Fabric Structure & Analysis I

Class Notes

Chapter 1 The different basic weaves

1.1. Classification of fabrics

 The fabrics are classified mainly into three groups .they are

i. Woven fabrics

ii.Knitted fabrics

iii.Non woven farics

 Woven fabrics are made by the interlacements of two series threads namely warp & weft .

 Knitted fabrics are made by knitting yarn threads in the knitting machine

 Non woven fabrics are made by bonding the fibres or yarns by different methods. yarns or fibres are laid in sheet form &bonding is done mechanically or thermally or chemically.

1.2. Representation of weave

 The weave is represented by the interlacement of two series of textile yarn threads named warp & weft .The interlacement of warp & weft is taking place at right angles to each other. The warp is passed above or below the weft or vice versa.

1.3.Use of Graph paper to represent the design

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 9 |  |  |  |  |  |  |  |  |  |
| 8 |  |  |  |  |  |  |  |  |  |
| 7 |  |  |  |  |  |  |  |  |  |
| 6 |  |  |  |  |  |  |  |  |  |
| 5 |  |  |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |  |  |
| 1 |  |  |  |  |  |  |  |  |  |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

 fig 1 Graph paper

 To indicate the order in which the warp & weft thread interweave to make a fabric , a sort of paper is used called Graph paper which is shown in figure 1. The paper is ruled in two sets of parallel lines ,crossing the other at right angles , dividing the paper into small rectangular spaces as shown in figure 1. The vertical rows of graph paper indicates the warp threads & the horizontal ones represents weft thread. Each small square on graph paper represents a position where a warp & a weft thread cross one another. A mark put in such small space may mean , according to the idea of designer, a warp passing over a weft (warp up) or a weft crossing over a warp (weft up).

In our case a mark in the small square indicates the concerned warp is up on concerned weft. A blank in the small square indicates the concerned weft is up on the concerned warp (the concerned warp is passes below the concerned weft)

1.4. Definitions

1.4.1 Design-- The processes showing the interlacement of warp & weft in the graph paper is called a design.

1.4.2 Drafting plan-- The processes showing the placement of warps through the male eyes of heald is called a drafting plan.

1.4.3 Lifting plan --The processes indicating the raising or lowering heald shaft during insertion of every weft is called a lifting plan.

1.4.4 Warp--The threads lying parallel to the length of the cloth are called warp. The individual warp is also known as End.

1.4.5-Weft- The threads lying parallel to the width of the cloth are called weft. The individual weft is also known as Pick.

 Chapter 2-- Plain weave & its derivatives

2.1. Plain weave Construction

|  |  |  |
| --- | --- | --- |
| 2 |  | X |
| 1  | X |  |
|  | 1 | 2 |

 fig---2 Plain weave

The plain weave is the most elementary weave. It is the combination a combination of two warp threads and two weft threads interlacing in alternate order. In this weave every thread in each series passes alternately under and over consecutive threads of the other series uniformly throughout the fabric . Figure no 2 is representing plain weave.

2.2 Characteristics of Plain weave

1. Warp & weft interlacement takes place in alternate order

2. It has highest nos of binding points

3. Stronger fabric is obtained

4.Yarns in a plain weave fabric are not easily displaced

5.The plain weave fabric tends to be farm and resist slipping

6. Two healds are required to construct a plain weave fabric.

2.3 Derivatives of plain weave

The derivatives of plain weave are as follows

2.3.1 Regular warp rib

2.3.2 Irregular warp rib

2.3.3 Regular weft rib

2.3.4 Irregular weft rib

2.3.5 Regular matt

2.3.6 Irregular matt

2.3.7 Variegated matt

|  |  |  |
| --- | --- | --- |
| 6 |  | X |
| 5 |  | X |
| 4 |  | X |
| 3 | X |  |
| 2 | X |  |
| 1 | X |  |
|  | 1 | 2 |

|  |  |  |
| --- | --- | --- |
| 8 |  | X |
| 7 |  | X |
| 6 |  | X |
| 5 |  | X |
| 4 | X |  |
| 3 | X |  |
| 2 | X |  |
| 1 | X |  |
|  | 1 | 2 |

2.3.1 Regular warp rib

|  |  |  |
| --- | --- | --- |
| 4 |  | X |
| 3 |  | X |
| 2 | X |  |
| 1 | X |  |
|  | 1 | 2 |

fig--3 Regular warp rib

 fig-4 Regular warp rib

 fig-5 Regular warp rib

 Regular warp rib weave can be constructed by extending the plain weave vertically. figure 3,4,5 are the examples of regular warp rib where in each case equal extension is taking place. Equal ribs were formed along the width of the fabric

|  |  |  |
| --- | --- | --- |
| 5 |  | X |
| 4 |  | X |
| 3 | X |  |
| 2 | X |  |
| 1 | X |  |
|  | 1 | 2 |

|  |  |  |
| --- | --- | --- |
| 6 |  | X |
| 5 |  | X |
| 4 | X |  |
| 3 | X |  |
| 2 | X |  |
| 1 | X |  |
|  | 1 | 2 |

 2.3.2 Irregular warp rib

|  |  |  |
| --- | --- | --- |
| 3 |  | X |
| 2 | X |  |
| 1 | X |  |
|  | 1 | 2 |

fig--6 Irregular warp rib

 fig-7 Irregular warp rib fig-8 Irregular warp rib

 Irregular warp rib weave can also be constructed by extending the plain weave vertically. figure 6,7,8 are the examples of irregular warp rib where in each case unequal extension is taking place. Unequal ribs were formed along the width of the fabric.

2.3.3 Regular weft rib

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 2 |  |  | X | X |
| 1 | X | X |  |  |
|  | 1 | 2 | 3 | 4 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 2 |  |  |  | X | X | X |
| 1 | X | X | X |  |  |  |
|  | 1 | 2 | 3 | 4 | 5 | 6 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2 |  |  |  |  | X | X | X | X |
| 1 | X | X | X | X |  |  |  |  |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

fig--9 Regular weft rib fig--10 Regular weft rib

 fig-11 Regular weft rib

Regular weft rib weave is just opposite warp rib and can be constructed by extending the plain weave horizontally. figure 9,10,11 are the examples of regular weft rib where in each case equal extension is taking place. Equal ribs were formed along the length of the fabric

2.3.4 Irregular weft rib

|  |  |  |  |
| --- | --- | --- | --- |
| 2 |  |  | X |
| 1 | X | X |  |
|  | 1 | 2 | 3 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 2 |  |  |  | X | X |
| 1 | X | X | X |  |  |
|  | 1 | 2 | 3 | 4 | 5 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 2 |  |  |  |  | X | X |
| 1 | X | X | X | X |  |  |
|  | 1 | 2 | 3 | 4 | 5 | 6 |

fig--12 Irregular weft rib fig--13 Irregular weft rib

 fig-14 Irregular weft rib

Irregular weft rib weave is also constructed by extending the plain weave horizontally. figure 12,13,14 are the examples of regular weft rib where in each case unequal extension is taking place.Unequal ribs were formed along the length of the fabric

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 |  |  |  |  | X | X | X | X |
| 7 |  |  |  |  | X | X | X | X |
| 6 |  |  |  |  | X | X | X | X |
| 5 |  |  |  |  | X | X | X | X |
| 4 | X | X | X | X |  |  |  |  |
| 3 | X | X | X | X |  |  |  |  |
| 2 | X | X | X | X |  |  |  |  |
| 1 | X | X | X | X |  |  |  |  |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 6 |  |  |  | X | X | X |
| 5 |  |  |  | X | X | X |
| 4 |  |  |  | X | X | X |
| 3 | X | X | X |  |  |  |
| 2 | X | X | X |  |  |  |
| 1 | X | X | X |  |  |  |
|  | 1 | 2 | 3 | 4 | 5 | 6 |

2.3.5 Regular matt

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 4 |  |  | X | X |
| 3 |  |  | X | X |
| 2 | X | X |  |  |
| 1 | X | X |  |  |
|  | 1 | 2 | 3 | 4 |

Fig 15 2-2 regular matt

 Fig 16 3-3 regular matt

 Fig 17 4-4 regular matt

 Regular matt can be constructed by extending the plain weave in both vertically & horizontally. Fig 15 ,16 & 17 are the examples of regular where equal extension is taking place. Fig 15 ,16 & 17 are known as 2-2, 3-3, &4-4 matt respectively according to the size of extension.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 6 |  |  |  |  | X | X |
| 5 |  |  |  |  | X | X |
| 4 | X | X | X | X |  |  |
| 3 | X | X | X | X |  |  |
| 2 | X | X | X | X |  |  |
| 1 | X | X | X | X |  |  |
|  | 1 | 2 | 3 | 4 | 5 | 6 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 5 |  |  |  | X | X |
| 4 |  |  |  | X | X |
| 3 | X | X | X |  |  |
| 2 | X | X | X |  |  |
| 1 | X | X | X |  |  |
|  | 1 | 2 | 3 | 4 | 5 |

2.3.6 Irregular matt

|  |  |  |  |
| --- | --- | --- | --- |
| 3 |  |  | X |
| 2 | X | X |  |
| 1 | X | X |  |
|  | 1 | 2 | 3 |

Fig 18 Irregular matt

 Fig 19 Irregular matt

 Fig 20 Irregular matt

 Fig 18 ,19 & 20 are the examples of Irregular matt .In this case unequal extension is taking place.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 |  |  |  | X | X | X |  | X |
| 7 | X | X | X |  |  |  | X |  |
| 6 |  |  |  | X | X | X |  | X |
| 5 |  |  |  | X | X | X |  | X |
| 4 |  |  |  | X | X | X |  | X |
| 3 | X | X | X |  |  |  | X |  |
| 2 | X | X | X |  |  |  | X |  |
| 1 | X | X | X |  |  |  | X |  |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 10 |  |  |  |  | X | X | X | X |  | X |
| 9 | X | X | X | X |  |  |  |  | X |  |
| 8 |  |  |  |  | X | X | X | X |  | X |
| 7 |  |  |  |  | X | X | X | X |  | X |
| 6 |  |  |  |  | X | X | X | X |  | X |
| 5 |  |  |  |  | X | X | X | X |  | X |
| 4 | X | X | X | X |  |  |  |  | X |  |
| 3 | X | X | X | X |  |  |  |  | X |  |
| 2 | X | X | X | X |  |  |  |  | X |  |
| 1 | X | X | X | X |  |  |  |  | X |  |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

2.3.7 Variegated matt

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 6 |  |  | X | X |  | X |
| 5 | X | X |  |  | X |  |
| 4 |  |  | X | X |  | X |
| 3 |  |  | X | X |  | X |
| 2 | X | X |  |  | X |  |
| 1 | X | X |  |  | X |  |
|  | 1 | 2 | 3 | 4 | 5 | 6 |

FIG 21 Variegated matt FIG 22 Variegated matt

 FIG 23 Variegated matt

Variegated matt can constructed by the combination of a regular matt & warp rib & weft rib. Figure 21,22,23 are examples of variegated matt weaves produced from 2-2,3-3,4-4 matt respectively.

Chapter 3 -Twill weave

3.1 Characteristics of twill weave

 The characteristics of twill weave are as follows

1. Represented by P/Q where P-warp float ( warp up) & Q-weft float(weft up)

2. Number of ends in a repeat = . Number of picks in a repeat,R=P+Q

3. Minimum no of ends/picks required to construct a twill=3

3. Twill weaves are generally characterised by a series of more or less pronounced diagonal wales or ridges &furrows, with either warp or weft preponderating , or equal quantities, on the face of the fabric.

3.2 Classification of twill weave

3.2.1 Simple balance twill

3.2.2 Warp face twill

3.2.3 Weft face twill

3.2.4 Rearrange twill

3.2.5 Broken twill

3.2.6 Haringbone twill

3.2.7 Zig-zug twill

3.2.8 Combined twill

3.2.9 Compound twill

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 6 |  |  |  | X | X | X |
| 5 |  |  | X | X | X |  |
| 4 |  | X | X | X |  |  |
| 3 | X | X | X |  |  |  |
| 2 | X | X |  |  |  | X |
| 1 | X |  |  |  | X | X |
|  | 1 | 2 | 3 | 4 | 5 | 6 |

3.2.1 Simple balance twill

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 4 |  |  | X | X |
| 3 |  | X | X |  |
| 2 | X | X |  |  |
| 1 | X |  |  | X |
|  | 1 | 2 | 3 | 4 |

FIG-24 2/2 twill

 FIG-25 3/3 twill

 The simple balance twill have equal nos warp float & weft float (ie P=Q) . figure 24 represents 2up 2down twill (2/2 twill) where each warp is raised continuously for two times in a repeat. Each weft is also raised for two times in a repeat. Similarly in figure 25 each warp & weft raised for three consecutive times.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 5 |  | X | X | X | X |
| 4 | X | X | X | X |  |
| 3 | X | X | X |  | X |
| 2 | X | X |  | X | X |
| 1 | X |  | X | X | X |
|  | 1 | 2 | 3 | 4 | 5 |

3.2.2 Warp face twill

|  |  |  |  |
| --- | --- | --- | --- |
| 3 |  | X | X |
| 2 | X | X |  |
| 1 | X |  | X |
|  | 1 | 2 | 3 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 4 |  | X | X | X |
| 3 | X | X | X |  |
| 2 | X | X |  | X |
| 1 | X |  | X | X |
|  | 1 | 2 | 3 | 4 |

FIG-26 2/1 twill

 FIG-27 3/1 twill FIG-28 4/1 twill

In warp face twill all warps are raised except one during insertion of every pick in a repeat. These will develop a series of diagonal wales or ridges of warp separated by furrows formed by single stitches of weft . In this case the weft float(Q) is constant & that is one . The warp float(P) may be any number other than one. Figure 26,27,28 are the examples of warp face twill design.

3.2.3 Weft face twill

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 5 |  |  |  |  | X |
| 4 |  |  |  | X |  |
| 3 |  |  | X |  |  |
| 2 |  | X |  |  |  |
| 1 | X |  |  |  |  |
|  | 1 | 2 | 3 | 4 | 5 |

|  |  |  |  |
| --- | --- | --- | --- |
| 3 |  |  | X |
| 2 |  | X |  |
| 1 | X |  |  |
|  | 1 | 2 | 3 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 4 |  |  |  | X |
| 3 |  |  | X |  |
| 2 |  | X |  |  |
| 1 | X |  |  |  |
|  | 1 | 2 | 3 | 4 |

FIG-29 1/2 twill FIG-30 1/3 twill FIG31- 1/4 twill

In weft face twill only one warps is raised & all others are lowered during insertion of every pick in a repeat. These will develop a series of diagonal wales or ridges of weft separated by furrows formed by single stitches of warp . In this case the warp float(P) is constant & that is one . The weft float(Q) may be any number other than one. Figure 29,30,31 are the examples of weft face twill design.

3.2.4 Rearrange twill

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 6 |  |  |  | X | X | X |
| 5 |  |  | X | X | X |  |
| 4 |  | X | X | X |  |  |
| 3 | X | X | X |  |  |  |
| 2 | X | X |  |  |  | X |
| 1 | X |  |  |  | X | X |
|  | 1 | 2 | 3 | 4 | 5 | 6 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 6 |  |  | X |  | X | X |
| 5 |  |  | X | X |  | X |
| 4 | X |  | X | X |  |  |
| 3 | X | X |  | X |  |  |
| 2 | X | X |  |  | X |  |
| 1 |  | X |  |  | X | X |
|  | 2 | 1 | 4 | 3 | 6 | 5 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 6 |  |  |  | X | X | X |
| 5 | X |  |  |  | X | X |
| 4 | X | X |  |  |  | X |
| 3 | X | X | X |  |  |  |
| 2 |  | X | X | X |  |  |
| 1 |  |  | X | X | X |  |
|  | 3 | 2 | 1 | 6 | 5 | 4 |

FIG-32-3/3 twill FIG-33 Rearrange twill

 FIG-34 Rearrange twill

 Rearrange twill can be produced by altering the ends of a regular twill. Figure 32 is a 3/3 regular twill & from this regular twill the rearrange twills in figure 33& 34 are derived. In figure 33 the no of ends are rearranged at time is two ie ends no 1&2 is exchanged by 2&1 . Similarly 3&4 is exchanged by 4&3, 5&6 is exchanged by 6&5. In figure 34 the no of ends are rearranged at time is three ie ends no 1,2&3 is exchanged by3, 2&1 . Similarly 4,5&6 is exchanged by 6,5&4.

3.2.5 Broken twill

 Broken twill can be constructed by breaking regular twill. There are two ways to construct a broken twill & they are

3.2.5.1 Rearranging the ends

3.2.5.2 Filling & missing principle

3.2.5.1 Rearranging the ends

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 6 |  |  |  | X | X | X |
| 5 |  |  | X | X | X |  |
| 4 |  | X | X | X |  |  |
| 3 | X | X | X |  |  |  |
| 2 | X | X |  |  |  | X |
| 1 | X |  |  |  | X | X |
|  | 1 | 2 | 3 | 4 | 5 | 6 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 6 |  |  | X |  | X | X |
| 5 |  |  | X | X | X |  |
| 4 |  | X | X | X |  |  |
| 3 | X | X |  | X |  |  |
| 2 | X | X |  |  |  | X |
| 1 | X |  |  |  | X | X |
|  | 1 | 2 | 4 | 3 | 5 | 6 |

FIG-35-3/3 twill FIG-36 Broken twill

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 6 |  |  |  | X | X | X |
| 5 |  |  | X |  | X | X |
| 4 |  | X | X |  |  | X |
| 3 | X | X | X |  |  |  |
| 2 | X | X |  | X |  |  |
| 1 | X |  |  | X | X |  |
|  | 1 | 2 | 3 | 6 | 5 | 4 |

 FIG-37- Broken twill

 This is somewhat similar to rearrange twill. But in this method all ends are not rearranged only some ends are rearranged in a repeat. In figure 36 two ends from a repeat of 3/3 regular twill are rearranged ie end no 3&4 in the figure 35 are rearranged by 4&3 . In figure 37 three ends from a repeat of 3/3 regular twill are rearranged ie end no 4,5 & 6 in the figure 35 are rearranged by6,5&4.

3.2.5.2 Filling & missing principle

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 4 |  |  | X | X |
| 3 |  | X | X |  |
| 2 | X | X |  |  |
| 1 | X |  |  | X |
|  | 1 | 2 | 3 | 4 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | X |  | X | X |  | X |
|  |  | X |  |  | X |  | X | X |
|  | X | X |  | X |  |  | X |  |
|  | X |  | X | X |  | X |  |  |
|  | 1 | 2 | 4 | 1 | 3 | 4 | 2 | 3 |

FIG-38- 2/2 regular twill

 FIG-37- Broken twill by " Filling &Missing principle" from 2/2 regular twill

- Broken twill by " Filling &Missing principle" can be constructed only from a simple balance twill. In this case any no of ends can be filled & any no of ends can be missed from a simple balance regular twill .Generally half the no of ends in repeat of regular twill is filled & one less than half the no of ends in repeat of regular twill is missed. If R be the no of ends in repeat of regular twill then

 No of ends to be filled ---R/2

 No of ends to be missed --(-R/2)-1

No of ends in a repeat of the broken twill ---R\*R/2

 FIG-37- represents the Broken twill by " Filling &Missing principle" from 2/2 regular twill . In this case 2 ends are filled 1end is missed& 8 ends will be required for one repeat .

3.2.6 Haringbone twill

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 6 |  |  |  | X | X | X |
| 5 |  |  | X | X | X |  |
| 4 |  | X | X | X |  |  |
| 3 | X | X | X |  |  |  |
| 2 | X | X |  |  |  | X |
| 1 | X |  |  |  | X | X |
|  | 1 | 2 | 3 | 4 | 5 | 6 |

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

FIG-38-3/3 twill FIG-39- Haringbone twill produced from 3/3 twill

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 4 |  | X | X | X |
| 3 | X | X | X |  |
| 2 | X | X |  | X |
| 1 | X |  | X | X |
|  | 1 | 2 | 3 | 4 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 4 |  | X | X | X |  |  |  | X |
| 3 | X | X | X |  | X |  |  |  |
| 2 | X | X |  | X |  | X |  |  |
| 1 | X |  | X | X |  |  | X |  |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

FIG-40-3/1 twill FIG41- Haringbone twill produced from 3/1 twill

 The haringbone twill is similar to the Broken twill. In this case the twill line is reversed in some repeats of the weave throughout the width of the fabric. Straight & Skipped draft combination is applied in case of haringbone twill produced from Simple Balance Regular twill & Straight draft is applied in case of haringbone twill produced from warp face twill . Figure 39 &41 are the examples of haringbone twill. In figure 39 , haring bone twill is constructed from 3/3 twill. Twill line is reversing from end no7. The 7th end is the opposite of the 6th end ( the "X" mark in the 6th is replaced by blanks in the 7th end. the blanks in the 6th is replaced by "X" in the 7th end.) Similarly 8th end is the opposite of the 5th end ,9th end is the opposite of the 4th end , 10th end is the opposite of the 3rd end , 11th end is the opposite of the 2nd end & 12th end is the opposite of the 1st end. By the same procedure haringbone twill is constructed from 3/1 twill in figure 41.

 3.2.7 Zig-zug twill

 Zig-zug twill can be produced from regular twill . Zig-zug twill produces the waviness of the twill line . The waviness may be formed horizontally or vertically. To produced waviness, the regular twill is changing the direction of twill at certain intervals . There are two ways by which the zig-zug twill is formed . They are

 3.2.7.1 Horaizental Zig-zug twill

 3.2.7.2 Vertical Zig-zug twill

 3.2.7.1 Horaizental Zig-zug twill

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 6 |  |  |  | X | X | X |
| 5 |  |  | X | X | X |  |
| 4 |  | X | X | X |  |  |
| 3 | X | X | X |  |  |  |
| 2 | X | X |  |  |  | X |
| 1 | X |  |  |  | X | X |
|  | 1 | 2 | 3 | 4 | 5 | 6 |

FIG-42-3/3 twill

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

 FIG-43- Horizontal zig-zug twill produced from 3/3 twill

 Horizontal zig zug twill produces the waviness throughout the width of the fabric . To construct horizontal zig zug twill any even no of ends are selected for a repeat. The no of picks in a repeat of the horizontal zig zug twill is the same as regular twill. Generally the direction of twill will not changed up to one more than half the no of ends in a repeat . After that the direction of twill will changed for the repeat. If R0 be the no of ends are selected for a repeat & R1 no of ends after which the direction of twill changes. Then we have

R1=( R0/2)+1.

 Figure -43- represent the Horizontal zig-zug twill produced from 3/3 twill .In this case after 7th no of ends the direction of twill changes as the R0 is 12.

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

 3.2.7.2 Vertical Zig-zug twill

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 6 | X | X |  |  |  | X |
| 5 | X |  |  |  | X | X |
| 4 |  |  |  | X | X | X |
| 3 |  |  | X | X | X |  |
| 2 |  | X | X | X |  |  |
| 1 | X | X | X |  |  |  |
|  | 1 | 2 | 3 | 4 | 5 | 6 |

FIG-44-3/3 twill

 FIG-45- Vertical zig-zug twill produced from 3/3 twill

Vertical zig zug twill produces the waviness along the length of the fabric . To construct a Vertical zig zug twill any even no of picks are selected for a repeat. The no of ends in a repeat of the Vertical zig zug twill is the same as regular twill. Generally the direction of twill will not changed up to one more than half the no of picks in a repeat . After that the direction of twill will changed for the repeat. If R0 be the no of picks are selected for a repeat & R1 no of picks after which the direction of twill changes. Then we have

R1=( R0/2)+1.

 Figure -45- represent the Vertical zig-zug twill produced from 3/3 twill .In this case after 7th no of picks the direction of twill changes as the R0 is 12.

3.2.8 Combined twill

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 4 |  |  | X | X |
| 3 |  | X | X |  |
| 2 | X | X |  |  |
| 1 | X |  |  | X |
|  | A1 | A2 | A3 | A4 |

|  |  |  |  |
| --- | --- | --- | --- |
| 3 |  | X | X |
| 2 | X | X |  |
| 1 | X |  | X |
|  | B1 | B2 | B3 |

FIG-46-2/2 twill FIG-47-2/1 twill

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 12 |  |  |  | X | X | X | X |  |  | X |  | X |
| 11 |  | X | X | X | X |  |  | X |  | X | X |  |
| 10 | X | X | X |  |  | X |  | X | X |  | X | X |
| 9 | X |  |  | X |  | X | X |  | X | X |  | X |
| 8 |  | X |  | X | X |  | X | X |  | X |  |  |
| 7 |  | X | X |  | X | X |  | X |  |  | X | X |
| 6 | X |  | X | X |  | X |  |  | X | X | X | X |
| 5 | X | X |  | X |  |  | X | X | X | X |  |  |
| 4 |  | X |  |  | X | X | X | X |  |  |  | X |
| 3 |  |  | X | X | X | X |  |  |  | X | X | X |
| 2 | X | X | X | X |  |  |  | X | X | X | X |  |
| 1 | X | X |  |  |  | X | X | X | X |  |  | X |
|  | A1 | B1 | A2 | B2 | A3 | B3 | A4 | B1 | A1 | B2 | A2 | B3 |

FIG-48- Combined twill produced from 2/2 & 2/1 twill

 Combined twill is produced from more than one regular twill. The no of ends/picks in repeat of the combined twill is the LCM of no of ends/picks in a repeat of the regular twills taken

3.2.9 Compound twill

 Compound twill is combination two or more regular twills. Figure no 49 represents the compound twill.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 6 |  |  | X |  | X | X |
| 5 |  | X |  | X | X |  |
| 4 | X |  | X | X |  |  |
| 3 |  | X | X |  |  | X |
| 2 | X | X |  |  | X |  |
| 1 | X |  |  | X |  | X |
|  | 1 | 2 | 3 | 4 | 5 | 6 |

 FIG-49- 2,1/1,2 twill

 3.2 Diamond Design

 There are three types of diamond designs . They are

3.2.1 Weft face diamond

3.2.2 Warp face diamond

3.2.3 Twill base diamond

3.2.1 Weft face diamond

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 10 |  | X |  |  |  |  |  |  |  | X |
| 9 |  |  | X |  |  |  |  |  | X |  |
| 8 |  |  |  | X |  |  |  | X |  |  |
| 7 |  |  |  |  | X |  | X |  |  |  |
| 6 |  |  |  |  |  | X |  |  |  |  |
| 5 |  |  |  |  | X |  | X |  |  |  |
| 4 |  |  |  | X |  |  |  | X |  |  |
| 3 |  |  | X |  |  |  |  |  | X |  |
| 2 |  | X |  |  |  |  |  |  |  | X |
| 1 | X |  |  |  |  |  |  |  |  |  |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Fig-50 : 10 ends Weft face diamond

 For constructing weft face diamond the following steps are performed.

1. Mark out the repeat size in the graph paper

2. Construct a 1/x 'Z' twill line starting from bottom of the left hand corner as shown in fig 50

3. Construct another 1/x 's' twill line starting from 1square in or 1 square down of the top of left hand corner as shown in fig 50. Thus weft face diamond is produced

3.2.2 Warp face diamond

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 10 |  | X |  | X | X | X | X | X |  | X |
| 9 | X |  | X |  | X | X | X |  | X |  |
| 8 | X | X |  | X |  | X |  | X |  | X |
| 7 | X | X | X |  | X |  | X |  | X | X |
| 6 | X | X | X | X |  | X |  | X | X | X |
| 5 | X | X | X |  | X |  | X |  | X | X |
| 4 | X | X |  | X |  | X |  | X |  | X |
| 3 | X |  | X |  | X | X | X |  | X |  |
| 2 |  | X |  | X | X | X | X | X |  | X |
| 1 | X |  | X | X | X | X | X | X | X |  |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Fig-51 : 10 ends Warp face diamond

 For constructing weft face diamond the following steps are performed.

1. Mark out the repeat size in the graph paper

2. Construct a 1/x 'Z' twill line starting from bottom of the left hand corner as shown in fig 51

3. Construct another 1/x 's' twill line starting from 1square in or 1 square down of the top of left hand corner as shown in fig 51.

4. Now there are two weft face diamond is produced. Convert all weft face diamond into warp face diamond by marking "X" in the squares leaving one line for stitch as shown in fig 51.

3.2.3 Twill base diamond

 Twill base diamond is constructed from a regular twill . It is constructed on the basis of of zig zug twill principle. Number ends/picks in a repeat required to construct a diamond design is the even number multiple of number of ends /picks in a repeat of regular twill taken.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **12** |  | X | X | X |  |  |  |  |  | X | X | X |
| 11 |  |  | X | X | X |  |  |  | X | X | X |  |
| 10 |  |  |  | X | X | X |  | X | X | X |  |  |
| 9 | X |  |  |  | X | X | X | X | X |  |  |  |
| 8 | X | X |  |  |  | X | X | X |  |  |  | X |
| 7 | X | X | X |  |  |  | X |  |  |  | X | X |
| 6 | X | X |  |  |  | X | X | X |  |  |  | X |
| 5 | X |  |  |  | X | X | X | X | X |  |  |  |
| 4 |  |  |  | X | X | X |  | X | X | X |  |  |
| 3 |  |  | X | X | X |  |  |  | X | X | X |  |
| 2 |  | X | X | X |  |  |  |  |  | X | X | X |
| 1 | X | X | X |  |  |  | X |  |  |  | X | X |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 6 | X | X |  |  |  | X |
| 5 | X |  |  |  | X | X |
| 4 |  |  |  | X | X | X |
| 3 |  |  | X | X | X |  |
| 2 |  | X | X | X |  |  |
| 1 | X | X | X |  |  |  |
|  | 1 | 2 | 3 | 4 | 5 | 6 |

FIG-52-3/3 twill

 FIG-53-Diamond design produced from -3/3 twill

 FIG-53-is the diamond design produced from -3/3 twill . The following steps are carried out to construct the diamond design

1. Mark out 12 ends & 12 picks in the graph paper.

2. Construct a horizontal zig zug twill on the basis of 3/3twill in the 12ends & first 6 picks as shown in figure 53.

3. Construct a vertical zig zug twill on the basis of 3/3twill in the first 6ends & 12 picks as shown in figure 53.

4. Construct another vertical zig zug twill on the basis of 3/3twill in the last 6ends & 12 picks as shown in figure 53.

3.3 Diaper design

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **12** |  |  |  | X | X | X |  |  |  | X | X | X |
| 11 | X |  |  |  | X | X |  |  | X | X | X |  |
| 10 | X | X |  |  |  | X |  | X | X | X |  |  |
| 9 | X | X | X |  |  |  | X | X | X |  |  |  |
| 8 |  | X | X | X |  |  | X | X |  |  |  | X |
| 7 |  |  | X | X | X |  | X |  |  |  | X | X |
| 6 | X | X |  |  |  | X |  | X | X | X |  |  |
| 5 | X |  |  |  | X | X |  |  | X | X | X |  |
| 4 |  |  |  | X | X | X |  |  |  | X | X | X |
| 3 |  |  | X | X | X |  | X |  |  |  | X | X |
| 2 |  | X | X | X |  |  | X | X |  |  |  | X |
| 1 | X | X | X |  |  |  | X | X | X |  |  |  |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 6 | X | X |  |  |  | X |
| 5 | X |  |  |  | X | X |
| 4 |  |  |  | X | X | X |
| 3 |  |  | X | X | X |  |
| 2 |  | X | X | X |  |  |
| 1 | X | X | X |  |  |  |
|  | 1 | 2 | 3 | 4 | 5 | 6 |

FIG-54-3/3 twill

 FIG-55-Diaper design produced from -3/3 twill

The diaper design is constructed from a regular twill . It is constructed on the basis of of haringbone twill principle. Number ends/picks in a repeat required to construct a diaper design is the even number multiple of number of ends /picks in a repeat of regular twill taken.

FIG-55-is the diaper design produced from -3/3 twill . The following steps are carried out to construct the diamond design

1. Mark out 12 ends & 12 picks in the graph paper.

2 Divide the whole repeat into four equal quarters

3. Construct a 3/3twill in the bottom left hand quarter.

4. Add "X" marks in 7th end which is opposite to 6th end . similarly 8th is opposite to5th end, 9th is opposite to 4th end,10th is opposite to 3rd end, 11th is opposite to 2nd end& 12th is opposite to 1st end,

5. . Similarly add "X" marks also in 7th pick which is opposite to 6th pick . similarly 8th is opposite to5th pick, 9th is opposite to 4th pick,10th is opposite to 3rd pick, 11th is opposite to 2nd pick & 12th is opposite to 1st pick,

3.4 Satin & Sateen weaves

 In pure sateen & satin weaves the surface of cloth consists almost entirely either of weft or warp float ,as in the repeat of a weave each thread of one series passes over all but one thread of other series .

 In addition , the interlacing points are arranged as to allow the floating threads to slip and to cover the' binding ' point of one thread by the float of another. This results in the production of fabrics with a maximum degree of smoothness & lustre. The term " sateen" indicates the weft face construction & that of "satin" indicates the warp face construction .

 The "sateen " & "satin" weaves are represented by R/S where R is the no of ends/picks in a repeat or weave no& S is the move no. The selection of move no (S) is totally depend upon the weave no(R).

3.4.1 Selection of move no (S)

 The move number(S) must not be either one, or one less than the weave number (R), and it must not have a common factor with the weave number. The possible move numbers for different weave numbers are shown in the table.

 Table 1

|  |  |  |
| --- | --- | --- |
| Weave number | Move numbers excluded | Possible move numbers  |
| 5 | 1,4 | 2,3 |
| 6 | 1,2,3,4,5 | none |
| 7 | 1,6 | 2,3,4,5 |
| 8 | 1,2,4,6,7 | 3,5 |
| 10 | 1,2,4,5,6,8,9 | 3,7 |
| 12 | 1,2,3,4,6,8,9 | 5,7 |

3.4.2 Classification of sateen & satin

3.4.2.1 Weft face regular sateen

3.4.2.2 Warp face regular satin

3.4.2.3 Irregular sateen

3.4.2.4 4ends & 6ends irregular sattinate

3.4.2.1 Weft face regular sateen

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 5 |  |  |  | X |  |
| 4 |  | X |  |  |  |
| 3 |  |  |  |  | X |
| 2 |  |  | X |  |  |
| 1 | X |  |  |  |  |
|  | 1 | 2 | 3 | 4 | 5 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 5 |  |  | X |  |  |
| 4 |  |  |  |  | X |
| 3 |  | X |  |  |  |
| 2 |  |  |  | X |  |
| 1 | X |  |  |  |  |
|  | 1 | 2 | 3 | 4 | 5 |

 FIG-56- 5/2 Weft face regular sateen

 FIG-57- 5/3 Weft face regular sateen

 FIG-56- represents the 5 ends Weft face regular sateen by taking the move number 2 & FIG-57- - represents the 5 ends Weft face regular sateen by taking the move number 3

3.4.2.2 Warp face regular satin

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 5 | X | X | X |  | X |
| 4 | X |  | X | X | X |
| 3 | X | X | X | X |  |
| 2 | X | X |  | X | X |
| 1 |  | X | X | X | X |
|  | 1 | 2 | 3 | 4 | 5 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 5 | X | X |  | X | X |
| 4 | X | X | X | X |  |
| 3 | X |  | X | X | X |
| 2 | X | X | X |  | X |
| 1 |  | X | X | X | X |
|  | 1 | 2 | 3 | 4 | 5 |

 FIG-58- 5/2 Weft face regular sateen

 FIG-59- 5/3 Weft face regular sateen

 FIG-58- represents the 5 ends Warp face regular sateen by taking the move number 2 & FIG-59- represents the 5 ends Weft face regular sateen by taking the move number 3

3.4.2.3 Irregular sateen

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 10 |  |  |  |  |  | X |  |  |  |  |
| 9 |  |  |  |  |  |  |  |  | X |  |
| 8 |  | X |  |  |  |  |  |  |  |  |
| 7 |  |  |  |  | X |  |  |  |  |  |
| 6\* |  |  |  |  |  |  |  | X |  |  |
| 5\* |  |  | X |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |  |  | X |
| 3 |  |  |  |  |  |  | X |  |  |  |
| 2 |  |  |  | X |  |  |  |  |  |  |
| 1 | X |  |  |  |  |  |  |  |  |  |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

 FIG 60 -10 ends Irregular sateen

 Irregular sateen can be constructed only for even of weave numbers . For constructing Irregular sateen the following steps are performed .

 1. Up to half the number of picks of weave no (R/2) , any possible move number can be taken say "s"

 2. In one more than half the number of picks of weave no (R/2+1) , move number in say "R/2"

 3. In the remaining picks of the weave number , the move number is "R-S"

 FIG 60 represents the 10 ends Irregular sateen where up to 5th pick move number taken is 3. In the 6th pick move number taken is 5. In the remaining picks move number taken is 7.

3.4.2.4 4ends & 6ends irregular sattinate

 Although regular sateen cannot be constructed for 4 &6 end but still irregular sateen is constructed for these ends by varying the move. These designs are known as " sattinate"

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 4 |  |  |  | X |
| 3 |  | X |  |  |
| 2 |  |  | X |  |
| 1 | X |  |  |  |
|  | 1 | 2 | 3 | 4 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 6 |  |  |  |  |  | X |
| 5 |  |  |  | X |  |  |
| 4 |  | X |  |  |  |  |
| 3 |  |  |  |  | X |  |
| 2 |  |  | X |  |  |  |
| 1 | X |  |  |  |  |  |
|  | 1 | 2 | 3 | 4 | 5 | 6 |

 FIG 61 -4 ends Irregular sattinate

 FIG 61-6 ends Irregular sattinate

Chapter 4. simple towelling & curtain fabric

 The characteristics feature of this weave are alternate raised & sunk diamond- shaped areas which give the effect of honeycomb. Its long floats make it particularly suitable for hand towels, glass cloth, dispensed roller towels &bath mats, where moisture absorption properties are particularly desired, but in similar coarse cotton qualities it is also used for quilts and soft furnishings, and in finer qualities for shirts and brocades. There are different types of honeycomb weaves . They are as follows

4.1 Ordinary honey comb

4.2 Ordinary double stitched honey comb

4.3Straight draft honey comb

4.4 Brighton honeycomb design

4.1 Ordinary honey comb

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

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

FIG 62-- A

 FIG 62-- B

 For constructing ordinary honey comb designs ,the steps are performed

1. Construct 1/x twill starting bottom left hand corner, then a similar one running in opposite direction and starting one square in or one square down from the top left hand corner ,so that there will be a clean intersection of the twill lines as shown at figure 62-A

2.In one of the two diamonds produced, leave a row of stitching points and then lift the remainder of the diamond solid as in the figure 62-B

4.2 Ordinary double stitched honey comb

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

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

FIG 63-- A

 FIG 63-- B

 For constructing ordinary honey comb designs ,the steps are performed

1. Construct two 1/x 'Z' twill one starting from bottom left hand corner& the other starting two square up from bottom left hand corner as shown at figure 63-A .

2. Construct two 1/x 'S' twill starting one square in and one square down from the top left hand corner ,so that there will be a clean intersection of the twill lines as shown at figure 63-A

3.In one of the two diamonds produced, leave a row of stitching points and then lift the remainder of the diamond solid as in the figure 62-B

4.3Straight draft honey comb

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

 FIG 64-Straight draft honey comb

 FIG 64- represents the Straight draft honey comb. In this case straight draft is used.

4.4 Brighton honeycomb design

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 12 |  | X | X | X | X | X |  | X | X | X |  | X |
| 11 | X |  | X | X | X |  |  |  | X |  | X |  |
| 10\* |  | X |  | X |  |  |  |  |  | X |  |  |
| 9\* |  |  | X |  | X |  |  |  | X |  |  |  |
| 8 |  | X | X | X |  | X |  | X |  | X |  |  |
| 7 | X | X | X | X | X |  | X |  | X | X | X |  |
| 6 |  | X | X | X |  | X |  | X | X | X | X | X |
| 5 |  |  | X |  | X |  | X |  | X | X | X |  |
| 4\* |  |  |  | X |  |  |  | X |  | X |  |  |
| 3\* |  |  | X |  |  |  |  |  | X |  | X |  |
| 2 |  | X |  | X |  |  |  | X | X | X |  | X |
| 1 | X |  | X | X | X |  | X | X | X | X | X |  |
|  | 1 | 2 | 3\* | 4\* | 5 | 6 | 7 | 8 | 9\* | 10\* | 11 | 12 |

Fig 65-12 ends Brighton honeycomb design

 For constructing Brighton honeycomb weave number of ends/picks in a repeat(R) should be an even number and half of the number of ends/picks in a repeat(R) also should be an even . For constructing Brighton honeycomb weave the following steps are performed.

1. Mark out the repeat size & divide the repeat into four equal quarters.

2. Mark the centre warp & centre weft in each quarter as shown in the figure 65.

3. Construct a 1/x 'Z' twill line starting from the bottom left hand corner.

4. Construct two 1/x 'S' twill line starting from one square in & one square down of the top left hand corner.

5. Now add the warp float which is equal to one less than the half of number of ends/picks in repeat in the centre warps . In our case it is (12/2)-1=5.

6. Now on the basis of these warp floats ,construct warp face diamond.

Chapter 5-yarn numbering systems

 Yarn numbering system indicates the fineness of yarn . Whether the yarn is thick or thin that was decided by the yarn numbering system. The term 'coarser ' & 'finer' yarn is used thick yarn and thin yarn . There are two major systems of yarn numbering system. They are

5.1 Direct system

5.2 Indirect system

5.1 Direct system

 The following are the direct yarn numbering systems.

5.1.1 Tex count

5.1.2 Danier count

3.1.1 Tex count---The tex count is defined as the weight of one kilometre of yarn expressed in gram. If the count of a yarn is 20tex then it indicates that the weight of 1 kilometre of yarn is 20 gram.

3.1.2 Danier count-- The danier count is defined as the weight of nine kilometre of yarn expressed in gram. If the count of a yarn is 90danier then it indicates that the weight of 9 kilometre of yarn is 90 gram.

5.2 Indirect system

The following are the indirect yarn numbering systems.

5.2.1 English count

5.2.2 Worsted count

5.2.3 Woollen count

5.2.1 English count---It is defined as the number of hanks having each hank 840yards contained in one pound. If a yarn have 30s English count then it indicates that the weight of 30\*840 yards is 1pound or 30\*840 yards contains in 1pound .

5.2.2 Worsted count---It is defined as the number of hanks having each hank 560yards contained in one pound. If a yarn have 45s worsted count then it indicates that the weight of 30\*560 yards is 1pound or 30\*560 yards contains in 1pound .

5.2.3 Woollen count-- It is defined as the number of hanks having each hank 256yards contained in one pound. If a yarn have 50s woollen count then it indicates that the weight of 50\*256 yards is 1pound or 50\*256 yards contains in 1pound .

5.3 Conversion of one count to another

we have the following relations among the counts

1.Tex count\*English count =590.5

2. Danier count\* English count=5315

3. Worsted count=1.5 \* English count

4. Woollen count=3.3 \* English count

5. 1pound=454 gram= 16 ouns=7000 grains

5.4 Resultant count of ply yarns

 If multiply yarn have the individual counts N1,N2,N3.........then the resultant count N is given by

1/N= 1/N1 +1/N2 +1/N3............(if the yarn counts are in indirect system)

N= N1 +N2 +N3............(if the yarn counts are in direct system)

example1. The weight of 100meters of yarn was found to be 2gram .Calculate its count in all direct and indirect system

soln: we have

 The weight of 100 meter = 2 gram

 The weight of 1 meter = 2/100 gram

 The weight of 1 km(1000 meter ) = (2/100)\* 1000 gram =20 gram

 The weight of 9 km(9000 meter ) = (2/100)\* 9000 gram =180 gram

 Counts are 20tex &180 danier

 we have TEX \* English count= 590.5

 English count = 590.5/Tex

 =590.5/20= 29.25

 we have Worsted count=1.5 \* English count= 1.5 \* 29.25=43.8

 we have Woollen count=3.3 \* English count= 3.3 \* 29.25=96.5

Chapter 6- Heald count & reed count systems

 There are two systems of reed counting

6.1 System based on the number of dents in given space

 Table 2

|  |  |
| --- | --- |
| Name of the system | Basis of numbering |
| Stockport | No of dents per 2 inches |
| Radcliff | No of dents per 1 inches |
| Huddersfield | No of dents per 1 inches |
| Metric | No of dents per 1 decm |

6.2 System based on the number of group of dents in given space

 Table 2

|  |  |
| --- | --- |
| Name of the system | Basis of numbering |
| Bolton | No of group of 20 dents per 24.5inches |
| Bradford | No of group of 20 dents per 36 inches |
| Blackburn | No of group of 20 dents per 45 inches |
| Irish | No of group of 100 dents per 40inches |
| Leeds | No of group of 19 dents per 9 inches |
| Macclesfield | No of group of 100 dents per 36 inches |

 example 1. What will be the number of ends per inch in a reed of 3/80 stockport

 80 stockport = 80 dents per 2 inches

 =40 dents per 1 inches

Therefore , no of ends per inch=40 \* 3=120

example 2. . What will be the number of ends per inch in a reed of 3/72 bradford

 72 bradford = (72 \*20)/36 dents per inches

 =40 dents per 1 inches

Therefore , no of ends per inch=40 \* 3=120