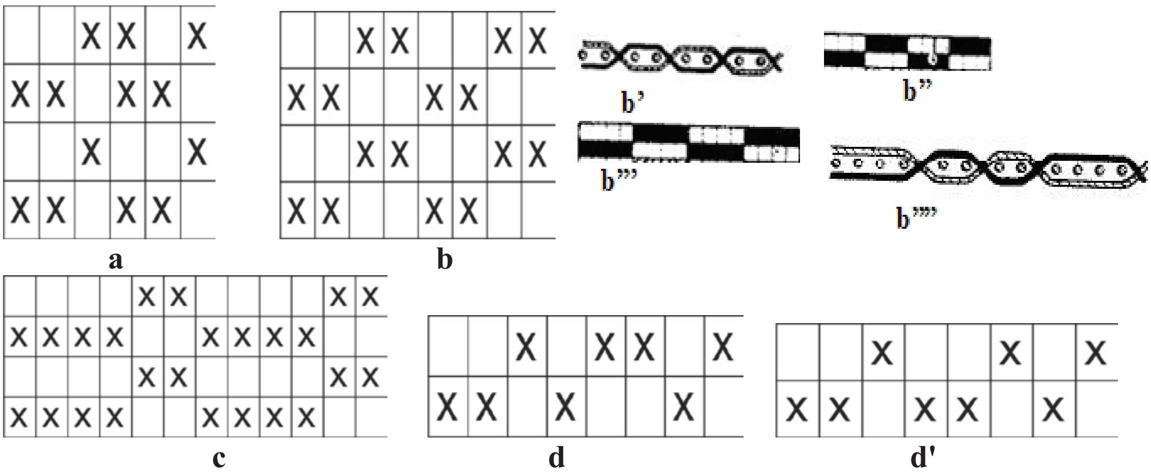


Fig. 2.2 Weft rib weaves

Figure 2.2 e show irregular weft rib of

In figure 2.2 a shows 2/1 irregular weft rib, b- show 2/2 regular weft rib, b' show the cross section of 'b' and b" show regular weft rib of 3/3 and other figures the reader has to analyse . These are exactly opposite to warp ribs in structure. Here the plain weave is extended in weft direction and the effects are produced in warp direction. Generally these are known as cord effects .When two ends are drawn through the same healdeye , weft ribs are produced .i.e two ends are lifted on single pick. Like in warp rib , various combinations of yarns are used to emphasize the effects. Irregular effects are produced when unequal ends are drawn thro' the heald eye alternately. Lifting of two ends on a single pick is referred as double end plain . There are two reasons for the application of double ends in a plain cloth structure. In the first place it enables a much closer setting together of the warp threads to be obtained, yet retaining a soft and pleasant feeling material. Again, 80 double threads per inch of 32s count are equal in weight to 40 single threads per inch of 16s count, but the fabric made from the first setting will be much superior in appearance sand in strength to that made from the second setting. For these reasons double ended warps used in such fabrics as flannelette and oxford shirtings. Double-ended plain cloths are also woven in such a manner as to produce a corded of ribbed appearance, running lengthways of the piece. These fabrics are called weft/ribs or moreens, and must be woven with many more picks than ends per inch, so that the warp is practically hidden by the weft. In other words weft ribs are wet faced constructions and produce strong fabrics .Following is one of weft faced construction

2/80s x 24s cotton (15/2 x 24.6 tex); 88x100; 3.5x10.9 percent; 23.2 mils; 4.5 oz.; K_c = 14.0+20.4=34.4

We know that it is difficult to achieve very high weft cover factors in weft-faced plain-weave cloths. But production of weft ribs does not call for loom with box motion as required in warp ribs. Following is a construction of an industrial cloth designed for a high warp-way strength

14s x 8s cotton (42x74 tex); 84x30; 9.6x3.6 percent; 22.6 mils; 7.2 oz.; K_c = 22.5+10.6=33.1

It is substantially warp-faced. The weft crimp is low because the close spacing of the warp threads has left no chance for the weft to bend. Moreover, the weft is thicker and more rigid. It is important to note these two distinct ways of using a weft rib weave: one in a weft-faced, the other in a warp-faced construction. The construction particulars of a laundry blanket is as follows.

2/8s x 2/6½s Y.S.W. (485/2 x 595/2 tex); 16x9; 8.6x3½ percent; 76 mils; 7.1 oz.;

K_c = 14.5+9.0=23.5

This cloth is heavily milled and raised, and in the finished condition has a weight of about 24 oz./yd^2 and a thickness of about 128 mils. In the finished fabric the weave is completely obscured. Here the 2/2 weft rib weave is used as a suitable basis for milling and raising, which give the fabric its ultimate characteristics. The transformation which occurs between the loomstate and the finished cloth is quite startling. Many other woolen fabrics such as blankets and velours undergo a similar transformation. Finishing here exercises a much more profound influence on the characteristics of the finished cloth than in most other fabrics.

Hair cords

These are the simple modifications (Fig.2.2d & d') of weft ribs . Point paper show three possible ways of producing Hair cords. These are extensively produced with 20' warp and 20's weft as furnishing or table cloth in which several ends are lifted on one coarse picks. Haircords also used as popular dress fabric in cotton, has pairs of ends weaving as one alternate with ends weaving plain. The pairs of ends form fine warp-way ribs or cords. This effect is enhanced if the pairs of ends are somewhat coarser than the single ends . A loom state details for a hair cord is as follows.

Warp :2 ends 32S cotton (18.5 tex) weaving is one, 1 end 45s cotton (12.8 tex)
Weft: 32s cotton (18.5 tex); 76x80; 2.1 x 9.4 percent; 13.2 mils; 3.8 oz.; K_c = 14.1+14.6=28.7.

MATT, OR HOPSACK OR BASKET, WEAVES AND FABRICS:

Matt weaves are (Fig. 2.3) produced by extending the plain weave structure both warp and weft way. They have 2, 3 or 4 adjacent ends working as one single end, and 2,3 or 4 picks in a shed. Matt weaves use either square or nearly square constructions. A simple regular 2/2 matt will be 25 % heavier than a square plain cloth made from same yarns Due to less number of intersections in the cloth , fabrics is porous or open .The weaves are principally used when we desire to make a fabric that will be very strong, thin and also very dense in the setting of ends and picks per inch without being too hard and stiff. The weaves enables us to set the ends and picks much closer together than is possible with the ordinary plain weave, and really 2,3 or 4 finer count threads are taking the place of one thick thread of the plain cloth.

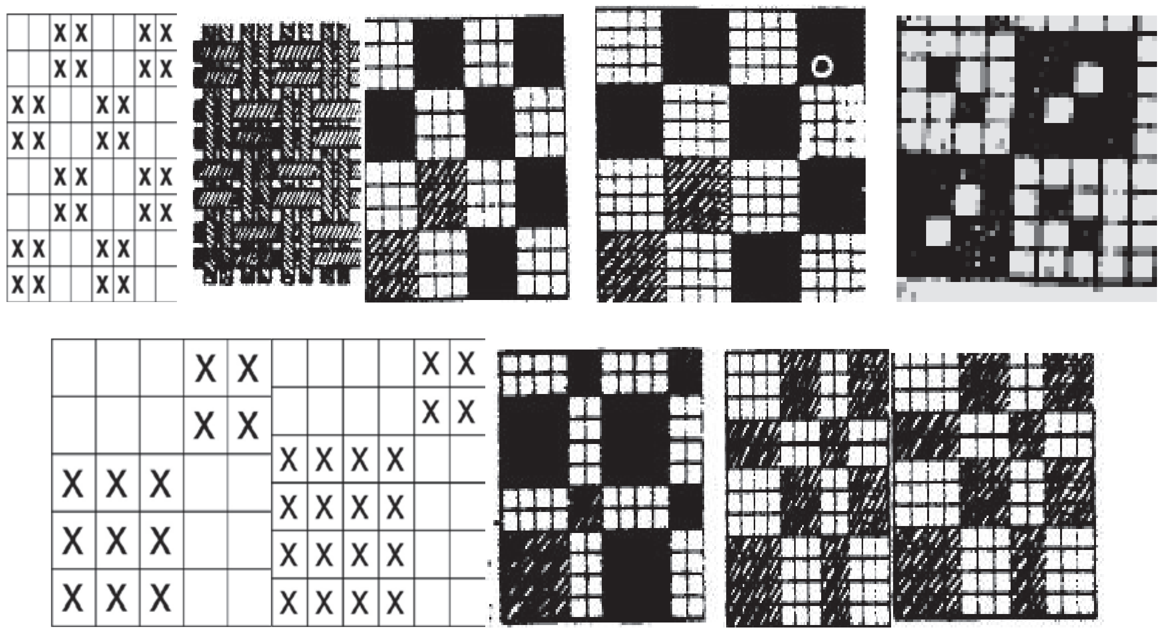


Fig. 2.3

The matt weave cloth will also have a much greater resistance to tearing, partly because it has more threads per inch, but chiefly because the threads are in pairs. When a plain-weave cloth tears, the yarns at right angles to the direction of the tear usually break one by one in rapid succession. At any instant, while the cloth is tearing, the tearing force is largely supported by a single yarn-the one which will break next. With 2/2 matt, the tearing force tends to be borne fairly equally by two threads – the pair which will break next; hence the matt weave cloth has a greater Resistance to tearing. The same argument applies to any cloth in which the threads weave in groups of two or more.

Sail cloth is often made in 2/2 matt weave because of its high resistance to tearing in both directions. Matt weaves tends to give smooth-surfaced fabrics, but with an appearance rather like that of a plain-weave fabric made from much thicker yarns. These characteristics are sometimes useful in dress fabrics, particularly in worsted suit and costume cloths; one can obtain an appearance of coarse texture without the disadvantages of excessive thickness and stiffness. Suitable details are :2/40s x 15s cotton (30/2 x 39.4 tex); 74x76; 4x8 percent; 13.3 mils; 9 oz.; K_c = 16.5+19.6=36.1. Larger matt weaves such as 3/3 or 4/4 give a small, neat, chess-board appearance in the fabric. They are seldom used in their simple form because they require very high cover factors to make a firm cloth. Matt weaves are used for shirting’s, canvas, sailcloth filter cloths and also for heavy “ducks” such as conveyor belts etc.

Modification of Matt : Fancy Matt and Stitched Hopsack (Fig. 2.4 to 2.7)

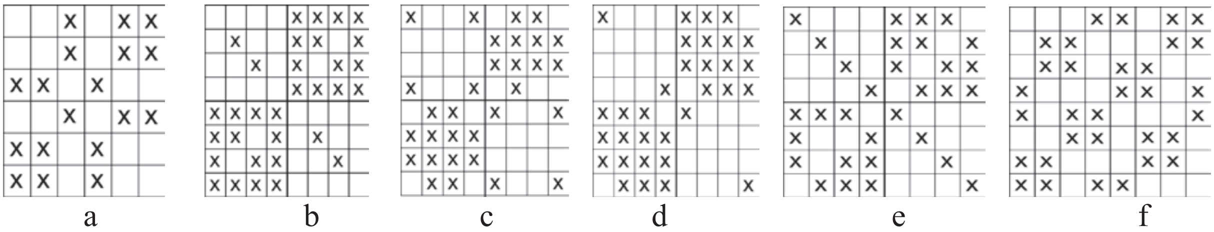


Fig. 2.4

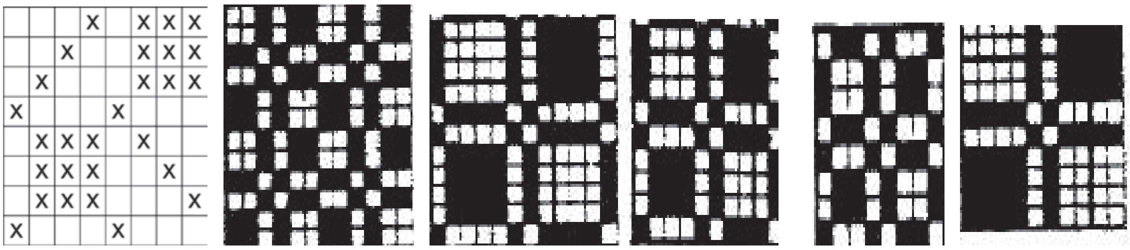


Fig. 2.5

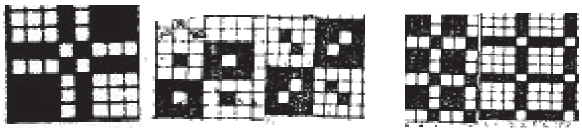


Fig. 2.6

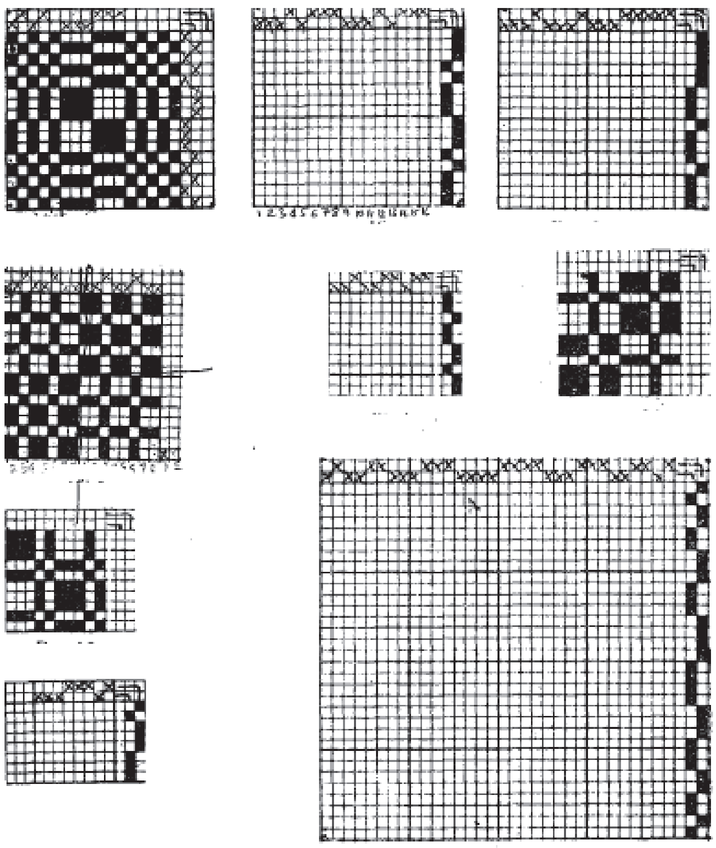
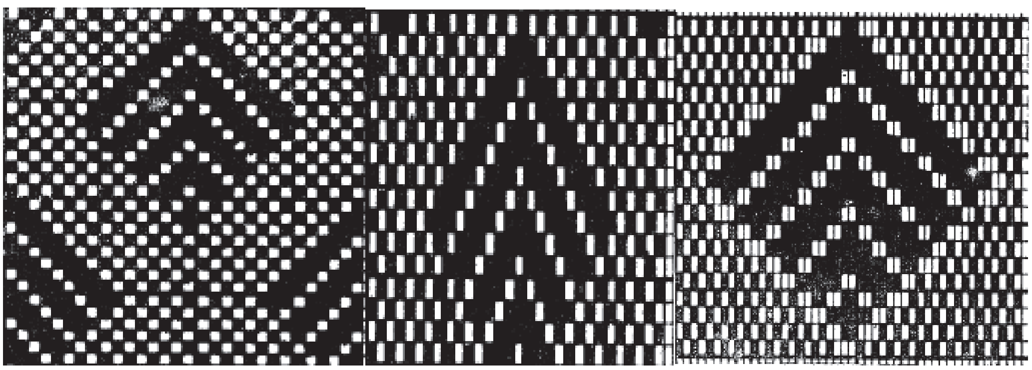


Fig. 2.7 Practice examples for reader

Matt is modified further into Fancy matt and Stitched hopsack weaves. Fancy matt weaves produced using four healds on plain power loom . Point paper show both along with weavers plans. They are termed fancy matts because they are made from irregular groups of ends and picks. While they affor excellent examples for practice in designing, their use as ornamental weaves is very limited. In some cases using boxes at one side only like 4 X 1 different effects are obtained . In stitched hopsack the stitching of the weave in the opposite corner provides firmness. Fig. 2.7 show Barley Corn weaves developed on the basis of plain and its derivatives.

POPLIN AND REPP FABRICS:

These fabrics have an excess of warp over weft and therefore the warp is the unit which would be used for figuring purpose. Poplin and Repp are warp-faced plain weave cloth in which the weft is much thicker than the warp, the intention being to produce prominent weft-way ribs. The intention is the same in true repp, but still more prominent and clearly separated ribs are obtained by using two warps and two wefts. Suppose that in an ordinary warp-faced plain-weaves construction we use two weaver's beams, with odd-numbered ends on one and even-numbered ends on the other. If, then, we tension one beam heavily and the other lightly, the tight ends will assume a low crimp and the slack ends a high one. The effect can be still further enhanced by using a fine, compact yarn for the tight warp, and since it must be strong, a two-fold yarn is often chosen. Again, by using two slack ends to each fine end, and weaving each pair of slack ends as one, it is possible to hide the thick weft completely and to produce a truly warp-faced fabric. This is particularly effective if the slack warp, which we may call the face warp, is made from low-twist filament yarn. The thick weft should be round and compact, and for this purpose a multi-ply (say 6-fold) cotton or worsted is effective. True repp is comparatively costly to produce and requires a loom with multiple shuttle boxes at both ends. It is used to a limited extent for upholstery, both plain and Jacquard-figured, and occasionally as a coating material These fabrics have an excess of warp over weft and therefore the warp is the unit which should be used for figuring purposes. When the fabrics are intended for curtains or casement materials it is desirable to have the figure showing as boldly on one side as on the other. This can only be done by having warp floats on the back as well as on the face.Figure 2.8 show these examples



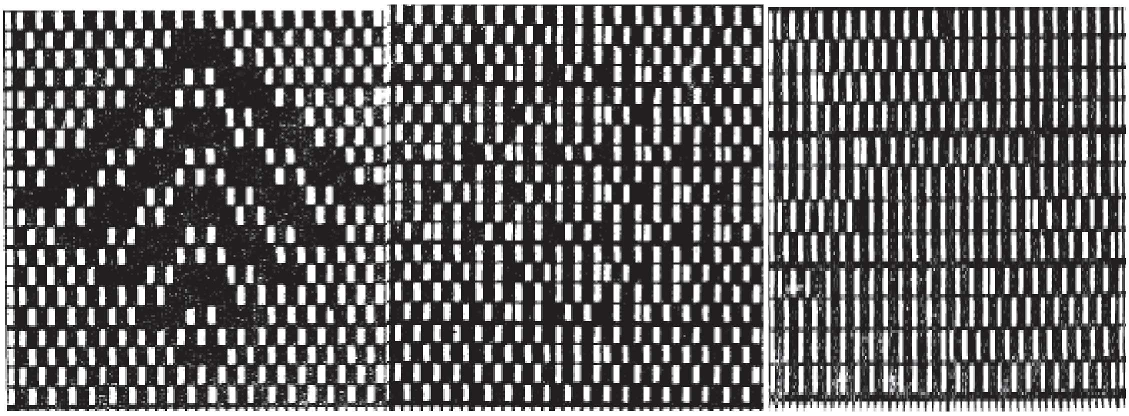


Figure 2.8 Examples of Poplin and Repp fabrics

FIGURED REPPS

The figured repp fabric is made with considerably more ends than picks per inch, but unlike the poplin it is a plain weave made with alternating single and double ends. The single ends are often ordinary cotton while the double ends are of mercerized cotton, or some other lustrous material such as rayon or silk. A distinct rib is made across the cloth, and if woven with two beams, one containing the single ends, the other the double ends, the latter not so heavily tensioned as the former, the rib is more pronounced on the face of the cloth than at the back. The rib will be still more distinct on the face of the cloth if coarser weft is inserted when the double ends are raised, than when the single ends are lifted. Repp fabrics are figured by making floats with the lustrous double ends according to the shape of figure required. The foundation of the fabric is plain weave. Thus all the double ends are lifted on alternate picks irrespective of the shape of the figure to be made, and the figure is developed by giving additional lifts, as indicated by the solid markings, to these double ends on the opposite picks. The effects produced in figured repps are distinctly one-sided and in fact the back of the figure consists of long floats of weft. (Figure 2.9). Reader is advised to complete the weavers plans for both designs .

CLASSIFICATION OF PLAIN CLOTHS

Today majority of the weaving include production of plain cloth in different constructions. This popularity is due to various reasons like: firmness in construction, ease of production of different sorts on plain power loom without any attachments, potential for ornamentation etc., Even if dress materials are considered ranging from infants to old age irrespective of gender, plain weave is used to a greater extent. In the light of the above explanation it is essential to know in detail about the plain cloth and following paragraphs give a detailed picture of classification of plain cloths.

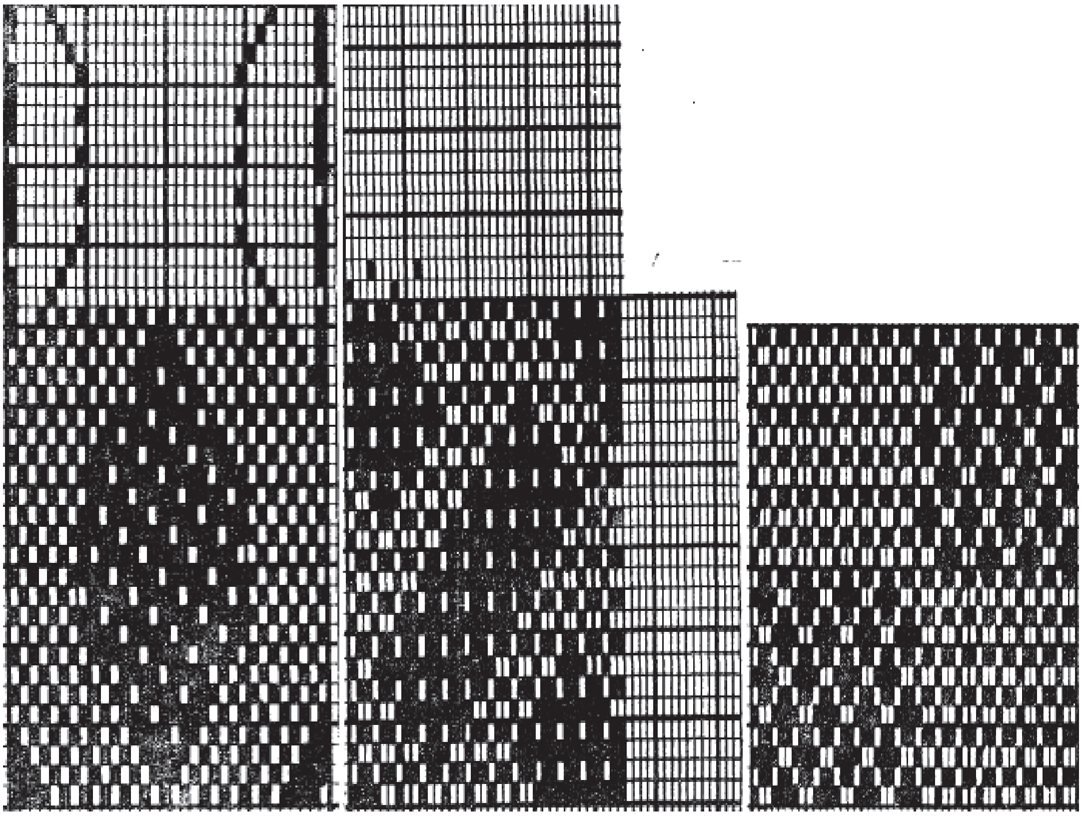


Fig. 2.9 Figured Repp fabrics

Basis of classification of plain cloths

A number of basis exists for classifying the plain cloths like construction, weight, threads set, weave, cover factor , ratio of weight factors etc.,

Based on construction

All the plain cloths are classified into Square set and Approximately square set fabrics depending whether all the parameters of warp is equal to that of weft. If warp count = weft count, warp crimp = weft crimp, ends / inch = picks / inch, then it is said to be ideal cloth (Perfectly Square set plain fabric) and is only possible with lot of deliberations in weaving and it may be observed that nearer values are obtained rather than the exact values. It should be noted that making warp crimp equivalent to weft crimp is a tough task as warp during weaving is under stress and weft is slack. The only easiest possible way to get equality is by using same count in warp and weft. Even to get threads / inch in warp and weft same, a great deal of work has to be done in selecting a pick wheel so that reed and pick are equal . On the other hand, Approximately square set fabrics are those in which warp and weft count, ends and picks per inch and hence warp and weft cover factors are approximately equal so that warp and weft are effective on both sides of the fabric. Majority of today's plain fabric belong to this class.

Based on Weight

Expressing the weight of the cloth in ounces / sq yd one can classify the approximately square plain cloths as

1 Light weight plain cloths where weight is less than 4 ounces / sq yd- and most of the dress materials are grouped under this head
2. Medium weight plain cloth–here weight range is 4 to 8 ounces / sq.yd.
3. Heavy weight plain cloths where weights are more than 8 ounces/sq.yd.

Based on Cover factor

Plain cloths are identified as Warp faced cloths if warp cover factors are more than weft cover or warp predominates on both sides of cloth. warp crimp is substantially higher than weft, warp and weft count may be similar etc.,

Plain cloths are classed as Weft faced cloths if weft cover is higher than warp cover and hence warp crimp is less than weft or weft is predominating on both sides

It should be noted as we move from approximately square set fabrics to weft faced cloths (plain) the number of fabrics under each category reduces .

Based on weight factor

In plain weave fabric geometry we normally compute warp and weft weight factors using count and respective threads per unit area. Let w1 indicate warp weight factor and w2 indicate weft weight factor , then if w1/ w2 is 1.01 -03.05 then fabrics are classed as warp faced cloths and if w1/w2 is less than 0.75 or 1 they are groped as weft faced fabrics and if w1 / w2 is exactly equal to 1, it is equifacedfabric .

APPROXIMATELY SQUARE PLAIN CLOTHS

These are made in weights ranging from less than 1 to more than 2 oz./yd^2 and from every type of yarn. Counts vary from 30 denier (3.3 tex) silk or nylon to 6/1s (3443 tex) cotton. Cloth cover factors range from less than 10 to over 30.

(1) Light-weight: less than 4 oz./yd^2
a) Openly set: K_c = 10-22
Fine and medium yarns, 5 to 40 tex; e.g. cotton cloths such as cheese cloth, butter muslin, tracing cloth, surgical dressings.
b) Closely set; K_c = 22-35
Fine yarns, 5 to 20 tex: e.g. cotton and linen cambrics, cotton and spun rayon printed dress fabrics, typewriter ribbon cloth; filament yarn cloths for lingerie, dresses, blouses, linings.
(2) Medium-weight: 4-8 oz./yd^2
Usually relatively closely set; K_c=22-35
Medium yarns, 20 to 60 tex: e.g. cotton and linen sheeting; cotton, linen and spun rayon cloths for curtains, loose covers, table linen; industrial filter cloths, sailcloths, tent cloths, rucksacs, ground-sheets; tropical worsted suitings; fine woolen dress fabrics; tailors interlinings.
(3) Heavy-weight: over 8 oz./yd^2
Usually closely set: K_c = 24-36
Coarse yarns, often folded, 60 to 600 tex; e.g. cotton and linen duck cloths for boot linings, water containers, conveyor belts; woolen and worsted suit, costume and overcoat fabrics.

I : Light-weight square plain cloths:

Their weights range from 0.5 to 3.2 oz./yd^2; they are all made from cotton yarns; and their cloth cover factors vary from 10.4 to 33.5.

Cotton dairy cloth:

38s x 44s (15.6 x 13.5 tex); 38x28; 2.9x7.4 percent; 9.4 mils; 0.51 oz.; K_c = 6.2+4.2=10.4

Cotton cheese cloth:

28s x 12s (21 x 49 tex); 33x44; 5.2x8.1 percent; 15.7 mils; 2.9 oz.; K_c = 5.2+9.9=15.1

The fabric is characterized by highly open set nature making it to be suitable for filtration purpose in dairy

Cotton cloth for electrical insulation:

60s x 64s (9.9 x 9.2 tex); 76x76; 4.6x7.5 percent; 7.0 mils; 1.8 oz.; K_c = 9.8+9.5=19.3

In this case it is desirable to have the insulation properties of the fabric.

Cotton tracing cloth:

62s x 70s (9.5 x 8.4 tex); 84x92; 2.4x6.2 percent; 6.9 mils; 2.0 oz.; K_c = 10.6+11.0=21.6

The cloth is medium set and is finished for meeting the specific end use.

Cotton filter cloth:

52s x 56s (11.4 x 10.5 tex); 112x114; 7.7x10.3 percent; 7.6 mils; 3.2 oz.; K_c = 15.5+15.2=30.7

It's an industrial fabric meant for filtration process with precise porosity .The fabric can be used for dust bags in spinning

Cotton typewriter ribbon fabric:

80s x 80s (7.4 tex); 140x160; 5.4x7.3 percent; 5.9 mils; 2.8 oz.; K_c = 15.7+17.8=33.5

It's highly dense and close set fabric and is very difficult to weave as the yarns are very fine . the cover factors used are very high exceeding the theoretical limits. The only demerit of cotton type writer ribbon cloth is poor abrasion resistance .However the performance can be improved by using Nylon instead of Cotton .

Bleached linen cambric:

150s x 150s linen lia (11 tex); 96x88; 4.1x3.1 percent; 5.4 mils; 2.4 oz.; K_c = 13.2+12.1=25.3

Cambric is a fine cotton or linen fabric not very closely set fabrics with a stiffened finish . The fabrics are calendered to give smooth finish Calendering also flattens the fabric. These are used as shirtings, handkerchiefs and if produced in heavy weights it is preferred as pillow covers.

Spun viscose dress fabric:

32s x 32s cotton count (18.5 tex); 92x63; 6x4 percent; 11.9 mils; 3.4 oz.; K_c = 15.5+10.6=26.1

Spun rayon dress fabrics are produced with resin crease resist finish. The fabric is also produced in blends and the properties expected are good handle , durability, stability etc.,

Filament nylon blouse and lingerie fabric:

45 denier x 45 denier (5 tex); semi-dullnylon; 128x104; 2.6x9.8 percent; 4.5 mils; 1.5 oz.;K_c = 11.7+9.5=21.2

This is a firm low cover fabric and low twist yarns are used

Filament nylon overall fabric:

205 x 205 denier (22.8 tex); dullnylon ; 67x56; 5x5 percent; 9.2 mils; 3.6 oz.; K_c = 13.1+11.0=24.1

This is an industrial fabric with robust construction intended to resist hard wear and is stiff and firm in nature. The easy care and hard wearing nature specially suited for protective clothing either for domestic or laboratory purpose.

II : Medium-weight square plain cloths:

Sheetings occupy an important place in this group of plain weave cloths. Today in market printed cotton sheetings are popular with one single or double side printing intended for bedspreads. Projectile gripper looms are very popular with sheeting sort and wider width fabric is chemically processed for a specific purpose or cut into desired widths. These are normally woven in widths of 60-100 in., but the same constructions, in widths of 24-40 in., are used for pillow slips and also, when suitably finished, for dresses. Sheetings are commonly made from cotton, and less frequently from linen yarns, in approximately square constructions.

Cotton sheeting:

22s x 18s cotton (27 x 33 tex); 64x60; 6.5x9 percent; 12.2 mils; 4.7 oz.; K_c = 13.7+14.3=28.0

Most cotton sheetings are made from carded American cotton yarns, but the best qualities from combed Egyptian yarns. Linen sheeting is usually woven with higher cover factors than cotton sheeting, and in weights of 5-7 oz,/yd^2. A typical construction is

40s x 40s boiled line (41.5 tex); 62x71; 17.4x3.4 percent; 13.2 mils; 6.0 oz.; K_c = 15.0+17.0=32.0

III : Heavy-weight square plain fabrics:

Duck fabrics are classed under this group as they are made from folded yarns. Today In India a number of industries are engaged in producing what are known as Tarpaulins from either dcuk or canvas fabrics. Both are similar in nature with slight variation in either folded count or ends or picks per cm. In canvas warp crimp is higher than weft and warp predominates in the fabric. Generally these are used for protective clothing from sun or rain or bad weather or for covering the material while transporting in lorries or vans etc., For the benefit of reader we are giving the procedure of manufacture of Tarpaulins in industry.

The cotton canvas or duck is inspected and passed through a jigger which contain paraffin wax along with a dye of desired shade maintained at higher temperature. Infact at this temperature the canvas cloth loose its tensile strength (norm 15 – 20 %) . the cloth is given a stiff finish and rolled. The fabric is spread on the floor and each piece is joined by stitches using a folded yarn as sewing thread. A the edge rivets are pressed for the purpose of tying with ropes. The Tarpaulins prepared need to be tested for loss of tensile strength, ash content ,etc., More details are available with IS : GSM for cotton canvas or duck ranges from 450- 600 g / m2 depending on the quality desired and end use planned.

Light-weight cotton duck

3/14s x 3/14s cotton (126/3 tex); 27x29; 12.5x10.5 percent; 29.3 mils; 9.5 oz.; K_c = 12.5+13.4=25.9

This fabric is used for lining the boots. The yarns are slightly flattened as noted by high crimp values.

Heavy-weight cotton duck

6/6s x 6/6s cotton (590/6 tex); 15x18; 22x7 percent; 70 mils; 22 oz.; K_c = 15+13=28

Thorn-proof tweed

2/24s x 2/24s Gala-cut woolen (207/2 tex); 24x24; 47 mils; 11.5 oz.; K_c = 14.3+14.3=28.6

WARP-FACED PLAIN CLOTHS:

An important characteristic of warp-faced plain cloths is that they tend to have more or less prominent ribs running across the cloth in the weft direction. These are formed by the rounded crowns of the warp threads as they bend over and under the picks. In fine constructions such as poplin, the ribs are not very noticeable, but they become more prominent in coarser fabrics, especially if the weft is thicker than the warp, as in poult and repp. Along any one rib, only half the ends are on the face of the cloth. The characteristics of warp-faced plain clothes may be summarized as follows:

a) The warp cover factor is greater than the weft cover factor, usually by 50 percent or more;
b) The warp crimp is high and weft crimp is low;
c) The cloth is thicker and heavier than a square plain cloth made from the same yarns;
d) The cloth exhibits more or less pronounced ribs in the weft direction.

Terylene shirting

55 x 80 denier Terylene (6 x 9 tex); 182x94; 8.2x3.5 percent; 5 mils; 2.6 oz.; K_c = 18.6+11.6=30.2

The wash-and-wear properties of nylon and Terrylene are very useful in shirting fabrics. Although the cover factors are substantially below the maximum theoretical setting, the cloth is firm as a result of thread flattening. Shirting fabrics made entirely from filament nylon or Terylene tend to be rather transparent. The capacity can be increased and the handle improved by using a bulked yarn such as Taslan in the weft.

Acetate dress poult

75 x 200 denier acetate (8.3 x 22 tex); 204x62; 8.5 mils; 3.9 oz.; K_c = 24.1+12.1=36.2

140 x 200 denier acetate (15.5 x 22 tex); 135x52; 7.4 mils; 3.9 oz.; K_c = 22+10=32

Cotton poplin

2/100s x 2/100s cotton (12.2 tex); 144x76; 14.4x3.5percent; 9.7 mils; 3.5 oz.; K_c = 20.3+10.7=31.0

This is a very popular plain fabric found sold in different states in market like bleached, dyed , mercerized and printed forms . Export variety include quality print for bedspread and pillow cover. Normally industry use 40's K warp and 40's C weft , 104 Reed and 72 Pick, with 14 % size and woven in widths like 44-46 " (finished) . Even though the reed and pick isrecommended , mill use 4 / 52's Reed so as to improve the production otherwise higher end breaks result due to use of higher reed

Cotton canvas for sports shoes:

2/32s x 2/12s cotton (37/2x98/2 tex); 80x40; 31x2.5percent; 25.6 mils; 9.2 oz.; K_c = 20.0+16.3=36.3

All sports shoes have the body wall made up of canvas fabric and it accounts for the shape of the boot. Flexibility is an important parameter in this application.

Cotton canvas for conveyor belts:

7/7s x 6/6s cotton (590/7x525/6 tex); 24 x 18 ½ ; 21x4 percent; 62.2 mils; 30 oz.; K_c = 24.0+16.8=40.8

This is a construction of an industrial textile. It is well known that belt is a composite with textile as a reinforcement and leather as matrix. The construction is meant for flat belt as V-belt use cord yarns.

WEFT-FACED PLAIN CLOTH:

A weft-faced plain cloth is thicker than a square plain cloth made from the same yarns, and by using a soft-spun weft, a full, soft handle can be obtained.

Cotton limbric:

50s x 36s Egyptian cotton (11.8 x 16.4 tex); 68x102; 4x8 percent; 11.6 mils; 4.0 oz.; K_c = 9.6+17=26.6

Cotton casement cloth:

Fabrics similar to limbric but made from coarser yarns spun from American-type cotton, are used for printed curtains. The loomstate particulars are

32s x 16s cotton (18.5 x 37 tex); 54x64; 4x17 percent; 15.0 mils; 4.4 oz.; K_c = 9.6+16.0=25.6

Like Cotton Poplin, casement is another popular fabric sold in different states in all the fields. Normally in market has casement has a wider width and is sold in dyed state. A special green color is recommended as hospital wear like operation theater dress material or furnishings in OT room or screen cloth for wooden frame etc,

Cotton-mohair lining fabric:

36s cotton x 13s worsted count mohair (16.5x70 tex); 46x42; 3.1x5.6percent; 15 mils; 3.1 oz.; K_c = 7.6+14.4=22.0

VOILE FABRICS:

The essential features of a voile fabric is a sheer appearance, which is obtained when the spaces between the yarns are large compared with the yarn diameter. This is achieved by using fairly open settings (warp and weft cover factors of 7-11) and yarns which have sufficient twist to resist flattening. The weave is usually plain. The fabrics are light-weight (usually of the order of 1-2 oz./yd^2) and as the open settings show up yarn irregularities, the yarns must be as uniform as possible. They used to be made chiefly from 2/80s and 2/100s combed Egyptian cotton yarns, and occasionally also from fine worsted yarns. The loomstate particulars of a cotton voile fabric are

2/100s x 2/100s cotton voile (12/2 tex); 60x52; 6x5 percent; 8.2 mils; 1.02 oz.; K_c = 8.4+7.3=15.7

The spacing of the threads is very uniform, indicating that the fabric has been woven with one end per dent in the reed. Voile fabrics are used chiefly for millinery, semi-transparent curtains and dance frocks. In recent years, however, Terrylene net, which is made either by gauze weaving or warp knitting, has largely replaced voile for curtains. The net fabric is more costly to produce but much firmer and more durable.

CHAPTER 3
Twill Weaves and Their Modification

Twill weaves.

These are the second primary weaves repeating on three ends and three picks. Twills are characterized by the presence of diagonal lines which may recede towards left side or right side describing 45 degrees angel with the horizontal. There is no theoretical upper limit for the repeat size

Principle of Construction

These are constructed by moving the point of intersection one step outward and one step upward resulting in what are known as " Z" twills or one step outward and one step downward resulting in "S" twills. (Fig 3.1 to Fig.3.6)

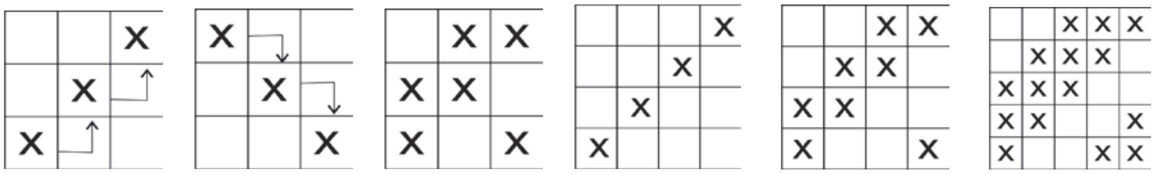
Characteristics of twill weaves

- These are characterized by diagonal line which may be towards right or left
- The twill line may be continued or reversed or broken
- Twill line may be elongated or curved
- Twill line may be reversed regularly or evenly or unevenly
- Twill line may be steep or flat
- Twills are only the weaves where in the twist direction of yarn is to be considered in relation to twill direction
- Two basic twill may be combined to get an elaborate or large twill
- A twill can be rearranged on satin base

Classification or Types of twills

A number of ways available to classify the twills based on the direction of twill line or twill construction or twill application. Following are types of twill weaves.

Balanced and Un balanced Twills In balanced and unbalanced twills (Fig. 3.1 e, Fig. 3.2 a3, Fig. 3.3 a3,Fig. 3.5 a & Fig. 3.1 c,d;fig.3.2b; Fig.3.3b; Fig.3.5b) depending on the number of intersections . In balanced twills the number of ups will be equal to number of downs. Balanced twills are also known as equi face twills and they repeat on even number of threads. The balanced construction may be either S or Z type. The diagonal line is obtained as follows. First end is lifted on first two picks. Second end is lifted on second and third picks. Third end is lifted on third and fourth picks and so on. The other way of obtaining the diagonal lines are as fallows. Lift first and second ends on first pick. List second and third ends on second pick. Third and fourth ends on third pick and so on. It should be noted that twill can be constructed with different footing (Fig. 3.2 at X & X'). On the other hand unbalanced twills are constructed wither warp face or weft face concept. The repeat size in unbalanced twill can be odd or even



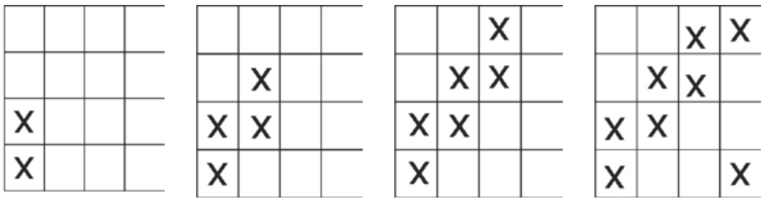
a b c d e f

Fig.3.1 Construction of twill weaves

Construction of Right hand (Z) and Left hand (S) Twills

Fig 3.1 a to f show basic twills and the method of construction. For any Z twill, the point of intersection is moved one step outward and one step upward, where as for any S twill the point of intersection moves one step outward and one step downward. Fig. 3.1 a, b,cshow the minimum sized twill . Four end Twills are shown in Fig. 3.1 d to f.

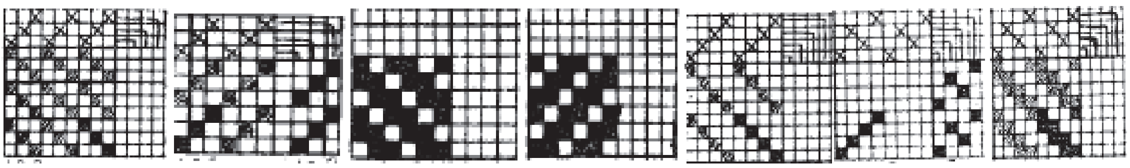
Stage –by- Stage construction of twills



a1 a2 a3 a4

Fig. 3.2 Stage by stage construction of 'Z' twill

Fig, 3.2 a to a4 show how exactly a twill is constructed in stages. Similarly Fig. 3.4 a to a3 show weft way construction of twills. It is worth note here that in some class of weaves (Weft Piles / Weft Backed cloths etc.,) basic weaves are constructed in weft way to facilitate the texture. Fig. 3.3 a to a3 show how an Left hand twill or 'S' twills are constructed.



a5 a6 a7 a8 a9 a10 a11

Fig.3.2 Construction of different types of twills

Figure 3.2 shows the methods of construction of twills . From a5 to a11, designs are given and the reader is advised to complete the blanks . The twills also show warp faced and weft faced in nature .

Following designs show the stages in completing twills (Fig. 3.2 a12 to a14)

a12 a13 a14

Fig.3.2 Construction of different types of twills

Effect of change in Footing

Twills are characterized by the twill line inclined to base line making 45 degrees even when footing is changed. It's to be noted here that in some standard fabric construction (Advanced fabrics like double cloths, treble cloths etc.,) to facilitate the selection of binding or stitching point , basic weaves with changed footing is preferred(Fig. 3.2 X & X1)

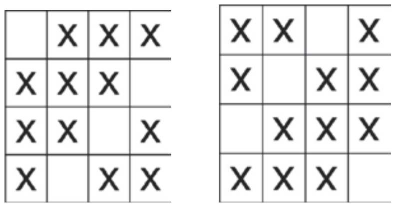
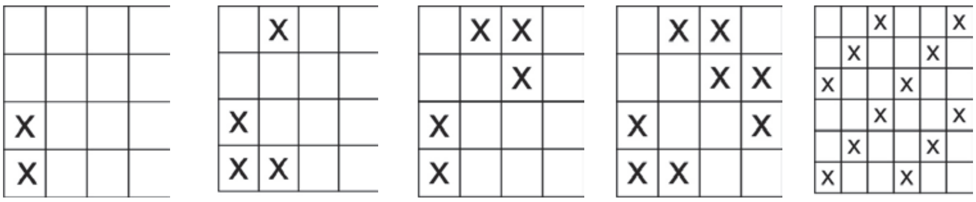


Fig. 3.2 X **Fig. 3.2 X1**

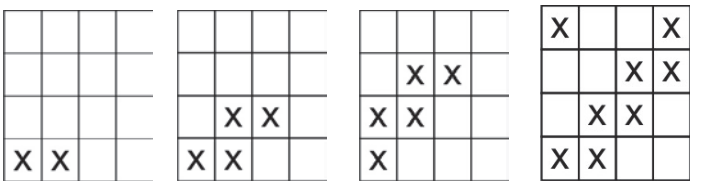


a a1 a2 a3 a4

Fig. 3.3 State by stage construction of 'S' Twill

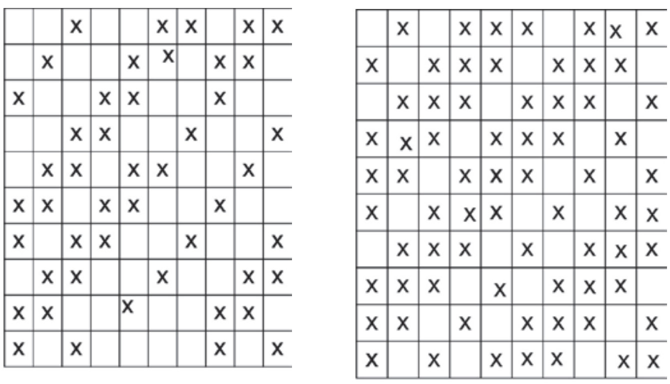
(i) By setting the warp threads much closer together than the picks, for example, 120 ends and 60 picks per inch, or, if a "flat" twill is desired, the picks will be set closer than the ends, i.e. 60 ends and 120 picks per inch.

(ii) The second method of changing the angle of the twill is to retain the square setting of the threads, but make the twill advance in steps of 2, 3, or 4 picks at each move 2/2



a a1 a2 a3

Fig. 3.4 Construction of twills weft way



2/1, 2/2, 1/2 3/1, 3/1, 1/1

a b

Fig. 3.5 Construction of twills

In actual practice it is usual to make "high angled" twills by combining both methods (1) and (2), i.e. for a wrap twill, set the ends closer together than the picks and employ a twill weave which advances in steps of two, three, or even four picks at each move. If a "flat" or weft-faced twill is required, the picks should exceed the ends per inch and the twill advance over several ends at each move. Fig. 3.6 show one such an attempt and reader is advised to refer Watson[1] for more details .

Angle of a Twill

All Types of Twill are characterized with the angle subtended by twill line with horizontal which is known as Twill angle and is 45 degrees for an ordinary twill either S or Z .However this angle is steepened or flattened depending on the change in the number of steps upwards or number of steps outwards but number of steps sideward or number of steps downward remains one only. Changing the Angle of twill is one form of ornamenting twill weaves. Angle of twill can be changed in a number of ways. When an ordinary twill weave is woven with equal numbers of ends and picks to the inch it produces a diagonal line in the cloth which runs at an angle of 45 degrees. Sometimes twills are required to give a "higher" angle than this, especially in such fabrics as gaberdines and whipcords. The angle of the twill can be varied in two distinct ways :

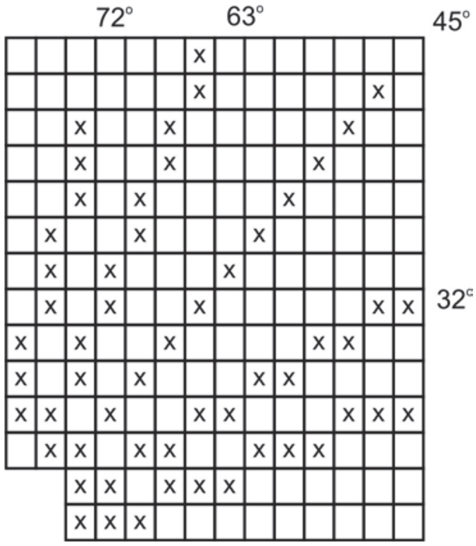


Fig. 3.6 Angle of a twill

Modification of Twill weaves

Any basic weave can be modified in a number of ways so as to increase the ornamental value and twill is not an exception. Twills are modified into

- *Re-Arranged twills (on Sateen Base)*
- *Transposed twills*
- *Combined twills (Warp and Weft way)*
- *Steep & Flat twills*
- *Zig-Zag or Wavy or Pointed twills*
- *Herringbone twills*
- *Diamond and Diapers*
- *Broken twills*
- *Skip twills & Special class of composed twills*

Re- arranged twills on Sateen base

These are simplest and most popular way of modification of twills and also serve a method of production of what are known as ‘Crepe weaves’ provided the float length doesn’t exceed 3.Re-arrangement may be made either by using regular or irregular sateens(It’s here by noted that reader first learn how to construct sateens for better understanding). The constructional steps are as follows

1. Select a suitable sateen
2. Construct the sateen
3. Encircle the sateen as base marks
4. Add the additional marks to complete the design.
5. Fig. 3.7 a to h show few examples .In Fig. 3.7 a the basic twill 3up and 3 down is rearranged as shown in b. The reader is directed to note the mode of re-arrangement like first thread in the basic weave is retained as original , second is arranged as 3rd in modified , third as fifth in modified and so on. It is advisable to show the changes by arrow mark as shown in Fig. 3.7 b

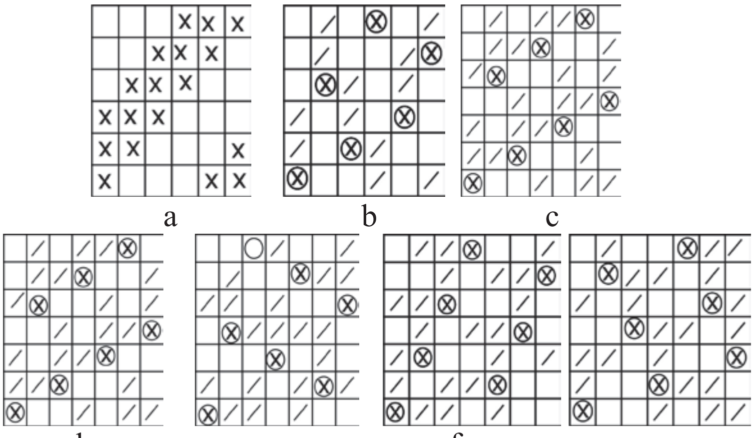


Fig. 3.7

Reader is directed to draw the weavers plans for the designs given.

Transposed twills

These are so called due to division of weave repeat size into blocks of 2 X 2 or 3 X 3 etc., so that the twill line is discontinued or twill angle changes . Popular construction is Mayo or Campbell weave in which a basic twill 3 up 2 down and 1 up 2 down is transposed into groups of two X two.

Following is the procedure for construction in general

1. Mark the basic twill
2. Based on the weave repeat size divide the weave size into 2 X 2 or 3 X 3 as the case may be.
3. Fill these blocks with 1 up N down (for example if the group is 2 X 2 then fill up with 1 / 1 in first Z way and in the second group 1 / 1 in S way. Similarly if it is 3 X 3 , fill up 1 / 2 Z twill in the first group and 1/2 S twill fashion)
4. Encircle the marks in the groups
5. Add the additional marks to the encircled marks to complete the design.
6. If the weave is grouped into 3 X 3 and the weave size is not having common factor, the final repeat will be on the LCM of the number of picks and group size. For example: group size is 3 X 3 and for 8 picks of the basic design, the final size will be on 24 ends and 8 pikcs.

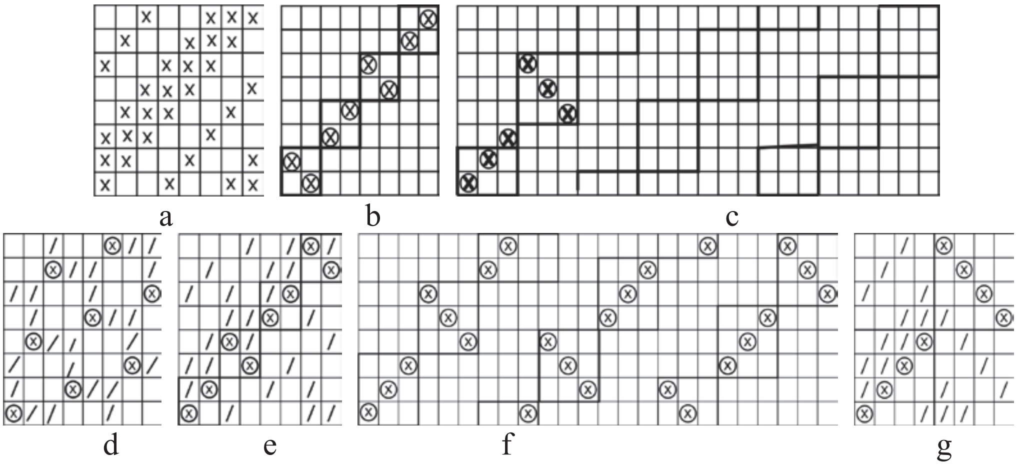


Fig. 3.8

Fig 3.8 f show the case mentioned in the step 6 and **the reader is directed to complete**. Fig. 3.8 **a** Show alternative way of Transposed twills in which the repeat is divided into half in both warp and weft way and the above procedure is repeated.

Combined twills

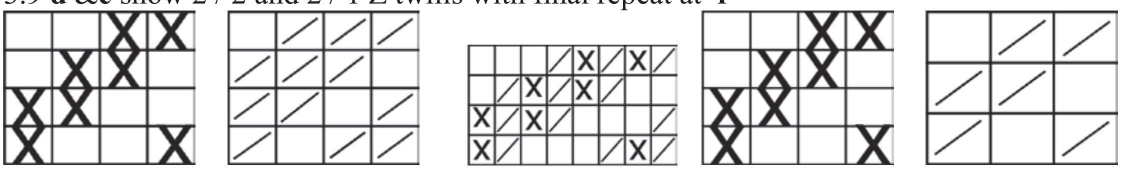
In this type two basic twills are combined either warp way or weft way with twill line describing 45 degree to the base. Eventhough, the basic twills are combined the twill angle remains with 45 degrees.

Procedure for constructing Combined twills

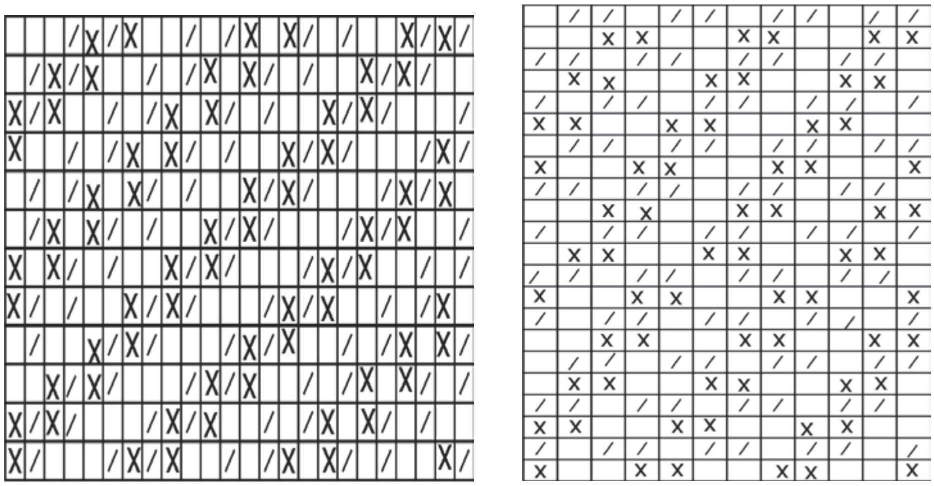
1. Select two basic twills (either two may be Z type or S type or combination) and mark separately
2. Workout the LCM of the weaves and the final repeat size depends on the direction in which Combination is required double the LCM is marked in the direction of combination. and the Other direction equals to LCM
3. Mark the final size and the first basic twill is marked either on even or odd ends.
4. Second weave is marked on the alternate ends to complete the design.

<u>End – to – End Combined twills</u>

Fig. 3.9 a show a 4-end twill (2/2- equifaced) and b show another 4-end twill (warp faced) and **c** has 8 picks and 13 ends but the repeat size is 4 picks and 8 ends for End – to- End combination. Fig. 3.9 **d** &**e** show 2 / 2 and 2 / 1 Z twills with final repeat at **f**



a b c d e



f g

Fig. 3.9

Weaving Arrangement

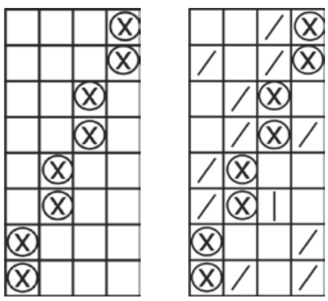
Drafting for Combined twills includes employment of straight with front healds for weave A and the back healds for second basic weave. Dobby is best suited for this purpose. **Reader is directed to draw the weavers plans for the designs given.**

<u>Pick –to- Pick Combination</u>

Fig. 3.9 **g** show a Pick –to- Pick combination twill from two basic weaves **d &e .**Weaving arrangements include use of straight draft with 12 healds and require 12 dobby lattices for pegging **Reader is directed to draw the weavers plans for the designs given.**

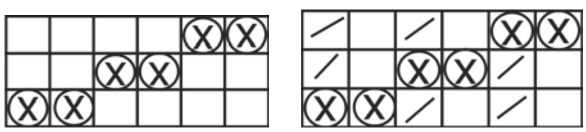
Steep and Flat twills

In a twill if the point of intersection is moved number of steps upward equal to number of ups in base mark, we get Steep twills with angle 63 degrees. If the base mark is 3 up and next intersection starts after 3 picks on the next thread, Steep twill is obtained with twill angle 73 degrees . But it should be noted that never we get 90 degrees in twills as intersections are placed opposite to final point on an end. Fig 3.10 **a** show the first step of Steep twill construction in which the basic marks are indicated and 3.10 **b** give the full design with additional marks. Similarly Flat twills are shown in Fig. 3.11 **a** and **b . Reader is directed to draw the weavers plans for the designs given.**



a b

Fig. 3.10



a b

Fig. 3.11

Pointed or Wavy or Zig – Zag twills

These are characterized by the sharp termination of Z twill line and S twill line at reversal point and are mainly employed in furnishing trade . Normally the weave repeats on double the number of basic weave. Point end is obtained by arranging the N + 1th thread same as N – 1th thread.. Pointed twills may be developed using either warp faced or weft faced or equifaced basic twills. Fig. 3.12 a to g’ show examples of Point twill. Reader is advised to complete the designs

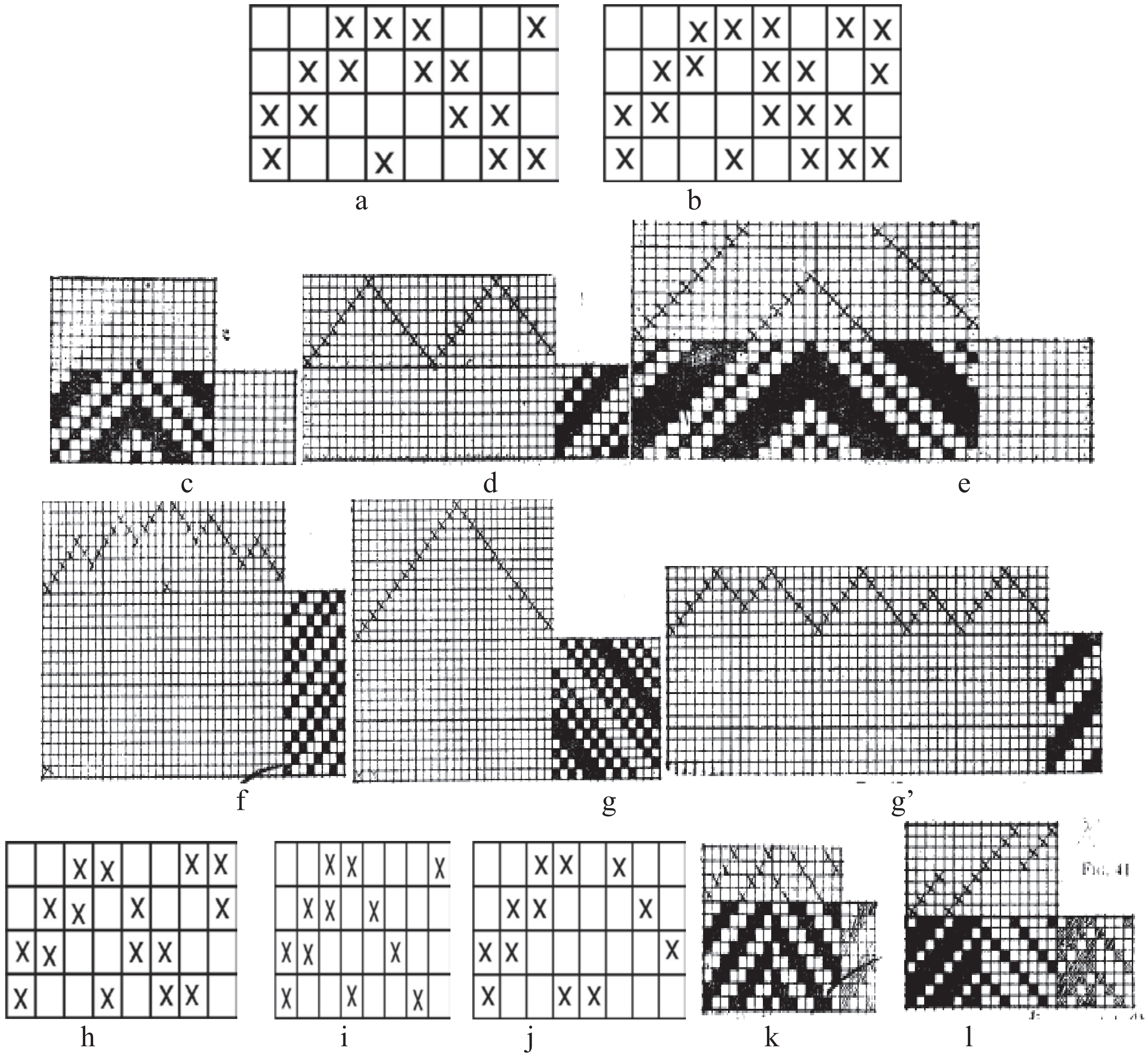


Fig. 3.12

Weaving Arrangements

Pointed twills are produced with characteristic Pointed draft on dobby. **Reader is directed to draw the weavers plans for the designs given.**

Herringbone twills (Fig 3.12 h to l)

These resemble fish herring bone in appearance and are featured by broken draft as a clear break appears after the completion of repeat of the basic weave. Different types of Herringbones are reported by John[2] depending on the regular and irregular concept.

Procedure for Herringbones construction

1. Select the basic twill

2. Mark double the number of ends as that of basic weave.
3. Mark half the repeat
4. Mark regular Z twill up to half portion
5. The next thread may be repeated similar to the third thread from this end moving towards the left or start of the design
6. Completing the remaining twill in S fashion

Fig. 3.12 show different types of Herringbone twills at **b ,c , d&e** respectively. We group Herringbone into regular balanced & unbalanced, Irregular balanced & Un balanced categories. Fig. 3.12 **b** is an example of Herringboe of Irregular Unbalanced type, where as c is regular balanced type, d is regular unbalanced and **e** show another example of irregular un balanced Herringbone twills. **Reader is directed to draw the weavers plans for the designs given.**

Diamonds & Diaper twills

These are the extensions of Herringbone and Pointed twills. Diamonds are obtained when two pointed twills are combined such that one is below the other which is tilted as shown in Fig. 3.14 a to f show different patterns. If a point of waved draft looming is used in conjunction with a waved twill for a peg-plan, we produce in the weave plan a series of diagonal lines crossing one another and forming diamond shapes.The diamond foundation gives the student ample scope for the development of original weave effects, and in this respect the diamond frame can be made. First select an area consisting of an even number of ends and picks, and make a single diagonal line from the top left-hand corner to the bottom right-hand corner. Cross this diagonal line by a second one commencing one pick above the bottom left-hand corner or, as an alternative, on the second end from the left-hand corner and running out to the top right-hand corner. These two diagonal lines produce two diamond shapes as shown and various figure effects can be inserted as desired.

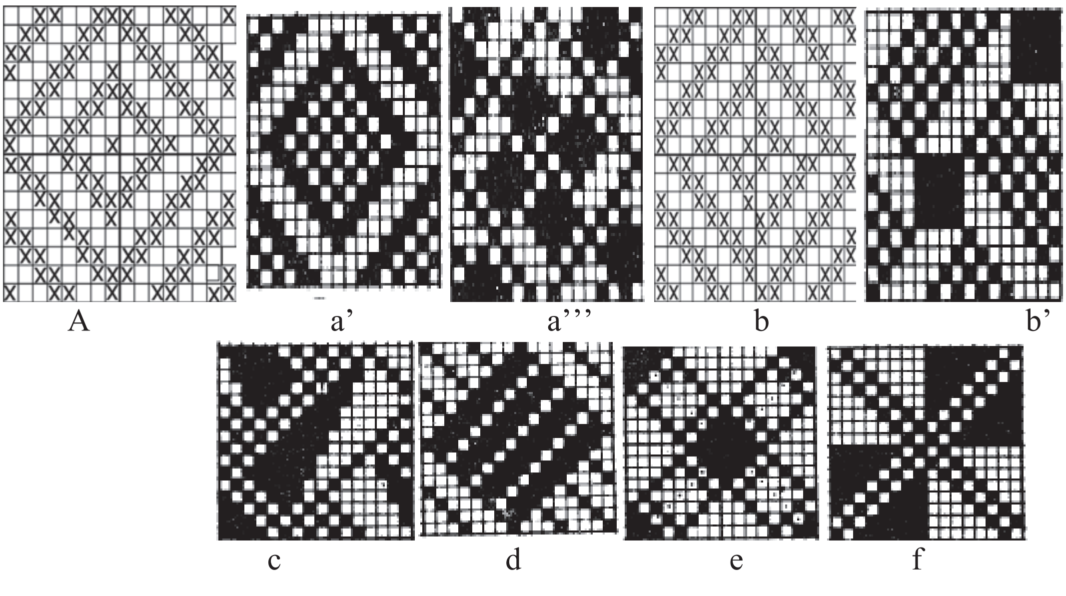


Fig. 3.14

The constructional procedure for a **Diamond** is as follows

1. Mark the repeat size and divide into 4 parts
2. In the first quarter insert the basic S twill
3. In the second quarter reverse the twill as that of in first quarter (Z)

4. Third quarter is filled with S twill
5. Fourth quarter with Z twill

In the above steps at the point of reversing it is necessary to follow the concept of wavy. Following is the procedure for **Diapers**

1. Mark the repeat size (four times the basic twill if necessary)
2. Divide the size into 4 parts
3. Fill up first part with S twill
4. Fill up the second part with Z twill
5. Fill the third part with S twill on Herringbone concept
6. Fill the last part with Z twill on Herringbone concept.

Weaving Arrangement

A typical Pointed and Broken drafts are used for Pointed and Herringbone twills respectively. However the peg plan in both cases will be half of the design. These are very popular for furnishing trade. **Reader is directed to draw the weavers plans for the designs given.**

Broken twills

As the name indicates these are the twills in which the twill line is completely and clearly broken after a repeat. For this purpose a basic twill is marked and then the twill direction is reversed.

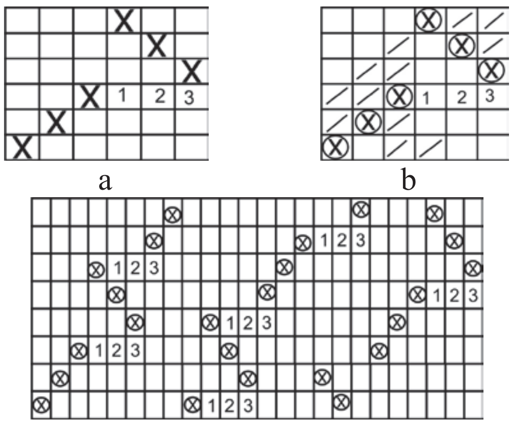
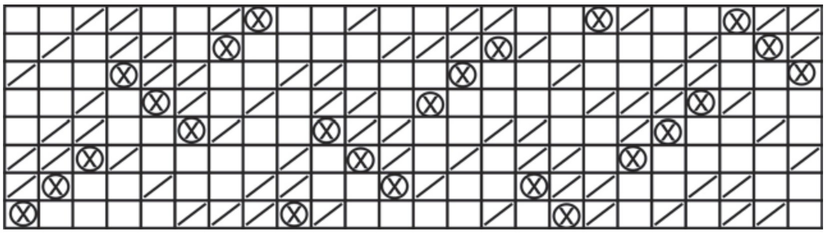


Fig. 3.15

Fig. 3.15 a and b show the example of broken twill. Reader is directed to draw the peg plan for the designs given.



d

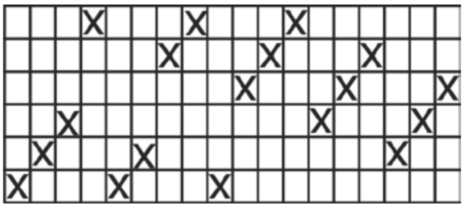
Fig. 3.15

Following is the procedure

1. Mark the full repeat size of the basic twill under consideration for conversion to broken twill
2. Construct Broken draft as shown in Fig. 3.15 **a**
3. Draft marks are encircled and additional marks are added
4. If a given basic twill is to be repeated on more number of picks with broken twill, calculate the final repeat by taking the LCM . For example the basic twill 3 / 3 Z twill is to be repeated on 8 picks , the final repeat will be on 8 picks and 24 ends with 3 ends per group reversed regularly (Fig. 3.15 **c**).

Skip twills

These are the twills in which the twill line direction is continued only one direction unlike Broken twill. The name is derived from the fact that the point of intersection is moved 'n' steps upwards instead of one as is the usual case and number of steps outward is one only. These are also known as



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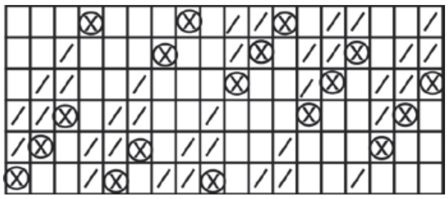


b

Fig. 3.16

'Grouping & Entering ' concept(Fig. 3.16 **a&b**). Any basic twill is converted to Skip twills by calculating the LCM . **Reader is directed to draw the peg plans for the designs given.**

Following is the procedure

1. Select a basic twill
2. Decide the number of threads per group
3. Calculate the number of steps to move upward with one step outward
4. Calculate the full repeat size and construct the Skip draft as mentioned below.
5. Construct the basic twill with in a group
6. Next thread after the basic twill repeat, move the point of intersection by number of steps upward as mentioned in step 3.
7. From this thread count the number of threads equal to group size and fill the basic twillcomplete the repeat with above steps.

Special twill

By combining the concept of Z and S twill , warp rib , matt weaves it is possible to develop a special class of weave as shown in Fig. 3.17. **Reader is directed to draw the weavers plans for the designs given.**

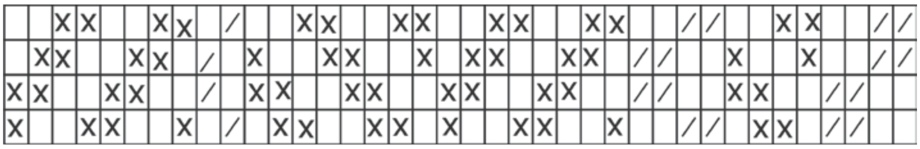


Fig. 3.17

Twist –Twill interaction (Emphasizing a twill)

It is necessary to consider the twill direction in relation to twist direction of yarns. To understand the twill twist interaction let us first consider the twist in warp and weft and the effect at the intersection point thereof.

Case I: warp ‘S‘ twist and weft ‘ S’ twist .It is observed that at the point of intersection, the fibres will be at right angles to each other , so they bed

Case II: warp ‘S‘ and weft ‘ Z’ ,fibres at the point of intersection are parallel to each other and hence they nest

There will be two mirror cases to the above .

Let us now consider the twill –twist interaction

Case I: Twill direction: Z , warp twist and weft twist :Z , it is observed that fibres will be at right angles to each other but the twill direction coincides with twist direction of warp .Thus weft twill will be prominent .(i,e twill direction is at right angles to the twist of weft) This condition is indicated byZ : Z X Z (Fig. 3.18 A) and there exists a mirror of this (S :S X S)

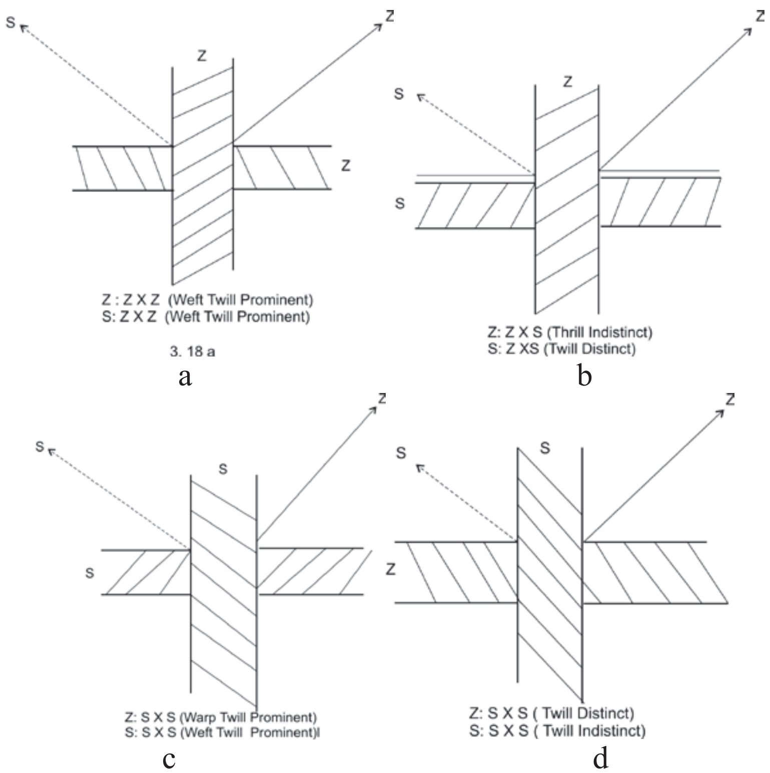


Fig. 3.18 : Twill-Twist Interaction

Case II : Z : S X S , (Fig. 3.18 C) here the twill direction is Z , but the twist direction of warp and weft is S, so therefore at the point of intersection the fibres will be parallel to each other, but the twill line is parallel to direction of weft twist and hence warp twill is prominent .(Mirrorcase :S :Z XZ)

Case III: S : Z X S, (Fig. 3.18 B)here the twist direction is not same and hence the fibres will be parallel and if the twill direction is S , both twist directions are at right angles to twill direction and hence the twill is distinct and clear. (Mirror case Z :S XZ)

Case IV: Z :Z X S(Fig. 3.18 D) here the fibres are parallel at the interface and the twill line is parallel to fibres at interface and hence the twill is indistinct. (Mirror case. Z: S XZ)

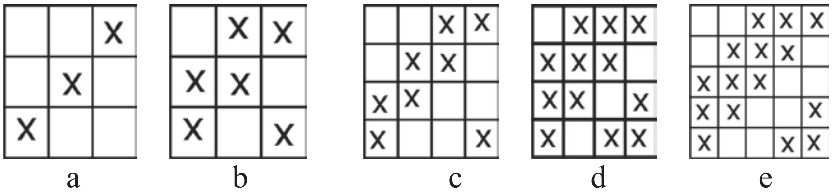


Fig. 3.13

<u>Commercial Twills</u> (Fig. 3.13 **a**to**e**)

Under this category following are discussed

1. Three end twills (Jeans / Denim & Gaberdine)
2. Four end twills (Gaberdine)
3. Five end twills

Three-end twills:

Jean is a warp-faced twill fabric, usually 2:1, traditionally made from singles cotton yarns, and recently also from yarns spun from blends of cotton with man-made staple fibre. It is woven grey and piece-dyed for slacks, light-duty overalls and similar puposes. Denim, used for light-weight military uniforms, is a similar fabric, but it is woven with a yarn-dyed warp and an unbleached, undyed weft.

20s x 18s cotton (30 x 33 tex); 93x62; K_c = 20.8+14.6=35.4; 8x9 percent crimp; 16.5 mils; 6.5 oz.; 2/1 twill weave. Gabardine is made in cotton and worsted, and also in blends of cotton and wool with man-made fibre. It is used principally for rainwear, and its water-repellent properties are obtained partly from the construction and partly from a water-repellent finish. For the finish to be effective, the thread spacing should be close. This is conveniently arranged by using a twill weave in a warp-faced construction, and this gives the fine diagonal lines which are characteristic of gaberdines.

2/48s x 2/48s worsted (37/2 tex); 110x56; K_c = 27.5+14.0=41.5; 12x5 percent crimp; 17.5 mils; 7.8 oz.; 2/1 twill.

Four-end twills:

The most widely used twill weave, 2/2, serves in a variety of ways in fabrics made from all the common fibres. It is particularly important in the woolen and worsted trades, in its simple or in a modified form, for producing a large proportion of apparel fabrics including trousers, suits, costumes and sportswear. Foulard was originally a 2/2 twill silk fabric made in fine, square construction for ties, scarves, blouses and dresses. It has been imitated in man-made filament yarns for similar purposes and also for linings.

100 x140 denier bright acetate (11x16 tex); 132x90; K_c = 18.1+14.6=32.7; 3x4 percent crimp; 6.5 mils; 2.5 oz.; 2/1 twill weave.

It is a firm serviceable cloth used principally for linings but also, printed, for ties, scarves and summer dresses.

2/80s x 2/80s mercerized Egyptian cotton (15/2 tex); 196x98; K_c = 31.7+15.5=47.2;

7x5 percent crimp; 10.6 mils; 5.3 oz.; 2/2 twill. 2/32s x 2/32s worsted (55/2 tex); 100x56; K_c = 30.6+17.1=47.7; 18x5.5 percent crimp; 26 mils; 11 oz.; 2/2 twill.

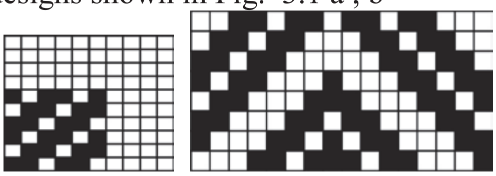
Florentine drill is a heavy-duty 3/1 twill fabric, traditionally made from cotton yarns, and now also from blends of cotton with man-made fibres. It is used principally for overalls and hospital wear.

12s (Z) x 10s (Z) cotton (49x59 tex); 86x50; K_c = 24.8+15.8=40.6; 11x10 percent crimp; 23.4 mils; 9.2 oz.; 3/1 twill.

Exercises

Assignment 1

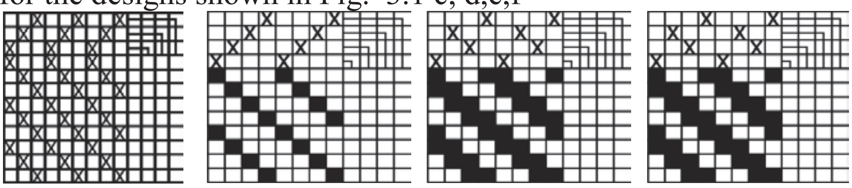
Draw weavers plans for the designs shown in Fig. 3.1 a , b



a b

Assignment 2.

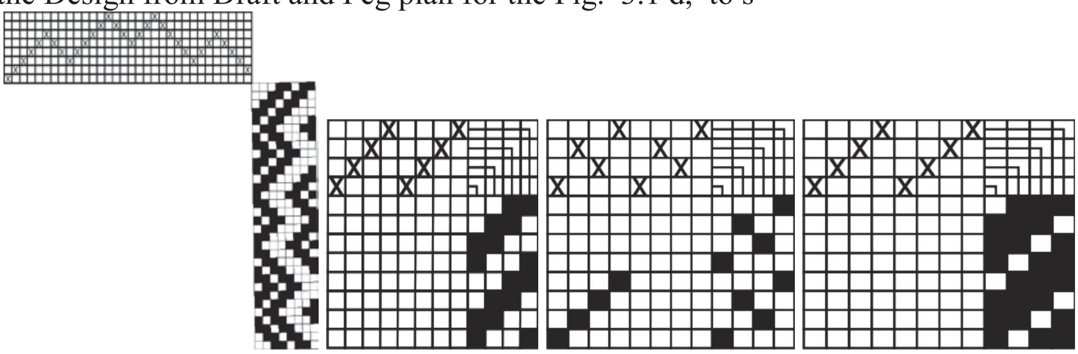
Draw Peg plan for the designs shown in Fig. 3.1 c, d,e,f



c d e f

Assignment 3

Draw the Design from Draft and Peg plan for the Fig. 3.1 d, to s



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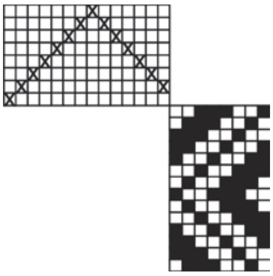

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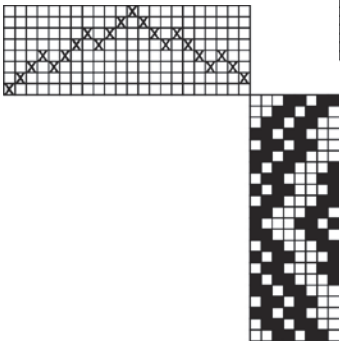

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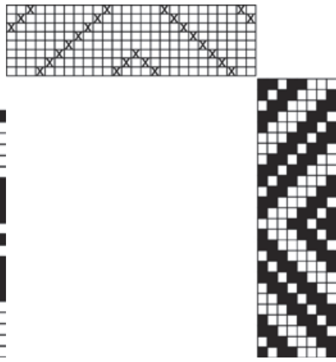

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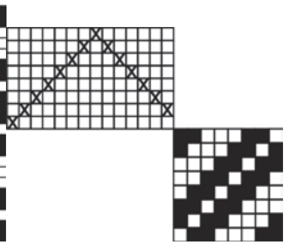

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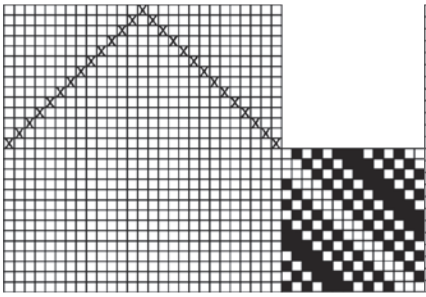

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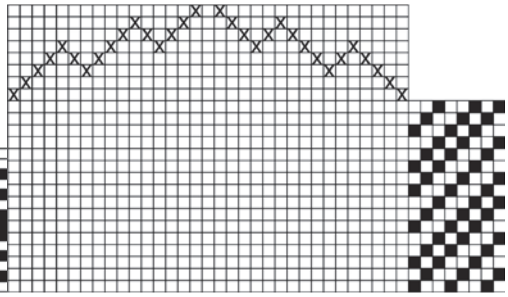

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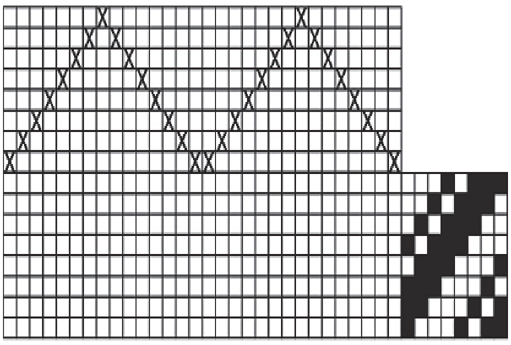

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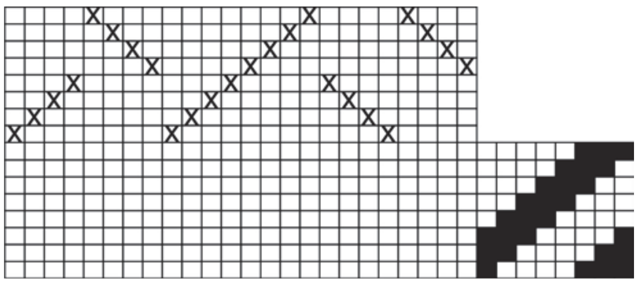

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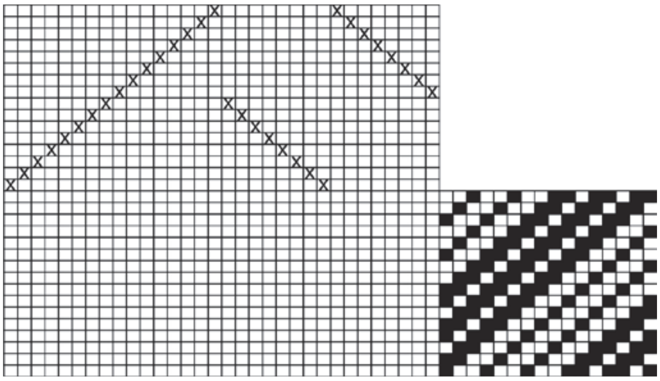

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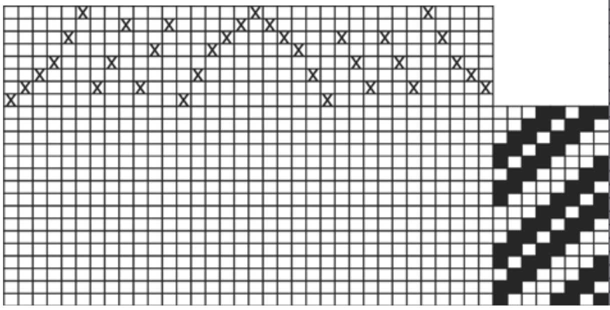

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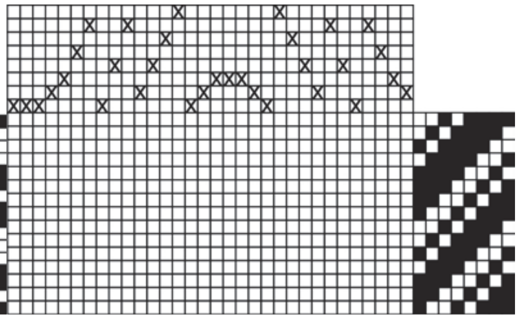

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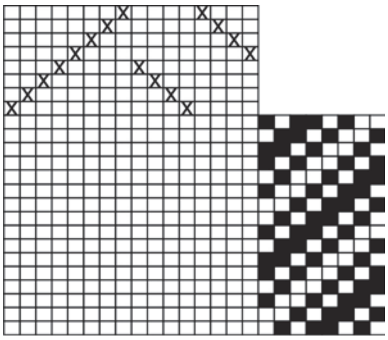

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CHAPTER 4
Sateen and Satin Weaves

INTRODUCTION AND CHARACTERISTICS:

Sateen and Satin are the third primary weaves which are characterized by special features of having only one intersection in the repeat of design. These are also called as floating weaves. Sateen is used as binding weave in complex fabrics like double, treble cloths, extra thread figuring etc. Sateens are not completely free from twill. In weaving 'face down' concept is used to weave sateens/satins. Characteristics of floating weave do depend on nature of material used and the end use thereof. Sateens are known for smooth surface and texture in which the interlacings of warp and weft are practically hidden beneath the floating material on the face of the fabric. The interlacement pattern will be such that there is less or least support to adjacent threads and the number of step or move or run is more than one, virtually twill lines are not distinct. In other words these are the surfaces either with warp (float-warp face) or weft float (weft face). In a repeat of sateen and satin each thread of one series passes over all but one thread of the other series. i.e. the interlacing points are so arranged to allow the floating to slip and to cover the binding point of one thread by the float of another. This is the main reason why sateens or satins are smooth and lustrous in nature. The main requirement of sateens.

TYPES OF SATEEN:

Sateen are classified into regular and irregular type, depending on the weave number (odd/even). The later repeats only on even number of threads where as former repeats on even or odd number of threads. Regular sateen construction include movement of point of intersection from left to right side always, where as in irregular the direction is reversed after half the number of threads are passed.Construction of sateen require what are known as move number which indicate the number of steps to move outward and one upward or number of steps to move upward and one side ward as the case may be. Following are the condition for selecting any number as move number.

1. The move number should not have common factor with weave number
2. The move number should not be one and one less than the weave number
3. The weave number must be such that a smaller number can be chosen as move number
4. In some cases, the move numbers when added may give the weave number itself (eg. 8-end sateen (regular) 3 & 5 are used)

CONSTRUCTION OF SATEEN:

Sateen or satin require move number and are selected as mentioned above. The point of intersection can be in warp direction (number of steps to go upward and one side ward) or in weft direction (number of steps to go outward and one upward) using move number. The method of verification will be simple as number of interlacements should be equal to weave number. In other words, no two intersections per thread is allowed. A table is constructed which guides the reader about selection of move number as per rules mentioned and the type of sateen.Sateen weaves are used as base weave in advanced fabric design

Sateen is also used as lining material for mens dress materials and as furnishing material if produced in coarse counts. But it should be remembered that sateen is not free from twill effect even though the construction is based on use of move numbers .

Examples on Weft Sateen

Fig 4.1 **a**show 4 end satinnate with move number 1, 2,1 . Construction procedure is as follows

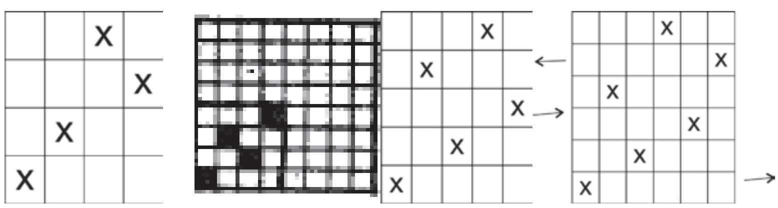
1.. Mark 4 X 4
2.. Calculate the move number using the foumulae

$$\text{Move Number} = \frac{\text{Weave Number}}{2} - 1$$

3. Mark half the number of picks
4. Start the sateen marks using the above move number and move to right until you cross half way mark and then increase move number by one and mark the warp up and after this pick revert back to old move number and in the opposite direction .
5 Draw the draft and we find that all the ends are working differently and thus we need to choose Dobby .

Table 4.1 move numbers for sateen

Weave number	Possible move number	Remark
4	1,2,1	Irregular sateen (as 2 ends 2 picks give plain, 3 ends and 3 picks give twill)
5	3 or 2	Regular sateen
6	2,3,2	Irregular sateen
7	2 or 3 or 4 or 5	Regular sateen
8	(i) 3 or 5	Regular sateen
	(ii) 3,4,3	Regular sateen
9	2 or 4 or 5 or 7	Irregular sateen
10	(i) 3 or 7	Regular sateen
	(ii) 4,5,4	Irregular sateen
11	2 or 3or 4 or 5 or 6 or 7 or 8 or 9	Regular sateen
12	7 or 5	Regular sateen
	5,6,5	Irregular sateen



a a' b c

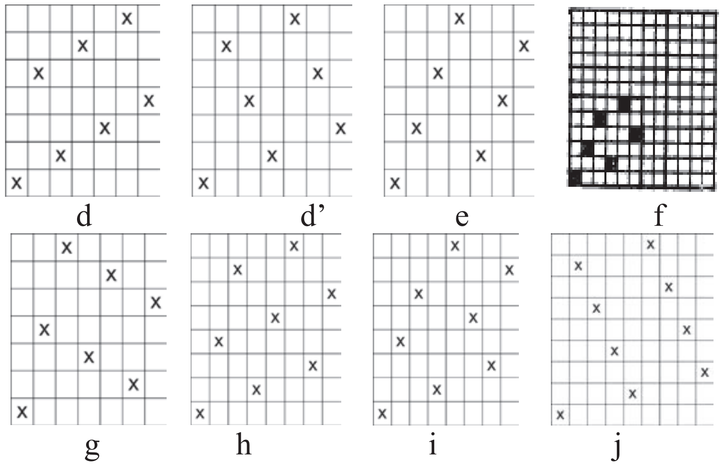


Fig. 4.1

Fig. 4.1 **b** show the design for 5 end sateen with two as move number . Working of 6 end sateen is shown in Fig.4.1 c and it is irregular sateen In some cases we find more than two move numbers in constructing the sateen and 7 end Sateen is one such example with 4 different MN

Fig. 4.1 d – 7 end Sateen with 2 as MN

Fig. 4.1 d’ - 7end Sateen with 3 as MN

Fig. 4.1 e’ - 7end Sateen with 4 as MN

Fig. 4.1 f – 7 end Sateen with 3 as MN

Fig. 4.1 g – 7 end Sateen with 5 as MN and so on

8 end Sateen is more popular design with 3 or 5 as MN . This weave is used as binding weave in advanced textile designs or as ground in Extra thread figuring or as one of the basic weaves in Multilayer fabrics. The weave is also used in Weft piles. Fig. 4.1 h show the design. It’s also to be noted that on 8 X 8 even irregular Sateen can be constructed with 3 , 4, 3 as move number . Fig. 4.1 i show the design. One of the salient features of irregular Sateen is that they are used as one of the weave in preparation of Crepe weaves by superimposing principle.

9 end Sateen is a regular Sateen with 2 or 4 or 7 or 5 as move number (MN). Fig. 4.1 j show the design

Construction of Warp Satin weaves

Satin is a warp faced construction and featured by long floats of warp and weft interelaces only once in the repeat of the design. All Warp Satins are constructed with the help of Weft Sateen. The procedure for construction of Warp Satin is as Follows

1. Mark the repeat size.
2. Select the suitable MN
3. Mark the weft Sateen by dots
4. Fill all the blanks by cross marks

Draft and Peg plan for Sateens or Satins

Sateens are characterized by single interelacement in the entire repeat of the design can be produced either by using Straight or a special draft known as “ SATEEN DRAFT” in which the draft is arranged as the basic weave itself. Peg plan is constructed based on the draft. If the draft is straight we know that peg plan is same as the design showing Linear relation among the elements of fabric Structure. On the other hand if the draft is Sateen draft , the peg plan will be a 45 degree line to base in peg plan giving a non linerar relation.

Satin Checks:

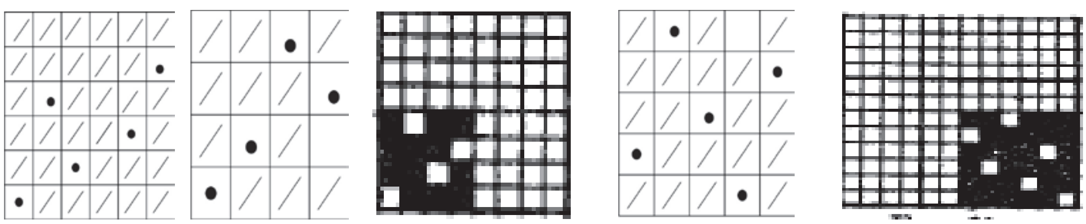
Check effects are produced by combining weft sateen weave with warp satin weave, so that a pattern is developed appears like checks. (Figure 4.2 k ,k’, k’’’ &l, Figure 4.3 a &b) Reader is directed to attempt the Figures 4.3 c , d, e respectively for further knowledge.

Satin stripes:

The satin weave is extensively used for the production of pleasing stripe effects on fabrics which have a plain ground, or some other ground wave such as a twill, broken twill, or crepe. Satin stripes shoeuld stand out boldly on the face of the cloth and present a solid appearance, and in order to bring this about, the satin stripe ends must be set closer together in the reed than the ends for weaving the ground portion of the fabric. Thus, if the ground ends are placed two per dent, the satin stripe ends should be placed three or four per dent if they are approximately the same count as the ground ends. Owing to the closer setting of the ends on the satin portion, and to the fewer interlacings which those ends make with the weft, when compared with the plain cloth portion, we find that the same colour of warp ends produces a much stronger colour effect in the satin stripe than in the plain portion of the cloth. Check effects are frequently made upon plain cloth fabrics by crossings stripes of warp satin with bars of weft sateen.(Fig. 4.2 i , j & j’))

Modification of Sateen

Sateens are modified either using a weft faced or warp faced concept. Using a 5 –end sateen and an additional mark for each sateen mark, we get Venetian weave. Buckskein is similar in construction but uses an 8 end satin. These constructions are used in the production of very heavy weft faced Cotton fabrics that are employed as protective clothing in situations in which a considerable degree of wear is expected. By introducing comparatively few ends per inch a very large number of picks can be inserted and a compact strong cloth is produced. When an 8 end sateen is constructed using 3 or 5 as move numbers, and additional marks for each sateen mark is added in weft direction such that in each pick 4 weft up is followed by 4 warpup . Such a modification is sateen is known as “Swansdown, or Lambskein or Imperial “weave and is shown on point paper. Below are Figure 4.2 a ,b, b’ c & c’ and Figure 4.2 ‘l’ is a special case.



a b b’ c c’

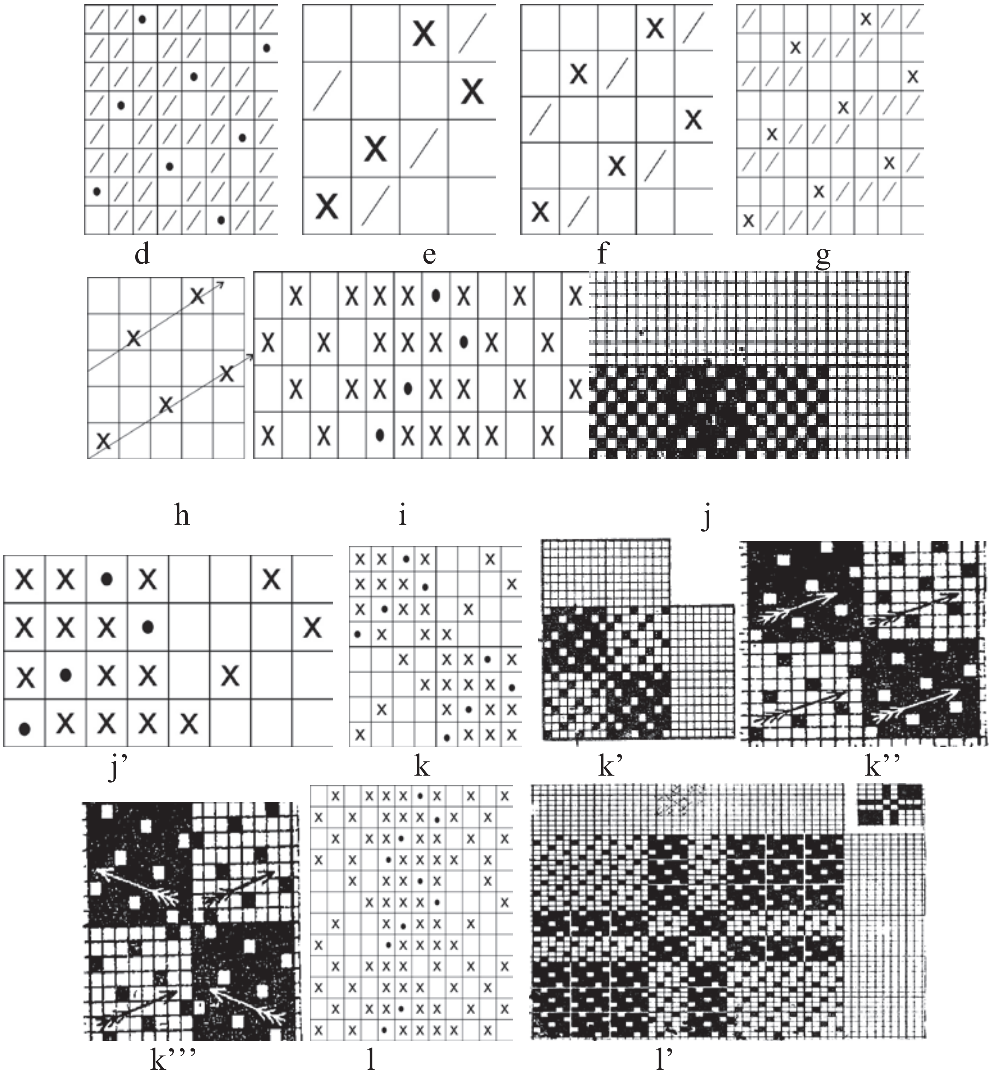


Fig. 4.2

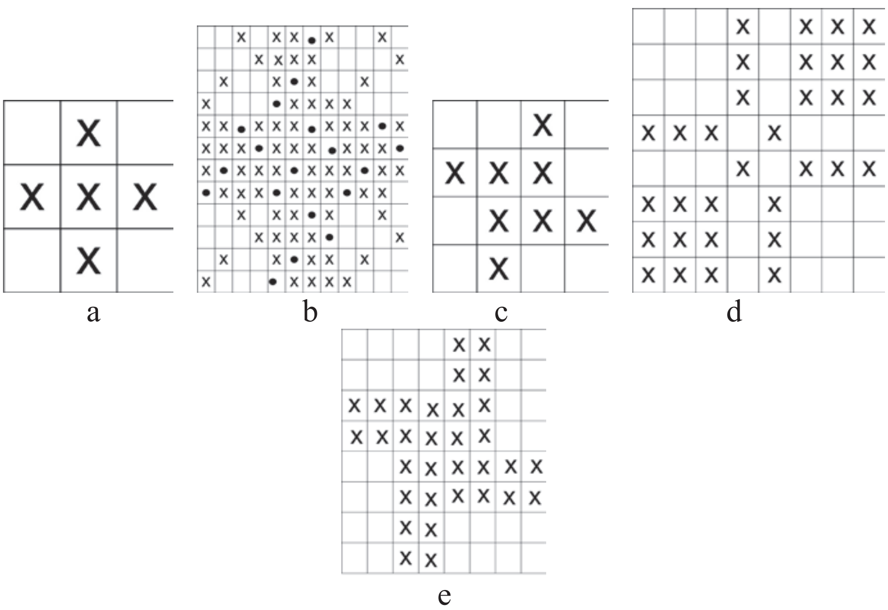


Fig. 4.3

CHAPTER 5
Colour-And-Weave Effects

Ornamentation of any fabric is necessary to improve its value addition and in this regard any weave can be ornamented in a variety way to improve the appearance. The effects obtained by colouring a basic weave in a particular proportion in warp and weft way (keeping other factors constant) is known as colour-and-weave effects. By colouring small geometrical patterns will be appearing without weaving of such patterns. Colour and weave effects may be obtained either in simple or complex way. The effects are very popular in woolen and worsted fabric for costumes, sports jacket, ladies coats and furnishings. Today the effects are also observed in $2/20^s$ to $2/40^s$ towels.

Principles of Colour-and-Weave effects:

To understand the concept following principles are considered. (Consider two colours black and white in warp and weft). (Fig.5.1 **a** to **d**)

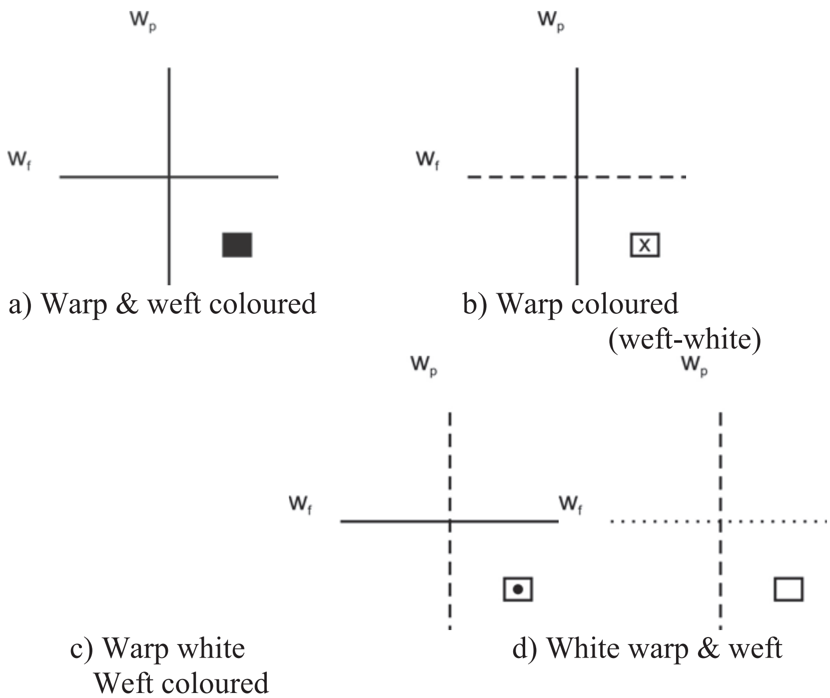


Fig. 5.1

1. If a warp end is coloured and if it is appearing on face side, the effect will be that of the colour to the observer and is indicated by (X) upmark.
2. If a warp is white coloured and is appearing on face side of fabric, the effect will be that of warp i.e. white and is represented by □

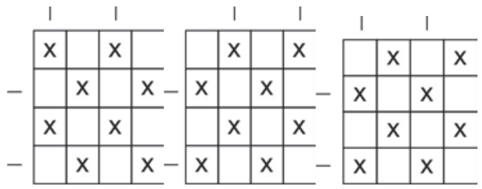
3. If a weft is coloured and appears on face side of fabric, the effect will be that of weft i.e.colour of weft and is represented by

If a weft is white coloured and appears on face side of fabric, the effect will be that of weft i.e. white and is represented by □

Examples on colour and weave effect:

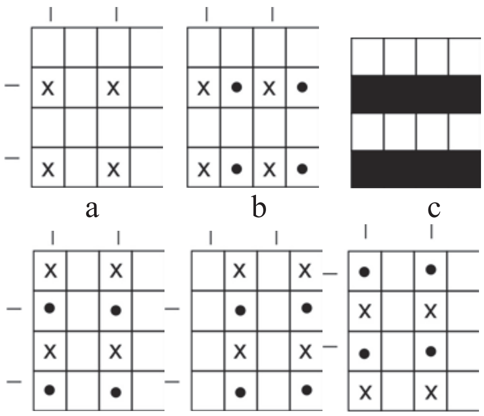
1. Development of coloured stripe for plain with 1:1 colouring

The procedure in getting colour and weave effect includes in representing the basic weave to be coloured with number of colours (consecutive or alternate or any other fashion) in warp and weft at first instant. Below this is a repeat size which is obtained after colouring. After getting the pattern with X and • marks, it is customary to solid the entire portion to give the effect shape. In all the cases Fig. 5.2 show A1 , B1 & C'1 as base designs .



A1 B1 C1

Example – 1: Here plain on 4x4 is alternately coloured in warp and weft way. The result is that horizontal stripes appear as shown in Fig.5.2 **a** to **f**



a b c

d e f

Fig. 5.2

(Note: One of the easiest way to get the effects is to retain the basic upmarks of coloured warp as it is and filling up of weft ups of coloured wefts by dot).

Example – 2: The same or modified style of colouring for the plain give vertical stripes (Fig. 5.2 d, e, &f)

2. Development of patterns with Compound Colouring:

It is possible to colour by 2:2, 4:4 in warp and weft. Point paper show examples which indicate such effects.

Eg. 1: When a plain weave on 4x4 is coloured in 2:2 in warp and weft, CROWS FOOT is obtained. More number of repeats of this can be obtained by colouring a plain weave on 8x8 with 2:2 colouring (warp and weft). (Fig. 5.3a &b)

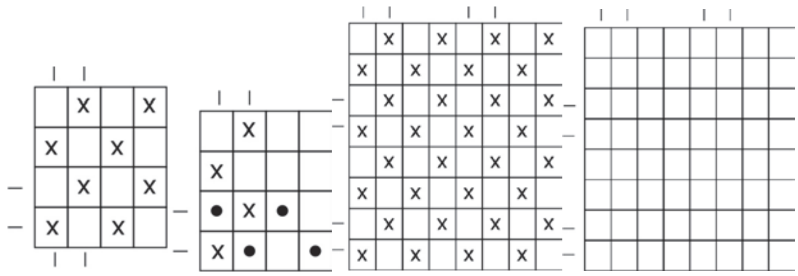


Fig. 5.3 a   Fig. 5.3 b

Eg. 2: When a 2/2 (Regular) matt is considered on 8x8 and coloured in 4:4 proportion, larger crows foot effects are produced. More number of repeats can be obtained by colouring 2/2 matt on 16x16 with 4:4 colouring (Fig. 5.4) (First four coloured and next four second colour) in warp and weft.

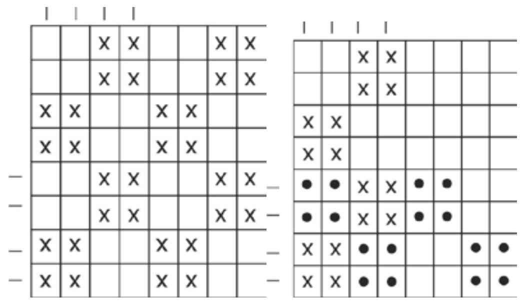


Fig. 5.4 a& b

Eg. 3: Reader is instructed to examine the effects produced on plain 2:2 and matt 4:4 by changing the footing (i.e. start with down).

Development of Dog's tooth and Hound's tooth:

Interesting cases may be obtained when a twill of 2/2 on 8x8 is coloured with 4:4 proportion. If coarser yarns are used the effect is known as Hounds Tooth and if finer yarns are used the effect is known as Dogs Tooth. Normally the end use of these effects are found in woolen and furnishing areas if produced in coarser cotton.

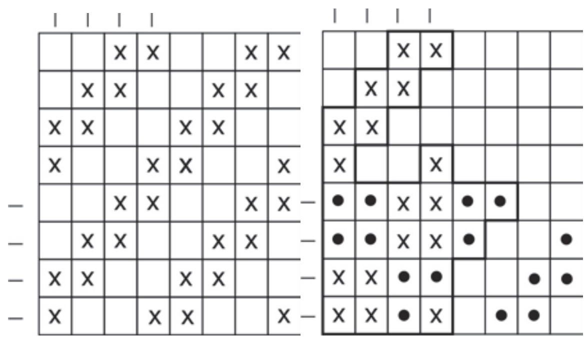


Fig. 5.5 a & b

Fig.5.5 showcolouring of 2/2 'z' twill on 8x8 with 4:4 colouring. Alternatively if 2/2 twill on 12/12 is coloured with 6:6, shephered check is obtained. A woolen coating is woven on this principle. Larger effects are produced if 8:8 is coloured on 16x16 and 12:12 is coloured on 24x24.

Stepped twill:

A 1:1 of colouring with 2/2 'z' twill give stepped appearance as shown in figure worsted suitings are produced by this way are most popular.(Fig. 5.6)

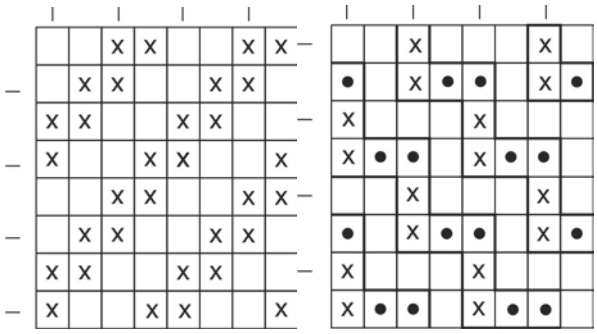
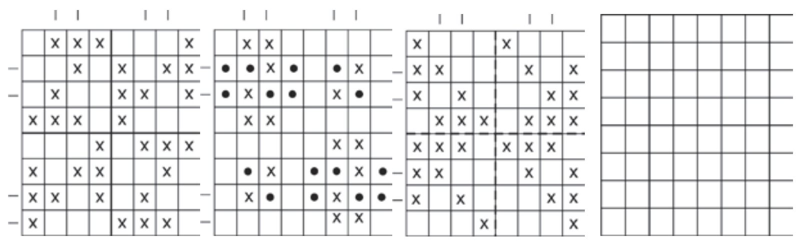


Fig. 5.6 a& b

Birds Eye view:

A variety effect known as Birds eye view is obtained when a crape weave on 8x8 is coloured on 2:2. Two possibilities of birds eye view is shown in Fig. 5.7



a b c d

Fig. 5.7

Stripe and Check effect:

By colouring 1:1 in different way for a plain on 16x16 give stripe and check effect. Similar effects can also be produced when 2/2 'z' twill is coloured on 2:2 (reader is instructed to practice this design).(Fig. 5.8)

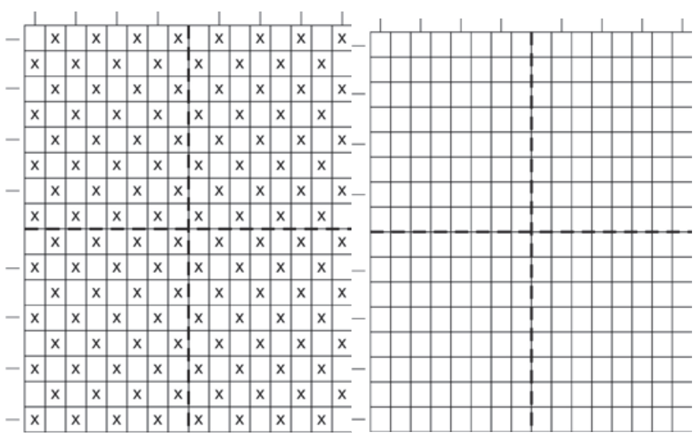


Fig. 5.8 a & b

Glen checks:

Four different glen checks are produced in following way: Weave: 2/2 'z' twill on 8x8

Colouring pattern:

Case (i) warp : Last four, weft First four

Case (ii) warp and weft : 2:2

Case (iii) warp : Last four, weft : 2:2

Case (iv) warp : 2:2, weft First four

Reader is directed to practice these designs

EXERCISES

I. Choose the correct answer from the alternatives given:

1. Colour and Weave effects require __________ warp preparation
   a) Beam b) Ball c) Vertical Mill d) Sectional
2. Only ___________ type of looms are used to get colour and weave effects.
   a) Dobby with 2x1 b) Box looms
   c) Jacquard with 4x1 d) 4x1
3. Majority of colour and weave effects are produced in __________ yarn
   a) Cotton b) Worsted c) Spun silk d) Woolen
4. While producing stripe and check effects in colour and weave effects it is necessary to
   a) Balance the colour pattern

CHAPTER 6
Huck - A - Buck Weaves

These are the special category of fancy weaves which are mainly intended for moisture absorption . Huck-a-Back are one of the type of toweling fabrics and are characterized by Honey comb effects as well in addition to rough surface. A huckback weaving pattern, also known as huggabag, huck-a-back, huckabag or simply huck, is an old weave used for towels. The name 'huckaback' may have been adapted from 'hucksters', known from around 1200. Hucksters were pedlars and used to sell linens in markets, after carrying goods on their backs. According to literature review huckaback pattern produces a specific uneven surface which allows towels to absorb water better and dry off quicker. Many derivations of the huckaback weaving pattern have been found in folk weaving, especially in Germany and Scandinavia. Huckaback towels won't take up as much space in wardrobe as conventional cotton towels.

Scope of Huck-a-BAck weaves

These weaves like Honeycomb are largely used for cotton and linen hand towels, glass cloths, quilting, lighter dress materials, shirting's, roller towels. Today the weave is extensively found used as special quality Napkins for sanitary purpose in larger hotels and also as ladies hand kerchief when produced in finer counts. ***Mainly the weave consist of tight and slack interlacements***.

Characteristics of Huck-a-Back Toweling fabrics (Requirements of water absorption)

The weave is characterized by the following

- Rough surface with floats for moisture absorption
- Pattern produces a specific uneven surface which allows towels to absorb water better and dry off quicker
- Plain weave solidly bind the threads into solid structure and floating threads form distinct layers and thus alternate tight and slack interlacements form distortions
- Firmness is imparted by plain weave which is the back bone for the Toweling weave
- The tightly woven plain portions tend to spread in all directions while the slack portion offer no resistance and thus become contracted in area. The degree of distortion depends on count and thread setting .
- These weaves are constructed with Floats and Plain weave in alternate quarters

- These are also constructed with weft floats on face side and warp float on back side.
- The weave in the toweling fabric dry the skin very effectively and thus stimulates the blood supply leaving the user revitalised and fresh.
- Except in some cases , Huck –a- Buck is produced in coarser cotton and Linen counts.
- A more balanced weave requires the weave repeat size as twice an odd number (2 X 5 = 10).The weave consists of floating threads (with fewer intersections) are much looser than continuous threads weaving plain . Below are the Figures 6.1 a to d

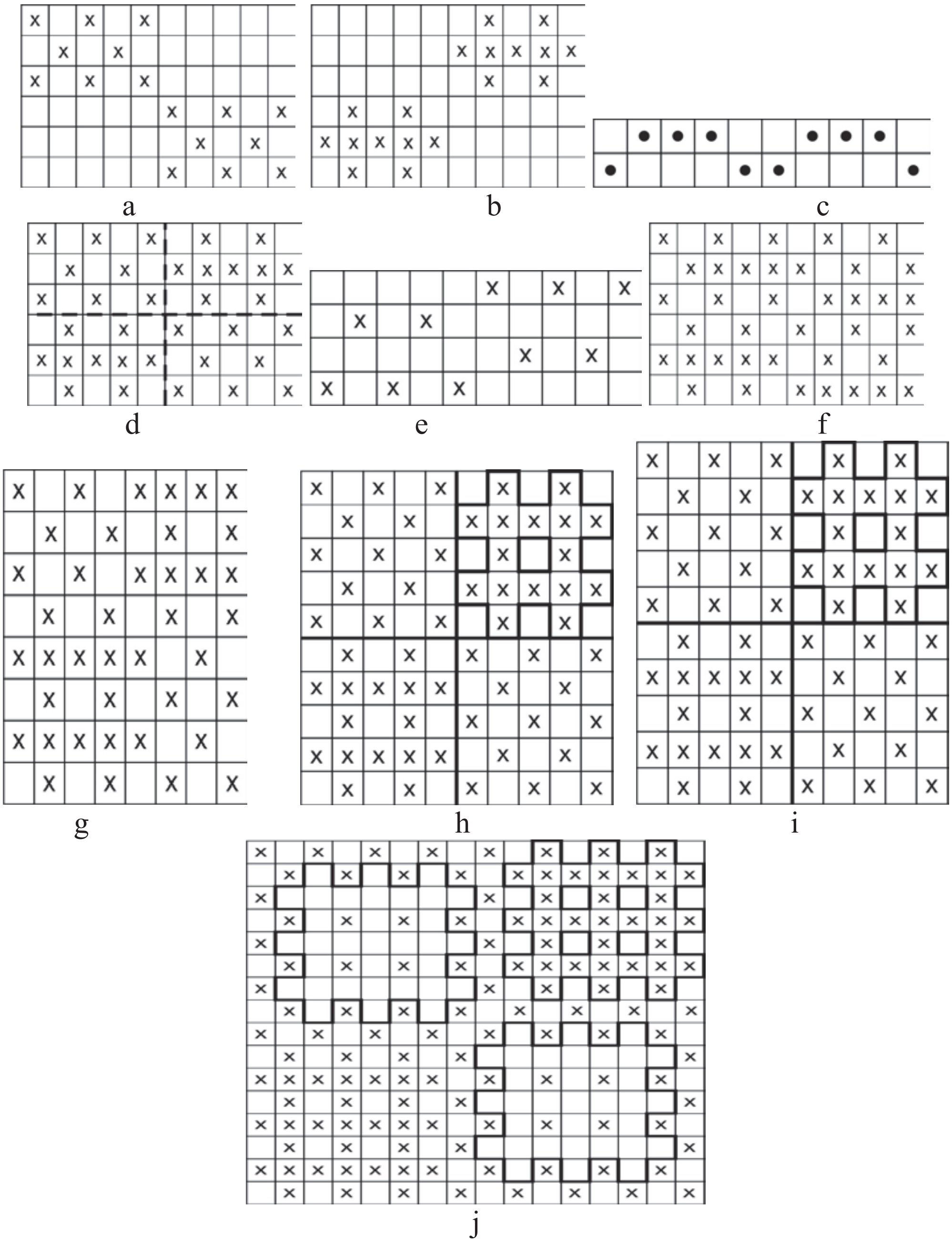


Fig. 6.1

Systematic construction of Huck-a-Back weave

Following are the stages of construction (Fig. 6.1 **a**to**j**)

1. Mark the repeat size and divide it into 4 quarters

2. Fill up the first quarter with a motif which has floats
3. Fill up the second quarter with plain weave with respect to the previous interlacement in each End.
4. Repeat the third quarter with the motif as filled in first quarter
5. Fill the fourth quarter with plain weave as mentioned in the step 3.

Present day Huck-a-Back are produced on even number of ends and picks. For example a toweling fabric is produced on 6 ends and picks with a motif on 3 ends and 3 picks. Above and adjacent to the motif plain weave is filled. Indeed a variety of designs are being produced in market.

Point paper representation (Fig. 6.1 a to j)

The standard design is known as Devon Huck (NonSquare)and constructed on 6 picks and 10 ends with H motif in opposite quarters and plain in the remaining . It requires only 4 shafts and can be produced by Tappet loom itself with regular or skip draft (as explained in the next section)

Modification of Ordinary Huck-a-Back

The ordinary Huck-a-Back are modified in various ways as shown on point paper. The design shown on 16 X 16 is referred as " Honeycomb-Huckback"as (Fig. 6.1 **j**)it contain a long float .A further development of this weave is on 16 X 16 with reversible arrangement and is known as " Grecian"

Weaving Arrangements - Beaming, Counts of Yarns & Type of Loom

A single beam (mono or multi colored)in 30 – 36 inches width of warp is prepared with both floating ends and plain ends. Toweling fabric also comprise weaves with Stripes only (either in warp or weft) and checks . It is better to have All metal reed than Pitch baulk reed as the texture of the fabric invariably depends on the type of reed employed. A single beam with more than 2 patterns (each may be warped from 100 to 300 meters). The towels are produced in 1.6 m to 1.8 m lengt . Some of the market sizes for (a) guest towels is 35cm x 50cm, (b) hand towels is 50cm x 70cm and (c) large bath towels is 100cm x 150cm. Huck weave is normally produced in dobby or tappet loom fitted with Loose Reed mechanism . In case of patterned warp and weft , 4 X 1 loom with side weft fork is preferred. Toweling weave with minimum number of ends like 6 X 6 is effectively produced in dobby with necessary adjustment in design pegging .design. Typical counts are 10 's , 2 / 14's , 2 / 20's ring yarn as warp and 10's rotor yarn as weft . Use of rotor yarn improve the absorbency and uniformity as rotor yarn is more uniform than ring . The best material suited for toweling is Cotton and Linen . Ring yarn with softer twists are preferred. Today as noted above toweling weave is also produced in finer variety like 30's or 40's. to improve the texture some constructions do use mercerized yarns for warp and weft .Presently in South Indian market towels are sold in bleached condition or dyed / printed in mono or multi color It is customary to use bleached yarns for warp and weft. It should be noted here that fabric structure or weave and its appearance is depending on the nature of the warp and weft. Fringed Towels are produced in the width (Finished) 28 – 33 inches with stripe or check patterns or Colour over while ground etc.,

Drawing and Denting arrangements

A regular drawing or skip order is followed . In the later the odd threads are drawn in the front (Odd) healdshafts and even threads in the back (even) heald shafts. Tappet shedding mechanism is used and operated by two tappets. The purpose of this special draft is to enable plain cloth to be woven in the healds(without re-drawing the warp) by coupling the healds 1 & 2 together and 3 & 4 together and operating them by first and fourth tappets. (Figures 6.1 c dentingand & e drawing)

The denting is irregular as two ends which are weaving plain throughout the repeat are drawn in same split of the reed ,so that the floating threads are discouraged from pulling all the threads which lie under them into groups.

Research studies on Huck-a-Back weave

A number of research papers published with an objective to investigate the effect of fabric structure on the mechanical properties of the fabrics woven on either 12 shaft or 10 shaft loom.

Generally it is well known fact that all toweling fabrics are washed regularly and frequent Laundering will have direct effect on the mechanical properties and fabric Handle. HITOMI MORINO *et al.,* in their experiment considered Huck-a-Back weave on 10 X 10 . They have defined the crossing- over firmness factor (CFF)and the floating yarn factor(FYF)as the parameters of the weave Structures for predicting mechanical properties and hand values. Both CFF and FYF are found to be related to mechanical parameters ; It was reported in this paper that CFF becomes bigger if the frequency of interlacing yarns is larger and on the other hand both CFF and FYF are found to be related to mechanical parameters ; It was reported in this paper that CFF becomes bigger if the frequency of interlacing yarns is larger and on the other hand FYF becomes larger with a longer floating length. Huck-a-Back was considered in studying the effect of fabric structure on the fabric handle using Neural Network by Fujita et.al.,

HONEY COMB WEAVES

Features of Honey Comb

The characteristic features of Honey comb weave is the presence of alternate raised and sunken diamond shaped areas giving the effect of Honey comb. Honey combs are characterized by point or V- draft as compared to special ordinary draft of Huck-A-Bucks. In Honey comb weaves, repeat size and the longest float (always ODD number) of the design and the number of heald shafts are related . The arrangement is such that the structure results in characteristic Point draft.. Honey Comb towels are the second class of toweling fabrics used to a greater extent .and are made from coarser count like Huck-a-Buck fabrics, Honey combs are produced by employing point draft unlike special draft as is the case of Huck-A- Buck. Generally all HC are constructed by marking one left and right twill lines and in some cases from left to right only one twill line is marked and from left to right two rows of twill line is marked. Whatever it may be , HC are observed to be less firmer except at the centre where plain weave is formed. Therefore some times to overcome this problem , it is customary to add double row of twill lines on both left and right hand sides.

These weaves are a distinct class of diamond structures in which the ends and picks are made to lie in different horizontal planes in the fabric, and thus produce ridges and hollows in regular order, giving to the cloth a cell-like appearance. Both warp and weft float freely on face and back side of fabrics. The fabrics are generally woven with fairly coarse yarns and appear thick and spongy, and since they possess long floats of warp and weft, they readily absorb moisture and are suitable for use as towels. Honeycomb weaves are also used for making bed-spreads and quiltings, and to a more limited extent for dress and coating materials because the weave effect is of a decorative nature.

When fabrics are made with long floats of warp and weft in close proximity to one another they tend to become thick and have rough surfaces, and this is notably the case if some tight weaving portions are introduced near to the longer floats of warp and weft.

How it absorbs water ?

Presence of floats warp and weft , coarser count material coupledwith rough surface results in excellent moisture absorption. The ridges and hallows may give complete cells or incomplete cells .In present day these weaves are used for ladies hand kerchiefs when produced in finer counts.

Classification of HC

HC are classified into two broad categories like : Ordinary &Brighton . Ordinary HC produce thee cellular effect on both sides where as in Brighton the effect is observed on only side.

Ordinary HC are classified into

- Ends leaded HC
- Picks leaded HC
- Special Ordinary HC
- Straight drafted HC

Construction of Ordinary HC

Simple Ordinary HC

These repeat always on even number of ends and picks. The smallest OHC of simple category is on 6 ends and 6 picks. The float length is 3 and it requires 4 healdsi.e one more than the half the number of threads in repeat of the design. Generally in OHC incomplete number of cells are formed. With point draft , the peg plan will be half of the design giving a non linear relationship among the elements of fabric structure. (Figure 6.2 a to d)

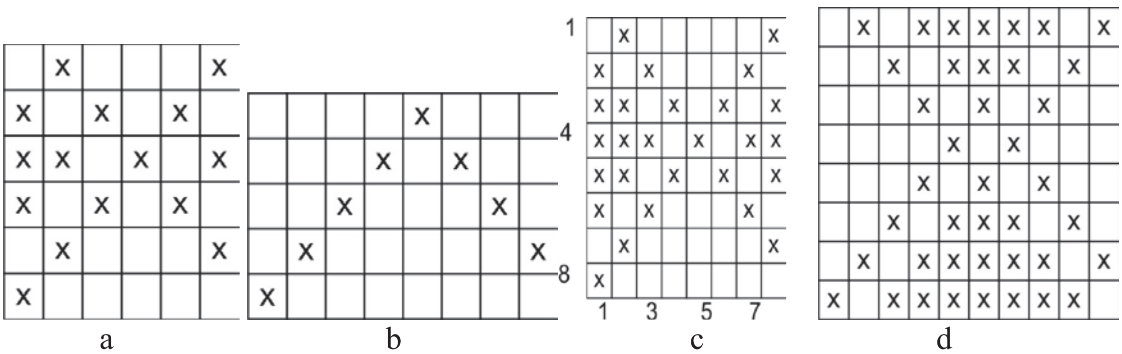


Figure 6.2 a to d

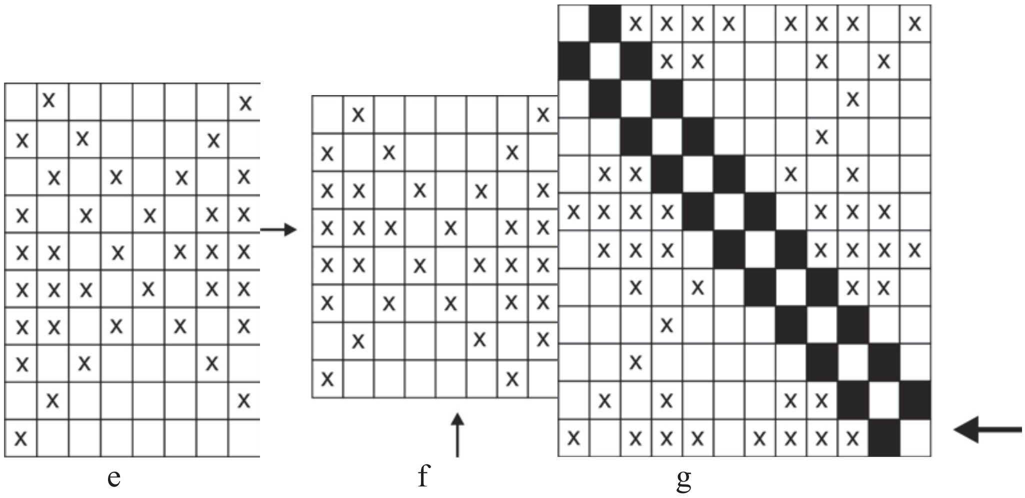


Figure 6.2

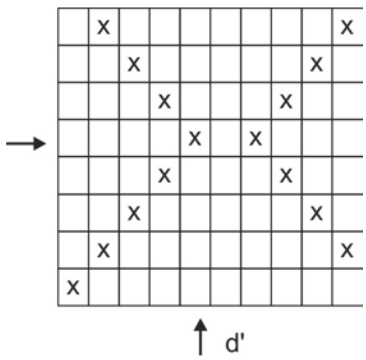
Fig. 6.2 a show OHC on 6 X 6 . The steps of construction are as follows

1. Mark repeat size (6 X 6)
2. Insert 1 up and 5 down twill line in Z direction
3. Inset a S twill line from opposite side such that there exists a plain weave at the centre
4. Start adding odd number of marks from the centre as shown in Fig. 6.2a
5. Repeat the similar work on the opposite side and you will observe that the cells formed are incomplete.

Reader is directed to draw peg plan and observe the fact mentioned above.

Ends leaded HC (Fig. 6.2 d & d')

Honey comb normally repeats on even threads. But this results in unequal cells length as observed in Fig.6.2**c** and to get equal cell lengths it is better to construct HC on two ends more than picks and Fig. 6.2 d show HC on 8 picks and 10 ends. It's a point to be noted here that when HC is constructed on two ends more than picks, heald shaft required will be more than the normal . to get the same cell length. d' to be completed by reader .

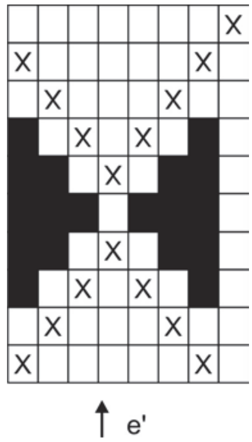


Procedure of construction

1. Mark 8 X 10
2. Introduce 1 / 5 Z twill up to 5 th pick and then move in S fashion
3. Introduce another twill line in S direction till 5 th pick and then move in Z direction .
4. Fill the diamond spaces with odd marks

Picks leaded HC (Fig.6.2 e& e ‘)

Similar to Ends leading HC, Picks leading HC gives cells of equal length.



1. Mark 10 X 8
2. Introduce 1 / 5 Z diagonal twill line
3. Introduce another twill line in S direction till it meets 4 th pick and then locate 5th end and count 5 th pick and move in S direction .
4. Fill the diamond spaces with odd marks

Straight Drafted HC

As the name itself indicates , this HC is constructed with straight draft which is not the case with any HC and is featured by equal cell length as shown in Fig.6.2 **f**

1. Mark 8 X 8
2. Introduce 1 /7 Z twill line
3. Refer Fig.6.2 **f,** from 5 th end and 3 rd pick work S twill
4. Similarly refer 6 th pick and 4 th end work S twill
5. Fill the cells on either side and it is found that equal length cell is formed

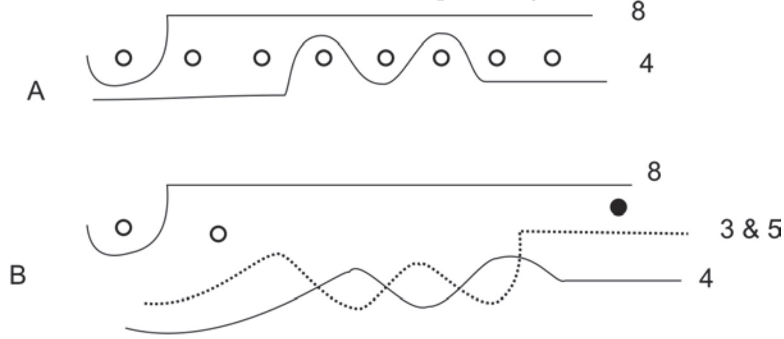


Fig. 6.2 h

Why Honey comb is called a 3- dimensional structure ?

The cellular effect produced by these weaves arises from the fact that the ends and picks composing the fabric are disposed in three distinct layers (Fig. 6.2 **c** & Fig. 6.2 **h : A &B**). There is firstly the upper layer consisting of the longest floats of warp and weft on the face of the cloth, and these form the ridges of the cells on the face. There is then a second layer consisting of the ends and picks which are subjected to the greatest amount of interlacing. Finally there is a third layer of ends and picks at the back of the cloth consisting of the longest floats of warp and weft on the underside.

Threads and picks numbered 1 give the extremities of this third layer. The spongy and cellular effect of the honeycomb weaves are greatest when the fabrics are square in structure, that is to say, contain equal numbers of ends and picks per inch, of equal counts of warp and weft, but a good many cloths are made with much coarser weft than warp. Again, the cellular effect can be varied by increasing the amount of plain tight weaving areas, and decreasing the lengths of warp and weft floats.

Brighton HC

This give more designed way of cells formation with equal number of cells (two large and two small) in the repeat. In BHC a large hollow at each place where the double line of marks crosses the single line and a small hollow in the centre of each diamond space. Unlike OHC, BHC need straight drafts as all the ends working in a repeat will be different. It is possible to calculate the length of longest float in B HC as one less than the half the number of threads in the repeat of the design. These are repeated always on multiple of four. The construction is shown in Fig.6.2 g and the steps are as follows

1. Mark 12 X 12
2. Devide the repeat size into four parts
3. Insert 1 / 11 Z twill line
4. Insert a double row of warp up with intersections starting one step above and one step sideward of Corner point as shown by arrow in Fig.6.2 **g**
5. Marks are then added to the double rows so as to form a small warp diamond in the right and left corners of each diamond space as shown in Fig.6.2 **g**
6. The diamonds are completed in upper and lower parts.

Ornamentation in HC

In both types of HC ornamental value of the good can be improved using color so that long floats formed on the surface are clearly observed. Long floats are formed on the surface as indicated by the position of the marks along the bottom and at the side of the design resulting in the formation of colour checks among the cells . Although BHC is not as popular as OHC, finds its application in quits , brocades, hand towels and glass cloths

Distinctions between OHC & BHC

Sl No.	Means of difference	O H C	B H C
1	Repeat on	Only even threads	Multiples of four
2	Minimum Size Repeat	6 X 6	8 X 8
3	Type of Draft	Point	Straight
4	Number of Cells formed	Incomplete cells are formed or only one cell is formed in the continuum.	Two large and Two Small cells are formed and complete in nature.
5	Maximum Length of the float	Cannot be ascertained even though in some cases it is one more than half the number of threads in repeat (Exception in the case of OHC on 6 X 6 has	It is calculated as one less than the half the number of threads in the repeat of the design

		float length as 3)	
6	Construction details	Normally with one row of Z and S diagonal lines and in some special cases two rows of lines are introduced Similarly in OHC the long centre floats of warp and weft form vertical and horizontal ridges.	One row from left to right and two rows from right to lest i.e one row of Z and two row of S are compulsory But in BHC two different sizes of Diamonds are formed as one large hollow at each place where double row line of marks crosses the single line and a small hollow in the centre of each diamond space.
7.	Scope for Ornamentation	It is limited	Two types thick and thin can be used to ornament the longest float.

Reference:

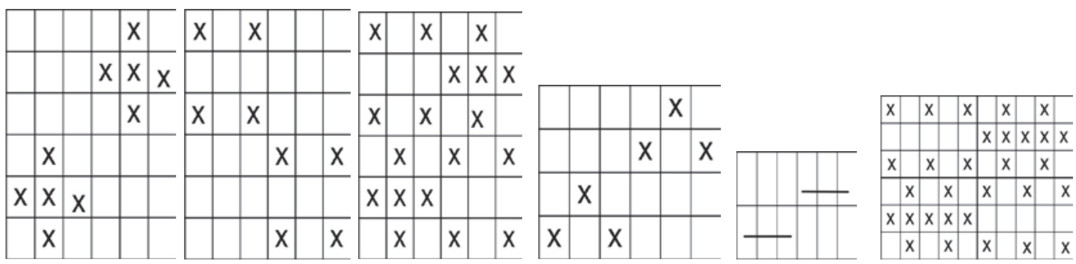
- Predicting Mechanical Properties and Hand Values from the Parameter of Weave structures
- HITOMI MORINO,MITSUO MATSUDAIRA &MINORU FURUTANI, TextileRes.J. 75(3),252ñ257(2005)

CHAPTER 7
Mock Leno and Distorted Effects

These are called as special weaves as they are characterized by perforated or openness . They resemble advanced structures like Gauze and Leno which are produced by doup wires They are produced in two ways : A. Simple open effects on Group denting concept resembling Gauze and leno and B.Distroted thread effects which have special threads (both warp and weft) known as distorted threads resembling net lenos.

Scope

Wide range of applications include embroidery cloths, Canvas cloths, light weight window curtains, and used for special purposes where in they are combined with plain as table linen, brocades, blouses, and dress wear.



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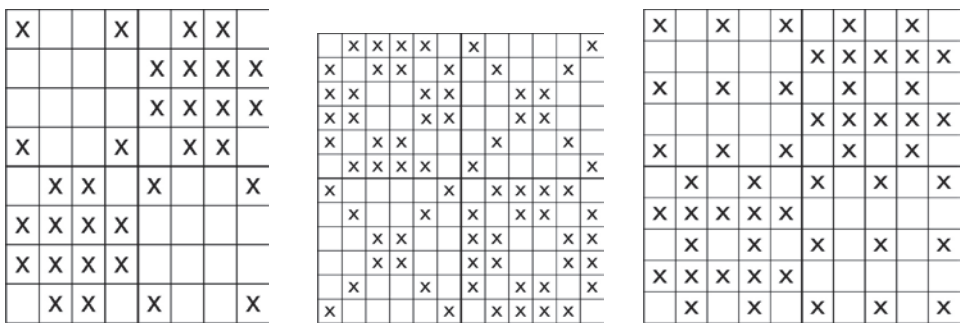

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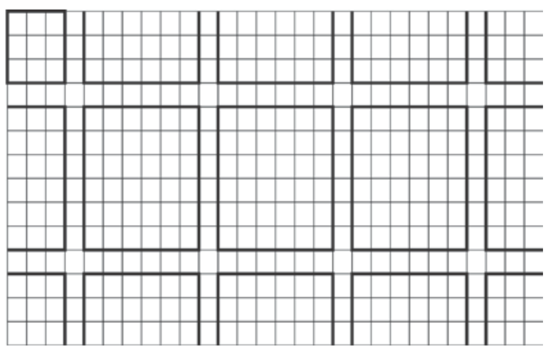

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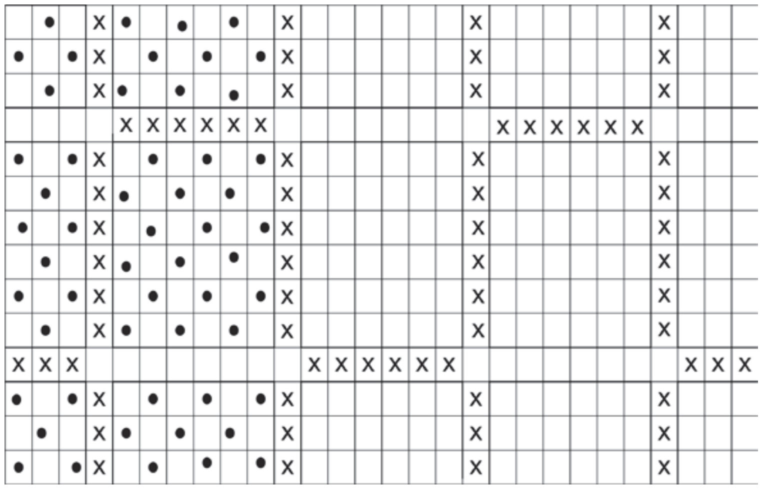


k

Fig. 7.1

Counts of Yarn

If used for furnishing coarse counts upto 20's are preferred and use of medium to fine provide other class of fabrics.

Construction of design for Perforated fabrics (PRNCIPLE OF TURN DOWN)

These are identified as 3 X3, 4 X 4 , etc. as mock leno ,indicating the number of threads per group in the design. (Fig. 7.1 **a**to **e**)The steps for constructing a 3 X 3 mock leno is as follows:

1. Select the mock leno (like3 X 3 or 4 x 4 etc.,)
2. Mark the Square repeat size
3. Divide the repeat into 4 parts
4. Fill a small motif in the first quarter
5. Fill the next quarter by Turn down principle
6. Repeat 5th step

The weaves in quarters oppose each other and there is a tendency for the outer threads of adjacent sections to be forced apart, where as in each section the order of interweaving permits the threads to readily approach each other. The warp threads thus run in groups with some space between and are crossed by weft picks which are also grouped.

How exactly the Openness is produced (Weaving arrangement) (Fig. 7.1 d & e)

It is necessary to note the weaving arrangements made in producing open or gauze imitation effects. Two points are important to understand. Firstly, the denting which allow the threads in group forms openness combined with a use of Coarser Reed count. Secondly, it is the Take up which is made inoperative or used as interrupted take up. In other words in denting the last end of one group is passed through the same dent or split as the first end of the next group, the tendency to make the threads to run together is counteracted ; but if each group of ends is passed through a separate dent threads will be in groups. For a higher Reed count if group is followed, the width in reed reduces and therefore it is better to use a coarser reed with more ends per dent in Reed. In another attempt, use of finer Reed with missing alternatedents . The interrupted take up increase the distance between the picks, today in market some samples are released where in irregular denting like five in one dent and the next one thread in one dent is practiced to get variegated open structure. It is also found that denting vary depending on the count of yarn used . For example with medium counts, five in two splits –one split missed –one end per split, ; for finer yarn counts ,two, one and two ends per split ,onemissed ,one per split one missed etc., Hence the texture and appearance of the fabric mainly depends on the denting plan.

Ornamentation of Mock leno

Mockleno coupled with basic weaves like plain and twill improve the ornamental value and such design is used mainly for window curtains. These are produced (Fig. 7.1 **f** to**i**)in the form of Stripe in which bands of irregular width are produced by plain and mock leno . Here it is to be noted that wherever plain is used ,regular denting (two ends/dent) denting is used and at places with mock leno irregular or group or dent and miss dent concepts are used. Majority of this class are being produced in decentralized sector under respective state owned Handloom corporations. A point paper designshow such an effect.

DISTORTED THREAD EFFECT

In these structures, certain ends or picks or both known as Distorted threads are introduced either from separate beam or shuttle tend to create the cellular appearance(Fig. 7.1 **j** & **k**) in similar fashion to gauze and leno.If distorted threads are used only in warp it is known as Warp Distortion and if used in weft they are called as Weft Distortion and if used in both directions it is referred as "Distorted Thread effects". The main salient feature of these structure is that they are produced with ground as plain weave two types of threads are observed namely plain and distorted. The Distorted ends float over all plain picks but pass under distorted picks and similarly the distorted picks float over one group of plain ends and under the next group in alternate order. The distorted ends are drawn from a separate beam and are let off rapidly than the ground ends and thus are drawn towards each other where the distorted picks float over ground picks. As the later floats occur in alternate order ,the ends are drawn together impairs and then separated and thus the cellular texture appears on fabric.

It is important to decide about the frequency of distorted threads depending on the end use . Following are the steps in constructing a Distorted thread effect(Warp and Weft)

1. Select the Number of Distorted ends and picks say 4th, 11th, 18th and 25th in warp and 4th and 11th in weft
2. Mark 14 picks and 28 ends
3. Mark the respective distorted ends and picks
4. Fill the ground ends with plain weave
5. Indicate lifts for all the distorted ends except at the places where they cross the distorted picks.
6. Similarly indicate the lifts for ground ends in alternate fashion over the distorted picks. i.e in the present design lift the 1, 2,3 ground ends over 4th distorted pick and lower the ground ends 5 to 10 under the distorted picks . Similar but opposite way the lifts are shown for the ground ends when 11th distorted picks cross ground ends.

The above steps are clearly shown on point paper designs.

CHAPTER 8
Crepe Surface & Crepe Weaves (Oatmeal)

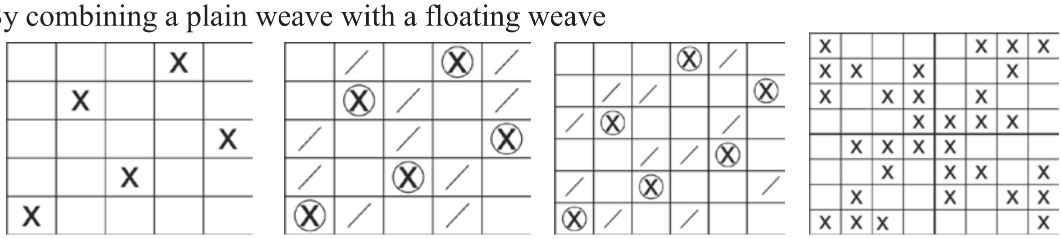
These are characterized by highly irregular , rough and random surface with the base cloth designed in plain or any other weave with maximum float of 3. These weaves are also called as 'OATMEAL' weaves and should not be confused with crepesurface . Practically any kind of weave which will produce a broken irregular appearance will form crepe weave. The surface of crepe weave woven fabric looks as if it is covered with small spots as when fine sand or oatmeal are scattered on it. The arrangement of the spots should not reveal any obvious satin or twill foundation, in spite of the fact that a good many crepe weaves are developed from such foundation weaves. In some cases crepe weaves are developed by using high twisted crepe yarns giving pebbly and puckered appearance.

Rough irregular surfaces are often produced by using specially prepared warp or weft yarns which have a high twist factor that causes them to crimp or curl when the woven fabric is being finished. Such yarns are given the name of crepon or crepe yarns and generally the fabrics produced from them are of a plain cloth weave. The irregular surface depends upon woven design and not upon the type of yarn used.

Construction of Crepe weaves

Following are the methods of construction of crepe weaves

1. On Sateen base
2. By Reversing small tufts
3. By Super Imposing
4. By combining a plain weave with a floating weave



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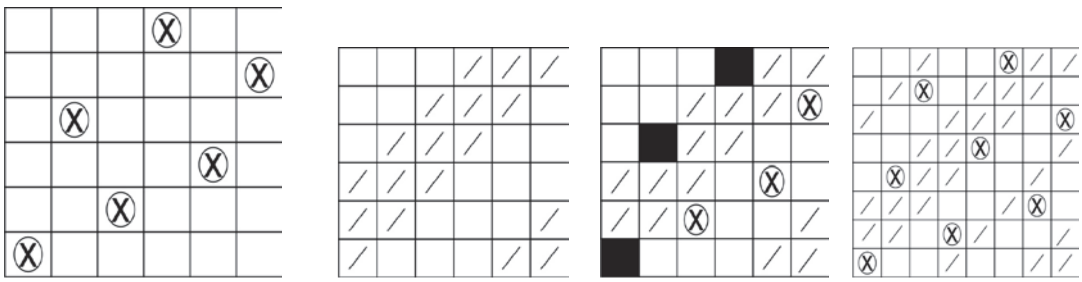

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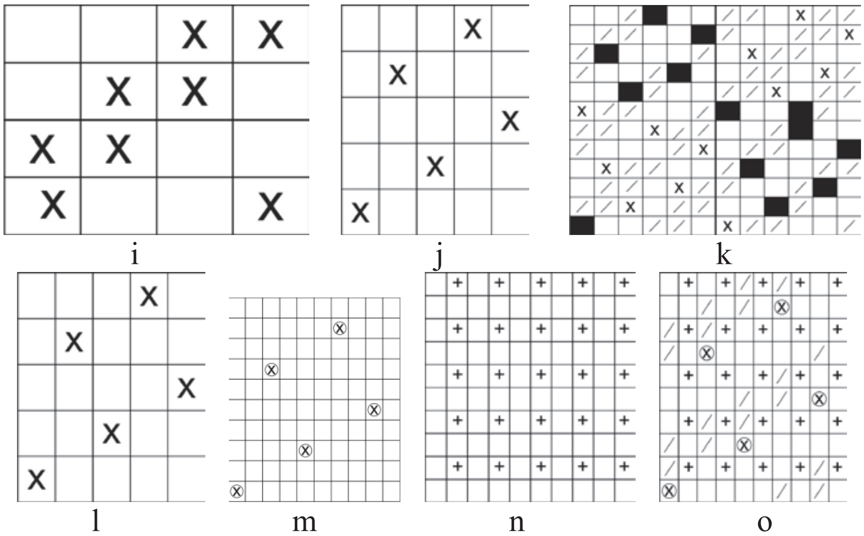


Fig. 8.1

On Staeen base (Fig. 8.1a &b)

These are also known as Re-arranged twills in which the random surface is obtained by selecting a suitable floating weave like sateen which may be regular or irregular in nature. The additional marks added to sateen marks are selected such that the maximum float length is restricted to 3 so that both warp and weft floats are similar .

Fig. 8.1**a** show a basic weave 5 end sateen and it is converted into crepe by adding additional marks to each sateen marks as shown in Fig.8.1 **b** Fig. 8.1 **c** show crepe on sateen base (6 end irregular sateen) with 2/1 ,1/2 additional marks. When a 10 thread sateen is used with equal warp and weft floats , it is called as ' SPONGE' weave and the reader is directed to practice the same. Fig.8.1 e show another example of 6-end sateen use in crepe with 3/3 marks. (Fig. 8.1 f & g)

Procedure for construction
1. Mark the repeat size
2. Select a suitable Sateen
3. Mark the sateen
4. Encircle the sateen marks
5. Add additional marks to the sateen marks such that the float length doesn't exceed 3

By Reversing small tufts (Principle of Turn Down)

In this method a small tuft is considered in the first quarter and is reversed in the second , third and fourth quarters. Indeed this method exactly give the randomness in appearance. Fig 8.1 **d** show this case. Steps of construction

1. Select the weave size
2. Divide into 4 parts
3. Select a small motif with float length not to exceed 3
4. Consider the second quarter and reverse all ups of the first quarter by downs in second quarter
5. In third quarter reverse to that of second
6. In fourth quarter reverse to that of third

By Superimposing

In this method we select two basic weaves and are superimposed to get final crepe effect. It is to be observed at the end of this method the predominance of weft over warp. Two weaves A & B are inserted one over the other. To emphasize the crepe effect it is necessary to have any one of the weave to be irregular in construction and it is better if both are irregular.Fig.8.1**i** show 4 end twill as one of the weave and **j** show the second weave which is 6-end sateen. At **k** the repeat size equal to the LCM of 4 & 6 (i.e 12 X 12) is shown with the superimposed areas are darkened. However this method requires more number of healds and hence dobby is the best loom equipment. Following is the procedure for Superimposed crepe. (Fig. 8.1 i& j)

1. Select two basic weaves (Say A &B) with one irregular in construction
2. Mark the two weaves separately
3. Work out the LCM of two weave numbers and mark the LCM size.
4. Divide LCM Size into equal parts as per the size of Weave A and fill that weave (i.e 4 end twill) (Fig. 8.1 i)
5. Divide the now LCM size into parts as per the size of Weave B and fill that weave. (i.e 6 end Sateen) (Fig. 8.1 j)
6. During the above step it is found at some places mark of Weave A exists and on the same place the second weave mark is placed and the place is darkened to note as superimposed areas. (Darkened places at 8.1 k)

Figure 8.1 **h** show super imposed crepe with 3 / 2 , 1 / 2 as weave A and 8 – end sateen as weave B. Reader is directed to complete the design **h**

By combining a plain weave with a floating weave.

In this method a floating weave is selected preferably irregular in nature. Normally it is customary to select plain on double the size of floating weave and plain can be represented on either of the ways

1. Plain on odd ends and odd picks
2. Plain on odd ends and even picks
3. Plain on even ends and even picks
4. Plain on even ends and odd picks.

In addition to above combinations , further plain can be found with either single end or double end types. Thus one get a large number of ways of constructing crepe by this method. Fig.8.1 **j**indicate 5 end sateen as floating weave and **n** show plain on double the ends of sateen i.e on 10 ends and picks . Plain in Fig. 8.1 **n** show single end only and that too on even ends and even picks. Plain weave is indicated by + mark. At **o** the complete design is shown. Following is the procedure for crepe with plain weave.

1. Select a floating weave (Fig. 8.1 l)
2. Mark double the size of floating weave and choose either single end or double end plain (Fig. 8.1 n)
3. Position of Plain may be on one of the combinations listed above (Fig. 8.1 n)
4. transfer the floating weave (Fig. 8.1 m) on alternate ends & picks
5. Mark the Plain weave
6. Encircle the sateen marks and add additional marks for each sateen mark with float length not to exceed 3

METHODS OF CREPE SURFACE PRODCTION

Production of Crepe yarns

The characteristic surface texture produced by crepe yarns in plain-weave cloths depends on the fact that the crepe yarns contract lengthways on wetting out and that, when they contract, they also crinkle. The crinkle has a minute, irregular wave form similar to the crimp of a fine wool fibre and it is not uniplanar, also like the crimp in wool. Suppose, for example, that a plain-weave cloth has a low-twist filament yarn warp and a crepe-twist filament yarn weft. On wetting-out, the crepe weft will contract, causing the fabric to shrink widthway by 25 percent or more. The warp yarns will be slightly displaced by the crinkling of the weft, and the surface of the fabric is no longer smooth and flat but covered with a random pattern of minute surface irregularities. This is known as crepe figure. The essential conditions for a yarn to contract and crinkle sufficiently to produce an acceptable crepe figure are: (i).The yarn must be very tightly twisted; (ii) The fibres must swell appreciably on wetting-out and (iii) The elastic properties of the fibre must be sustainable.

When a crepe yarn swells on wetting-out, the angle of twist increases, and this is equivalent to inserting more twist. The conditions are suitable for crinkling if the fabric is free to contract. Further, it is unlikely that the strains due to twisting and swelling will be uniformly distributed along the length and through the cross-section of the yarn, and so localized, non-uniform stresses will result in crinkling. Cotton, silk, wool, viscose and cuprammonium rayons all have the combination of properties necessary to develop crepe figure. Cotton and wool crepe yarns are nearly always two-fold, spun with normal twists but with a high doubling twist in the same direction as the singles twist. They are not much used, partly because they are costly to produce in the fine counts required for light-weight fabrics – and it is in light-weight fabrics that crepe yarns are most successful.Silk crepe yarns have been very widely used in the past for well-known fabrics such as crepe-de-chine, marocain and georgette. They are usually made by twisting together two or three 13/15 denier (1.6 tex) grege yarns with a folding twist of 60-70 t.p.i. They are described as 2/13/15 crepe yarn is 2x14=28 denier (3.1 tex), but the actual denier is greater by about 15 percent, owing to take-up in twisting.Silk crepe yarns contain the natural gum of the raw silk, and when a silk crepe fabric is given its first wet treatment in the 'creping' process, the gum slows down the swelling and consequent shrinking, and a fine, regular crepe figure results. it is found that swelling and shrinkage occurres simultaneously, and the result is a coarse, irregular crepe figure. Viscose crepe yarns are therefore sized before crepe-twisting and the size performs the same function as the natural gum of silk. The type and amount of size applied to some extent controls the fineness and regularity of the crepe figure.

Control of crepe figure:

Crepe figure may be described in terms of fineness, regularity and intensity. In general, the object is to produce a figure as fine and regular as the particular cloth construction will permit. Occasionally a coarse, bold figure may be required, but in any case it should be regular.

The fineness of the figure depends primarily on the frequency of the crinkles which develop during creping, and this in turn depends on the length of the fibre helix, that is to say, on the turns per inch. The higher the t.p.i. the finer the figure will tend to be, so for fine figure we should use the highest t.p.i. which will avoid beading and too great a loss in strength. Crepe yarns are always substantially weaker than the parent yarn, because their twist is well above that which gives maximum strength.The regularity of the figure is controlled to some extent by the type and amount of size and by temperature and other conditions during crepeing. Pre-crepe embossing offers a way of controlling much more effectively both the fineness and regularity of the figure. Before crepeing, the loomstate fabric is lightly embossed with a roller engraved from a photographic reproduction of an actual crepe fabric, selected for fineness and regularity. The figure developed on the embossed cloth during crepeing tends to follow the embossed pattern. By using different rollers, a variety of effects can be obtained on the same cloth.For a given fabric construction, the intensity of the crepe figure in the finished fabric depends mainly on the amount of shrinkage retained in it. In the fully-shrunk condition after crepeing, the fabric usually has a rough, uneven appearance and a stiff, harsh handle. During stentering, the fabric is stretched in one or both directions, so that its finished dimensions are somewhere between the loomstate and fully shrunk dimensions. The amount of residual shrinkage, i.e. between the loomstate and finished cloth, varies a good deal but is usually of the order of 10-15 percent in one or both directions. The greater the residual shrinkage, the more intense the figure will be.Some crepe fabrics, such as georgette, have crepe warp and weft and will clearly shrink substantially in both directions. Many crepe fabrics have a normal-twist warp and a crepe weft. In these the principal shrinkage occurs in the weft direction, but some warp-way shrinkage usually takes place because of the displacement of the ends by the crinkling of the weft.

Dimensional stability:

Crepe fabrics tend to have a softer handle and better draping properties than similar ones made from normal-twist yarns. Those properties can be obtained by using crepe-twist secondary cellulose acetate yarns, usually as weft across a low-twist acetate warp. Acetate crepe-twist yarns do not contract and crinkle on wetting-out, and so acetate crepe fabrics do not develop a crepe figure. As they do not shrink on wetting, they are dimensionally stable.

Examples of crepe fabrics:

Georgette is a light-weight, open-textured, plain-weave cloth made entirely from crepe yarn. Originally a silk fabric, it has been imitated in cotton, wool and viscose rayon.

Warp and weft : 45 denier, 65 t.p.i., Tensaco crepe, 2S:2Z (11.8 tex actual);100x84 loomstate, 122x96 finished; 1.75 oz. finished.

Warp and weft : 75 denier, 60 t.p.i., viscose crepe, 2S:2Z (10 tex actual);60x60 loomstate, 72x70 finished; 2.0 oz. finished.

More commonly, plain-weave crepe fabrics are made with normal-twist warp and crepe-twist weft. Crepe-de-chine, French crepe, Italian crepe, Canton crepe and marocain are typical examples, in ascending order of weight. They were all originally silk fabrics and have been imitated in rayon.

Warp : 140 denier, (16 tex) dull, low-twist acetate; Weft: 150 denier, viscose crepe, 2S:2Z (21 tex actual); 102x53 loomstate, 120x59 finished; 4.4 oz. finished. The warp and weft shrinkages are about 12 and 18 percent, respectively.

CHAPTER 9
Bedford Cords & Piques

In Bedford cords the cords rundown in warp direction and the fabric is covered by plain weave. Bedford cord are identified as " Semi compound fabrics" as more then one series of warp and more than one series of weft are used still forming single layer fabric only. These are characterized by

"Sunken lines" or "Fine Cut" lines as if they are cut with a knife. Due to this fabrics are featured by cords which run parallel to warp . It can be recalled that in Plain weave is modified by inserting two or more picks in the same shed (prepared from ply winding at pirn winding) to produce cord effects in warp direction. The same principle is observed in Bedford cords also. Between these sunken lines the cord ends or face ends float over one pair or alternate picks in the first cord and allowed to intervene in plain form in the second cord. Thus pairs of picks float in first cord and intervene plain in the second cord . This is known as principle of Bed ford cords and the cross section justify the method. (Refer Figure Below)

Scope

Bedford cords are produced in medium weight cotton or spun rayon fabrics for various applications like furnishing, ladies blouses, dress material, Bleached or Printed dresswear ,sports wears, ornamental trimmings etc. In heavier qualities it is produced in cotton for soft furnishings . medium cotton and as ground weave for extra warp or extra weft. If produced in finer counts , Bedford cords are used for trouser fabric if produced with worsted yarns .Today Trouser are also produced in blends like P/C or P/V.

RTP

As mentioned above Bedford cords are characterized by the following type of threads

WARP Way:

(A) Cutting ends (Which are drawn in separate dent and are finer ends weaving plain)

(B) Face ends (normally coarse ends and the number may depend on the cord width required. for example if the cord width is 4, then there shall be 4 cutting ends, four + four {for first and second cord}face ends giving a minimum of 12 ends. Based on the cord width the repeat size vary accordingly.

(C) Wadding ends: Introduced in warp way such that they are not visible to observer. If it is desired these can be stitched with face threads. Normally two wadding ends per cord is preferred

.These are coarse yarns and are introduced to increase the weight of the fabric economically. Wadding ends do increase the prominence of the cords also.

Weft Way:

Regular Bedford cords include only face picks which work in pair or in alternate fashion. To improve the texture and to compensate the cost , it is desirable to use what are known as “ Backed threads” which may be two picks for every 6 or 8 face picks

Classification of Bedford cords

Bedford cords are classified as follows

1. Simple Bedford cord or Plain faced BC
2. Plain faced BC with alternate picks
3. Wadded BC
4. Varigated BC
5. Crepon BC
6. Twill backed BC

Simple or Plain faced Bed ford cords (Fig. 9.1 a to f)

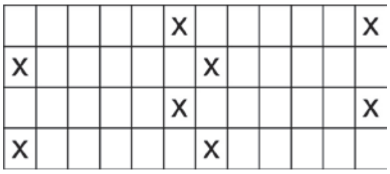
These are constructed on plain base in which four plain ends are arranged in pairs in between the cord ends or face ends. The cord width may be varied depending on the number of face ends . By increasing or decreasing the number of face or cord ends it is possible to produce variegated effects in BC It is usual to find 20-30 ‘s count as warp and weft. Point paper designs include the following steps of Plain based BC

1. Decide the cord width and hence calculate the total number of face ends or cord ends.
2. Add 4 plain ends to get the total repeat on four picks and the same is marked
3. Mark firs the plain ends. for example if the cord width is four, then first, sixth, seventh andtwelth are marked
4. Introduce the regular plain 1 up and 1 down
5. Indicate the lifts for face or cord ends on first pair of picks in the first cord and lifts for face or cord ends on the second pair of picks in the second cord
6. Complete the plain weave on the cord ends or face ends.

The above steps are indicted step by step . Fig. 9.1 **a** show the repeat size in which the cord size is considered as four , and the total number of ends will be 2 X 4 (as cord width is 4 and there are two cords) + 4(Plain ends – two at the centre and two at the ends) = 12 ends and four picks. The complete repeat is at last. (Fig.9.1 **a** to**e**)Construction particulars for a bleached printed dress material is warp – 26 singles cotton ,weft- 50’s singles cotton , Reed X Pick 130 X 86 (18’s cotton resultant count for Wadding if used). Fig. 9.1 **e** show the draft indicating the use of Dobby.

Bedford cord with alternate picks

This is similar to the above with a difference that instead of pairs of pick , alternate single picks are introduced in weft direction. Point paper design show the details(Fig. 9.1 **f**)



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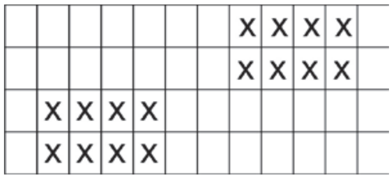

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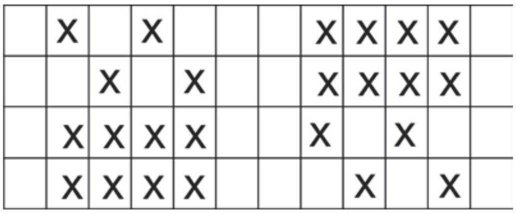

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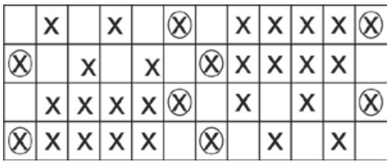

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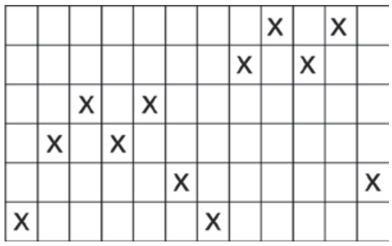

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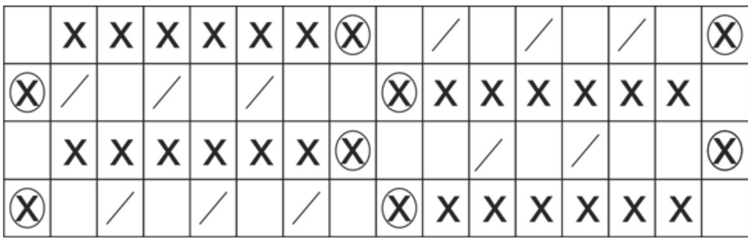

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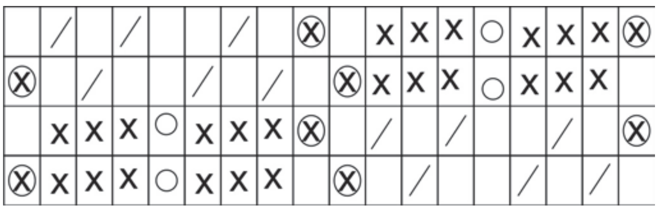

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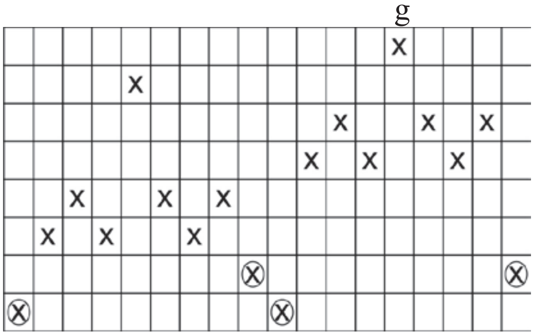

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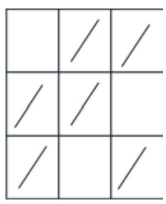

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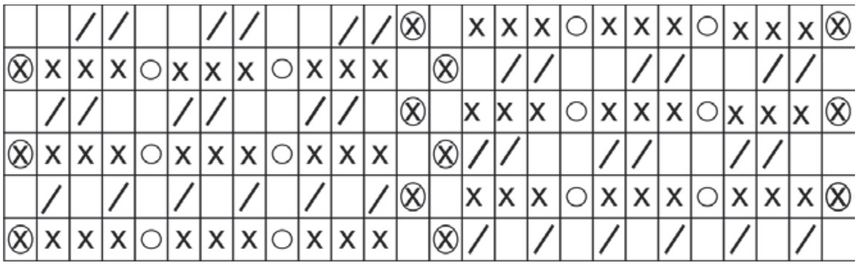

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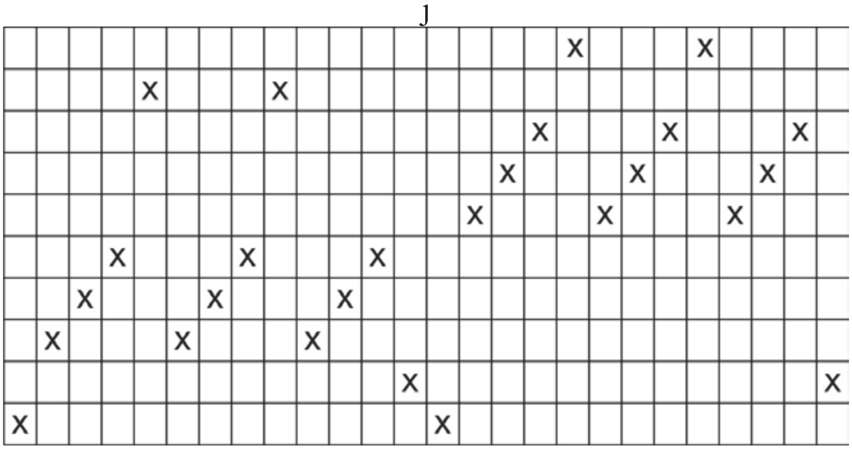


k

Fig. 9.1

WADDED BEDFORD CORDS

Wadding Ends and their arrangement in weaving

The objective or purpose of using Wadding ends are as follows:

- These are introduced to produce fabrics most economically.
- They increase the stability, warmth and weight of the fabric
- They tend to increase the prominence of the cord effect

Wadding threads are drawn separately in a healdshaft . Fig. 9.1 **g** show Bedford cord with 2 wadding ends per cord. Wadding ends are lifted on the picks which float below the cord and lowered which intervene in plain fashion. They never interface with weft, but remain straight their contraction during weaving is nil. This necessitates their being wound upon a separate warp beam, and held at greater tension than face warp threads during wearing. The wadding end is made to lie exactly at the centre of the fabric. To get this objective lift the wadding ends on the picks which float and lower on the picks which intervene in plain form.

Point paper designs are shown (Fig.9.1**g**)with two wadding ends for a plain based Bedford cord. Note the lifts for the wadding ends (indicated by ‘ O’). Wadding ends are drawn thro’ a separate healdshaft(Fig.9.1 **h**)

Sometimes it is customary to improve the ornamentation of BC by allowing the wadding ends to intervene in the form of spot effects.(Reader is advised to refer Grammer of Textile Design by Nisbeth to learn more about this)When wedding ends are present denting is usually 3 ends /dent the wadding ends in the centre so that the face of the cloth is just as full as when no wadding ends are present. Suitable construction particulars for a wadded BC is singles 20 tex cotton as cord ends with 42 epc, singles 16 tex weft with 34 ppc, and 30 ‘s resultant cotton as Wadding .It is quite interesting to note that these are analysed in a typical way. First on backside wadding ends are counted if any and then the analysis is continued.

TWILL FACED BEDFORD CORDS (Fig. 9.1 i to k)

Bedford cords are ornamented in various ways and Crepon BC is one such approach. Primary weave like twill is used as cord weave in place of plain and Twill backed Bedford cord is a another modification of the bed ford cord. Here instead of the picks interweaving with warp of alternate cords in plain order, they interweave in twill order. The result is, the warp is brought more prominently to the surface. Point paper show (Fig. 9.1 i) a basic Twill 2/1 'Z' is used as cord weave and whole design repeats on 6 picks (as 3 picks are present in basic twill). The total number of threads in repeat is as follows:

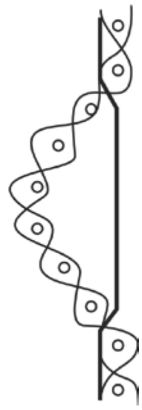
Plain ends: 4, No. of repeat of basictwill : 3 Face or Cord ends / cord : 9, Wadding ends : 2 (one each in between cord ends) and thus total is 4 + 9 X2 + 2 X 2 = 26 (Fig. 9.1 j)

DENTING: Denting of threads in the reed is of primary importance in the weaving of these fabrics if well defined cords are to result. The usual rule is not to place the tin "stitching" ends which weave plain throughout in the same dent, but to see that they are separated by a reed wire. This ensure a more pronounced cord, than when both the stitching ends are placed in the same dent. Cutting ends are drawn in one dent , face or cord ends either two or three per dent as the case may be. Sometimes cutting end is coupled with a face or cord end .In other words the number of face ends of the cord has some influence on the order of denting.

DRAFTING: The cutting ends (ends which weave plain) are drawn through frontheald shafts. The face or cord ends are drawn in separate healds. Thus a minimum of 6 healds is required (two for plain ends, two for cord ends in first cord and two for cord ends of the second cord).From this it is very clear that one can find use of Dobby for production (Fig.9.1 **k**)

WELTS OR PIQUES

Welts or Piques are compound fabrics very similar to bed ford cords. Like bed ford cords they are characterized by more of less pronounced ridge and furrows producing a series of ribs, welts or cords, extending in parallel lines, but transversely across the width of the fabric (selvedge to selvedge) unlike the Bedford cords. Pique fabrics may have ribs or welts of uniform width between the furrows or variegated ribs of two or more different widths in order to obtain variety of decorative effects. Indentations are formed when a figuring end or stitching end drawn from a taut beam is lifted over cutting picks and is allowed to float on the rear side . Pique is a semi- compound fabrics made of two warps and one, two or three system of filling Pique fabrics are used for ladies dress material, men's fancy vests and for domestic purpose.



Types of threads and their arrangement (R T P)

Piques consist of two types of warp ends and more than two types of weft threads . The warp ends include ground and figuring or stitching. Ground ends or face ends are drawn from a moderately tensioned beam ,where as the figuring ends or back ends or stitching ends are from a separately weighed (Heavily) beam. Normally a ratio of 2 :1 ,Ground : Figuring is followed in warp and the arrangement is G FG G FG inwarp .In weft direction the threads are indicated as face picks and cutting picks in ordinary welt . The number of cutting picks used depends on the respective structure . for example for Two pick Pique, two cutting picks are used .However in backed Pique and Wadded Pique additional picks like Wadding picks and Backed picks are used. The number of Wadding and Backed picks is not governed by any rule but depends on the texture requirement and end use. Normally two Wadding picks and two Backed picks are used

Classification of Piques

Piques are classified into **Loose back. Fast back and Half fast back** depending on the status of figuring or stitching thread used . If the stitching is not intervened with face picks but allowed float over cutting picks, then it is classed as Loose back (Fig.9.2 **a**). If however to increase the firmness , the figuring or stitching is connected to ground or face picks at one or two places , it is referred as (Fig.9.2 **b**)Fast Back. In comecases , the figuring end is tucked with face or ground at irregular intervals giving raise to Half fast back piques (Fig.9.2 **d**) . In another classification, Piques are classes as Wadded Piques as Wadding picks are used and same is the case with Backed Pique. Ornamentations in Pique is improved by arranging the motif or the lift of the figuring ends in forming a figure such that the indentations formed are in wavy shape . Such Piques are called as “ Waved Pique” .

SIMPLE OR PLAIN PIQUE

(Single filling system – face or ground and cutting picks are same)

These fabrics may be woven in any ordinary type of loom with either tappet or dobby shedding motion. Howeverfor ornamented piques jacquards are used. As mentioned earlier all pique fabrics have two series of warp; face warp and back warp. The face and back ends are usually in the ratio of 2 face and 1 back. In plain pique fabrics there is only one type of weft – face weft and so they are same times referred to as one system of filling piques. Point paper show (Fig. 9.2 **a**) a typical example of a plain faced pique with one system of filling, and the warp threads are arranged in the order of 1 face, 1 back (or stitching), 1 face. All the picks are face picks. The face warp threads weave with the face picks in plain order. The back or stitching warp threads are lifted over 2 consecutive picks to provide stitching points. Hence these are named as " 2 pick Pique" and similarly the titles 3 pick Pique , 4 pick Pique etc., Thus in the design there are four picks between the indentations or cuts. (Note: Usually the number of consecutive picks that are unstitched should not exceed twelve). From the examples shown it is possible to calculate the cord width.

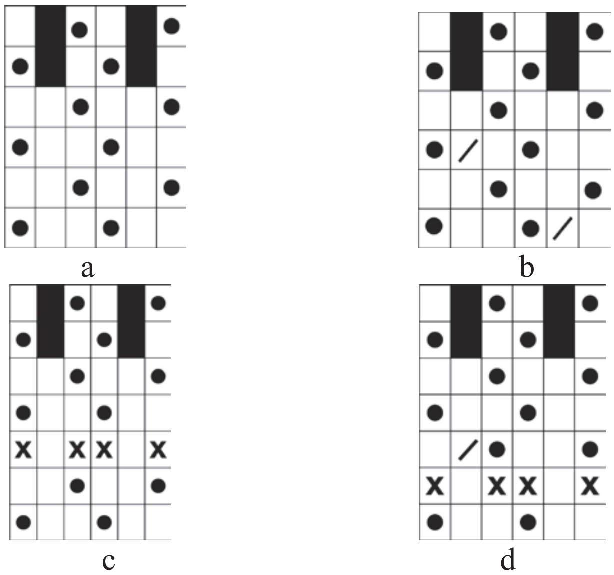


Fig. 9.2

PIQUE WITH TWO SYSTEMS OF FILLING

In order to increase the prominence of the rib or cord. One, two or more stuffer (or wadding) picks may be introduced in (Fig.9.2 **c**)each rib. These picks simply lie quite straight and free between the surface tissue and the back warp threads, thereby increasing both the relative prominence of the ribs and also the weight and bulk of the fabric economically. The wadding picks are usually thicker than the ground weft. Fig.9.2 **d** show Fast back pique with wadding. The stiffer picks are usually introduced as two picks at a place and will require a 4 x 1 drop box loom. Sometimes the same kind of weft can be used for both the ground and wadding, when ordinary single shuttle box looms are used. In these cases a single wadding picks may suffice as the case may be. If stuffer picks inserted singly and are different from the ground or face weft, then a 4 x 4 loom will be needed.

How exactly the Wadding picks are made to lie at centre ?

All the face ends are raised when the wadding picks are inserted, as indicated by '+' in the design, while the stitching ends are left down. Whatever form the wadding picks take, they are inserted strictly as extra picks and the take up motion is made inoperative and thus production of this type of structures may prove costly as the production reduces . (Note: It is general rule that wadding picks should not be inserted until at least four picks face picks have followed the cutting picks of each rib. Otherwise, the wadding picks would prevent those face picks that follow them from approaching near enough to the proceeding cutting picks, thereby involving the risk of producing cracks or facts immediately after each furrow of cutting,)

BACKED PIQUES (WITH THREAD SYSTEM OF FILLING – FACE, BACK AND WADDING OR STUFFER)

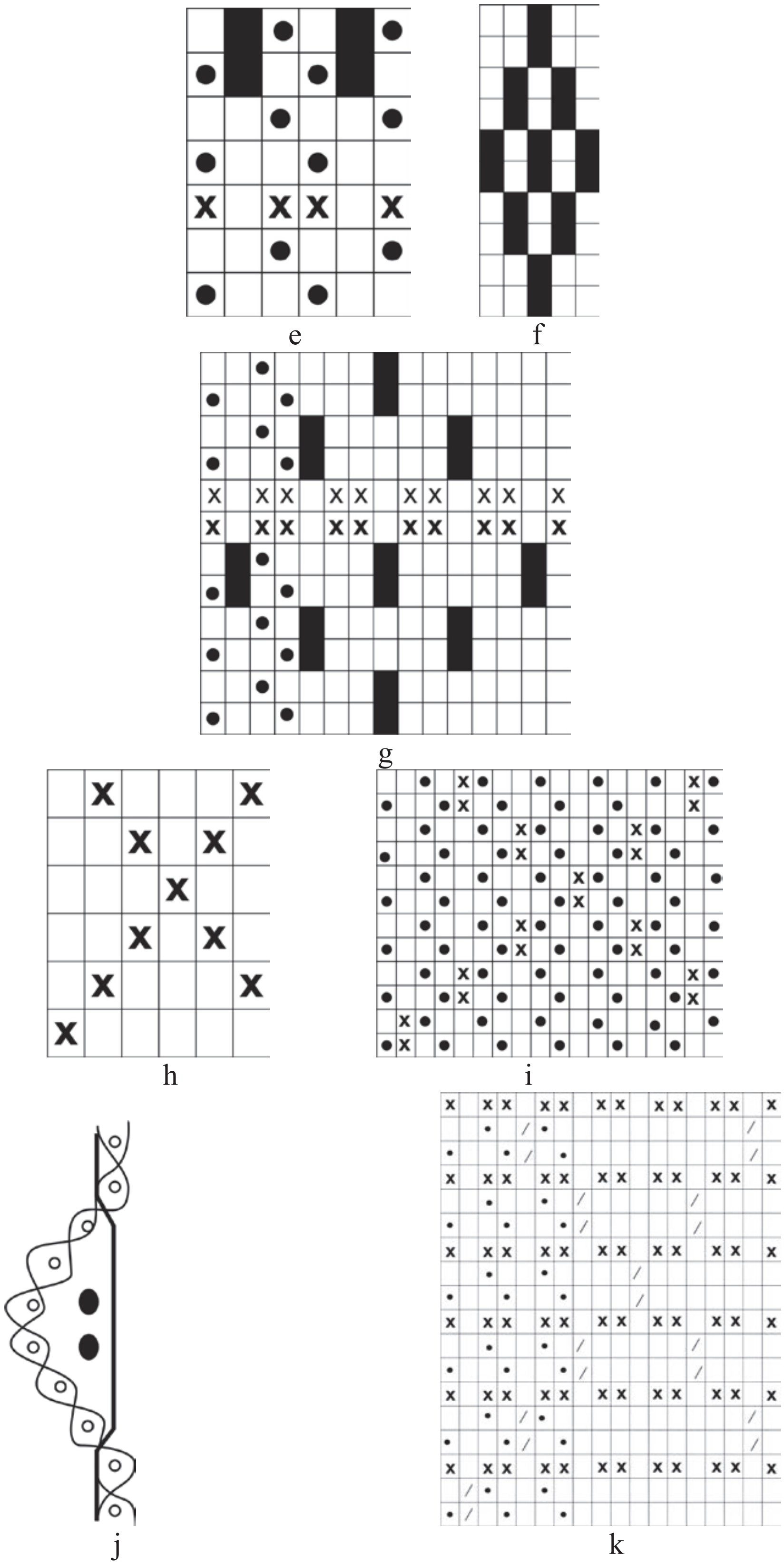


Fig. : 9.2

In order to increase the weight, strength and firmness or stability of the fabric and at the same time TO get most prominent rib, three types of weft are inserted namely: Face, back and wadding.In all the above examples of pique, the back warp has floated underneath the filling and is lifted only over the cutting picks to form furrows(LOOSE BACK). On the other hand the back warp ends are made to interweave with some of the wadding packs in plain order to produce a "FAST BACK" Pique. Fig. 9.2 l show the cross section of a pique with two wadding or stuffer picks

WAVED PIQUE

These are the Piques in which the indentations follow a wavy fashion which is mainly due to use of motif or figuring weave . Fig.9.2 **f** to **j** show the method of constructing the piques with base figures or stitching end interelacing in the form of a motif. Fig.9.2 **h**show the basic weave used for constructing waved piques . Fig.9.2**i** show developed pique with out wadding picks and in **j** wadding picks are used .

Constructional steps for Waved Pique

1. Select the motif preferably a waved one like Diamond or Rhombus shape.
2. Mark the repeat size with RTP 2:1 in warp and cutting picks and Wadding picks in weft side
3. Fill the ground weave i.e plain where face ends interlace with face picks.
4. Show the lifts for Figuring ends as per the motif
5. show the lifts for face ends on Wadding picks.

Weaving Arrangements for Piques

Denting : Generally in Semi compound structures like compound structures, denting order will be same as R T P. The Denting order is not significant like Bedford cord as here the cord effect is in weft direction. Two Ground or face ends and one stitching or backing or figuring end are drawn in the same split as shown in the figure .(solid line – Reed Wire)

| G G S |

Drafting:

Face ends or Ground ends are drawn in a separate heald shaft with skip draft and the figuring end is drawn in the separate heald. Depending the on the status of figuring end i.e Loose back or Fast back, number of heald shafts are used accordingly.

Loom Equipment

It is better to use Dobby with box motions as different types of wefts are to be inserted.

Distinction between Bedford Cords and Piques

Sl No	Means	BEDFORD CORDS	PIQUES
1	Direction of Indentations	Cords run parallel to selvedge	Cords run across the width or perpendicular to selvedge.
2	R T P in Warp	Cutting ends, face ends and Wadding ends	Piques are made of two series of warp namely ground or face and figuring or back or stitching
3	R T P in Weft	Bed ford cord is made of only one series of filling	It is made up of one, two or three systems of filling
4	Direction of Wadding threads	Wadding ends are inserted to increase prominence or roundness of cords	Wadding picks are inserted to increase prominence of cords
5	Classification	Simple or plain faced, BC with alternate picks, Wadded BC and Twill backed BC	Fast back, Loose back, half fast Back, Wadded, Backed and Waved Pique
6	Principle of cord formation	Corded effect is produced by allowing alternate picks of weft or alternate pairs of picks to float on the back of the fabric behind each cord and these interweave in plain order with cutting ends	The corded effect is produced by interweaving the light stitching ends into the plain face texture with the result that the latter is pulled down and an indentation is formed on the surface
7	Scope for Ornamentation	Bed ford cords afford little scope for variation of structure	Piques afford wide scope for variation of structure.
8	Drafting arrangements	Cutting ends in front healds, Face ends in one set of healds, wadding in separate healds	Skip for ground and one set for figuring or backing ends
9	Number of beams	Only one warp beam is required	Two warp beams are required for weaving piques
10	Type of loom	A loom with Single boxes are sufficient for weaving bed ford cords	Drop box loom is required for inserting cutting, face and wadding and back picks if they of different counts.

Exercises

Answer the following questions in two or four lines

1. Why Bedford cords are classed as Semi compound fabrics
2. Mention the types of warp and weft thread found in BC
3. How exactly the wadding end is made to lie at centre
4. Why it becomes necessary to introduce wadding ends in BC
5. How do account for the texture of BC based on denting plan
6. How do proceed to analyze the wadded BC
7. How do you get variegated effects in BC
8. Why it is necessary to use dobby for BC production
9. Mention the yarn counts and weaving arrangements for the BC
10. Why BC is used as ground weave in Extra thread figuring .
11. How Bedford cord differ from Cordouroys.

CHAPTER 10
Ornamentation of Fabrics

What is meant by Ornamentation ?

Ornamentation is a technique by which the appearance /texture of plain cloths is improved. Ornamentation can be brought by various means. This technique contribute to value addition of plain garments.

Principles of Ornamentation

The principle include in improving the appearance of the plain cloth by use of colour, by count selection, by setting, and any other means which bring change in the appearance of the fabric so that it improves the sale value of the fabric.

Approaches for Ornamentation of Plain Cloths

1. Use of Colour
2. By Balancing the pattern
3. By using fibres varying in substrate & Geometry
4. By variation of twist
5. By variation of Count , Sett & Twist
6. By using differential shrinkage methods
7. By special finishes

USE OF COLOUR

It 's well known fact that by using colour the sale value of the plain fabric is increased. Color scheme usage is unlimited in warp direction than in weft direction . This limitation is due to manufacturing facilities. By using color in warp direction stripes are produced. When colours are used in both direction we get checks. Colours introduced may form symmetrical or asymmetrical patterns . Regular and irregular patterns may be produced . Today irregular patterns are very popular in shirts . For example if the weave is plain when colours are in selected threads, we get stripes . When a plain weave is coloured in 4:4, Crows foot design is obtained. Larger crows foot is observed when matt is coloured on 16 X 16 with 4:4 .Colours used can be bright , dull, semi dull shades of dyed in warp and weft. Even colours can be used with bleached yarns also. Using different colours thro' printing various effects are produced on a bleached ground. Today due to advancements in Textile chemical processing, fabrics are dyed with colours which change the colour in the day .

Use of fibres Varying in Geometry & Substrate

Due to advances in synthetic fibre technology, fibres of various cross sections can be produced to suit the specific end use. Today some of the Synthetic fibres like Polyester is produced in different geometry like Super high tenacity (SHT), DD (Dope dyed) , BDD (Black dope dyed) , TBL (tri lobal) , Bi component & Bi constituent etc. these fibres have different properties and thus respond differently in different conditions. Staple fibres can be produced in different staple length and can be dyed in different shades to produce special effects in the spun yarn.

By Varying Twist

Twist is an important parameter for a spun yarn or filament yarn. Higher the twist lesser is the luster or lesser is the light defracted or diffused . If twist is increased the yarn will be highly resistant to flattening .By varying twists shadow stripes are produced. Differently twisted yarns under go shrinkage to a different extent.

By Varying Count , Sett & Twist

Effective patterns can be produced in plain weave or in its modification when combination of variables are changed. Several commercial examples are observed under this class.

COCKLED, BLISTERED AND SEERSUCKER EFFECTS:

Cockled, blistered or seersucker effects arise when the yarns (warp or weft, or both) in some parts of the fabric contract more than those in other parts. There are three basic ways of producing them:

a) By differences in warp tension during weaving;
b) By using groups of ends or picks, or both, which will contract by different amounts when the fabric is relaxed, and
c) By special finishes applied to ordinary loom state cloth.

Tension differences: seersucker

Suppose we arrange for alternate groups of ends in an approximately square plain cloth to be woven at widely different tensions.This is easily achieved by using two beams, tensioning one heavily and the other lightly. When the fabric is wet relaxed, the heavily tensioned ends, having been stretched more, will contract more than the lightly tensioned ones. Alternate stripes containing the tight ends will remain flat, but the stripes which contain the slack ends will cockle. This is the basis of cotton seersucker effects.

In practice this effect is often used in conjunction with colour-woven warp-way stripes, and the seersucker effect may be of secondary importance. It may be enhanced by using a closer setting (e.g. a coarser warp yarn) for the cockled stripes. If the setting is not sufficiently close, the extra length of the slack ends may be taken up by an increase in their crimp, without appreciable cockling.

Differential shrinkage:

In this case the cockling does not depend on differences in tension during weaving, there is no need to use two beams and we are not restricted to warp-way stripe effects. The necessary difference in shrinkage can be obtained by using

- Alternate group of normal-twist and crepe yarns;
- Alternate group of preshrunk and unshrunk thermoplastic yarns, or
- A thermoplastic yarn which contracts sharply at a relatively low temperature , in conjunction with any normal type of yarn.
- Before the introduction of thermoplastic fibres such as nylon, the use of crepe yarns was a convenient way of producing blistered effects, but the fabrics lacked dimensional stability: like

other crepe fabrics, they were prone to stretch and shrink in use. They are no longer of much interest.

- A normal, unset nylon yarn will shrink 6-8 percent in hot water, but if it has been preshrunk or heat-set, it will not shrink more than about 1 percent subsequently. Consequently, cockled effects result from using alternate groups of normal, unset yarn, and either preshrunk or heat-set yarns.

Yarns which have been dyed before weaving are necessarily preshrunk by the hot, wet treatment they undergo, so a seersucker effect results from weaving a plain cloth with alternate stripes of normal, undyed nylon and dyed nylon. If a white or piece-dyed fabric is required, the yarn for alternate warp stripes must be preshrunk before warping.Re-twisted yarns with 15 to 30 t.p.i. are often used for the blistered parts of the fabric, to give a more sheer effect. It is necessary to heat-set them in order to reduce their twist liveliness. A combination of twist-set and normal-twist, unset yarns will therefore give a seersucker effect.

By arranging the normal and the preshrunk or heat-set yarns in small groups of 4-8 threads in both the warp and the weft, an all-over blistered effect is produced. This is the commonest type of nylon seersucker.

Certain types of thermoplastic yarn, such as Thermovyl, contract by as much as 30 percent in boiling water. By using a relatively small proportion of such yarn, it is possible to produce intensely blistered effects, and since the shrinkage is irreversible, the fabrics are dimensionally stable. The effects produced are very striking, more suitable for fashion fabrics than for everyday use.

Special finishes:

If a closely-woven plain cotton cloth is printed with caustic soda of mercerizing strength, swelling of the fibres and contraction of the yarns occurs in the treated parts, and the untreated cockle. This effect is also called seersucker. Various simple designs are possible. Phenol has a similar action on nylon, and blistered designs, simulating embossing, are sometimes produced by printing light-weight plain nylon fabrics with phenol. The fabric is heat-set before printing to prevent shrinkage in the parts to which phenol is not applied: if it occurred, it would partly neutralize that produced by the phenol.A commoner method of producing similar effects is to pass a plain, unset nylon fabric between two calendar rollers, one of which is steam-heated and embossed with the required pattern. Those parts of the fabric which contact the raised parts of the embossed roller shrink more than the rest, and a blistered pattern results.