UNIT 8  FABRIC CONSTRUCTION
TECHNIQUE-WEAVING

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8.0 OBJECTIVES

After we have learnt about the various raw materials that are required for making of a fabric, let us now learn about the different construction techniques that can be deployed for constructing the actual fabric. Purpose of this Unit is to introduce you to the weaving technique of fabric construction. This Unit will help you to:

• Understand the basic operations of weaving;
• Know the types of weaves used to construct cloth;
• Have a brief idea of variation in weaves; and
• Know the characteristics and uses of each weave.

8.1 INTRODUCTION

A fabric is a pliable, plane like structure that can be made into two or three-dimensional products. The fabric forming process or fabrication method contributes to fabric appearance, texture, suitability for end use, performance, and cost. Weaving is one of the oldest and major methods of fabric manufacturing. Woven fabrics are constructed with two or more sets of yarns interlacing with one another at right angle. Yarns running in the lengthwise direction are called warp yarns or ends and, yarns running in crosswise direction are called weft or filling or pick. The right angle position of the yarns gives the cloth more firmness and rigidity than yarn arrangements in knits, braids, or laces.
8.2 ESSENTIAL WEAVING OPERATIONS

Weaving is done on a machine called loom. Earlier, very simple and hand-operated looms were used. Cloth weaving is nowadays accomplished on sophisticated, high speed, precision looms of various types, but the basic principles and functions remain the same. Warp threads are held between two beams, and filling threads are inserted and pushed back to make the cloth.

Fig. 8.1 shows simplified drawing of a two harness loom. The sheet of warp yarns, consisting of the required number of ends of considerable length, is wound upon a beam called warp beam. On the conventional loom, the warp beam is mounted at the back of the loom. The warp ends from the beam are then drawn through the healds and, threaded through the splits of reed. Ends are then conveyed to a beam called the cloth roll/cloth beam, which is at the front of the loom and on which cloth is wound as it is constructed.

The weaving process itself consists of four fundamental operations which form a continuous cycle whether in the simplest handloom, or in the most complex automatic machine.

- **Shedding** - the separation of the warp yarns into upper and lower layers forming a shed, or a tunnel through which the weft is passed
- **Picking** - the insertion of the weft yarn through the shed
- **Beating up** - the carrying forward of the last inserted pick of weft to the cloth already woven
- **Taking up and letting off** - winding the finished fabric on the cloth beam and releasing more of the warp from the warp beam

The picking, beating up and the taking up operations are fixed no matter what type of fabric is being produced, but the shedding motion is variable and can
be described as the heart of weaving as it is here that the nature of the
interlacing, or the weave is decided.

**Shedding**

Shedding, during which the warp yarns are manipulated to produce a given
interlacing, is achieved by threading each end through an eye of a heald wire,
and raising or lowering this wire is dependent on whether it is required to lift
the end above the weft, or to keep it below the weft during picking. Various
shedding systems or devices are used to raise and lower the warp yarns. In
*tappet and dobbý shedding systems* heald wire are not operated singly, but are
attached to heald frames, or heald shafts also known as harness, and each
wire on a given shaft conforms to the movement of that shaft, raising or
falling together with it. The *tappet or cam* system is used to control the
shedding where, due to simplicity of interlacing; only few heald shafts, or
healds, are required. *Dobby shedding systems* offer considerably greater
scope for producing figured effects and are often capable of controlling up to
24 healds. In *jacquard shedding mechanism*, one or more warp yarns are
lifted independently of others without the use of heald shaft.

**Picking**

The filling yarn is inserted through the shed by a carrier device. A single
crossing of the filling from one side of the loom to the other is known as a
pick. Weft insertion can be carried out by various means.

*Shuttle insertion* uses a shuttle, which contains pirn (bobbin of weft yarn)
from which yarn is released as the shuttle reciprocates across the loom. In
*projectile insertion*, the picking action is accomplished by a series of small
bullet like projectiles which grip the filling yarn and carry it through the shed
and then return empty. All the filling yarn is inserted from the same side. In
*water jet insertion*, a pre measured length of filling yarn is carried across the
loom by a jet of water. *Air jet insertion* method utilizes a jet of air to propel
the filling yarn through the shed. *Rapier insertion* is another means of
inserting the filling thread. When a single rapier is used, it crosses the loom
to pick up the weft from the supply package and pulls it into the shed during
its return movement. In two rapiers system, one carries the weft to the center
of the loom where it meets the other and transfers the grip-hold on the tip of
the yarn. The second rapier then completes the pick insertion as the rapiers
are withdrawn.

**Beating up**

The reciprocating reed is responsible for pushing the pick into the fell of the
cloth for beat-up. A reed is a set of wires in a frame, and the spaces between
the wires are called dents. It resembles a comb. Dents hold the warp
yarns/ends at a designed, usually uniform spacing in the fabric.

The most frequent type of commercial loom is a four-harness loom. This
loom is extremely versatile and can be used to produce most basic woven
fabrics. These fabrics comprise the greatest percentage of woven fabrics
currently in the market and explain the popularity of the four harness loom.
Additional harness or other devices that control the position of the warp yarns are used to produce more intricate designs. However, generally six harnesses are the limit in terms of efficiency. Patterns that require more than six harnesses are made on looms that use other devices to control the warp yarns.

8.3 WOVEN FABRICS: SOME CONCEPTS

Selvedge

A selvage is the self-edge of a fabric formed by the filling yarn when it returns to go back across the fabric. The conventional loom makes the same kind of selvage on both sides of the fabric but the new shuttle less looms have different selvages because the filling yarn is cut and the selvage looks like a fringe.

Plain selvages are similar to the rest of the fabric. They do not shrink and can be used for seam edges in garment construction. Tape selvages are made of larger and/or ply yarns to give strength. They are wider than the plain selvage and may be of basket weave for flatness for example selvage of sheets. Split selvages are used when narrow items such as towels are made by weaving two or more towels side by side and cutting them apart after weaving. The cut edges are finished by a machine chain stitch or a hem. Fused selvages are the heat-sealed edges of ribbon or tricot yard goods made from wide fabric and cut into narrower widths.

Fabric count

Fabric count also known as thread count or fabric set is the number of ends (warp yarns) and picks (filling yarns) in a square inch or square centimeter of fabric. A fabric with 60 ends and 70 picks in one inch will have fabric count of 60×70. Fabric count ranges from as low as 20 yarns per inch to as high as 350 yarns per inch.

Fabric count indicates closeness of yarns or compactness of fabric, which is one of the most significant factors affecting durability of fabric. A closely woven fabric has large number of yarns than a loosely woven fabric and is therefore more serviceable. It is firm with high cover and body and, ravels less. A garment made from such a fabric shrinks less in washing, slips less at seam and, keeps its shape. On the other hand, a low fabric count provides better drape, flexibility, pliability and air permeability to garment.

Balanced construction

A fabric is said to be well balanced if the number of ends and picks are almost equal. For example, a fabric with fabric count of 66×63 is considered well balanced. A fabric of 28×24 count is also well balanced. In contrast, a fabric of count of 144×76 has poor balance. Although balanced construction produces fabric of good wearing qualities, but it is not always related to quality.
Check Your Progress I

Note: Use the space provided for your answer

1. Discuss the four fundamental weaving operations.

2. Explain the following concepts:
   a) Selvedge  
   b) Fabric count  
   c) Balanced construction

8.4 BASIC WEAVES

Weave refers to the order of interlacing of the warp yarns and the weft yarns. Broadly, weaves can be classified into two types- basic weave and fancy weave (Fig. 8.2). Basic weaves are also called simple weaves or elementary weaves. In basic weave, only one set of warp yarns and one set of weft yarns are used. All the constituent yarns are equally responsible for both the aspect of utility or performance in a fabric and the aspect of aesthetic appeal. The three basic weaves in common use for the majority of fabrics are plain, twill, and satin, with some variation.

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Fig. 8.2 Classification of Weaves
Plain weave

Plain weave is sometimes referred to as tabby or taffeta weave. It is the simplest type of construction and is consequently inexpensive to produce. The plain weave is formed by the yarns at right angles passing alternately over and under each other (Fig. 8.3). Each warp yarn interlaces with each filling yarn to form the maximum number of interlacings. Plain weave requires only a two harness/heald loom and is the least expensive weave to produce. It is described as 1/1 weave, read as one harness up and one harness down or as one up, one down, which describes the position of the harness when forming the shed. Thus, when the filling yarn is inserted and pushed into place, it goes over the first warp yarn and under the second warp yarn. In a plain weave fabric this pattern is repeated until the filling yarn has interlaced with all the warp yarns across the width of the loom. Plain weave fabrics have no technical face or back due to the weave.

![Fig. 8.3 1x1 Interlacement Pattern in Plain Weave](source)

*Source: Textile Science*

*Note: Each black square indicates that a warp yarn is passing over the filling yarn while the white square represents a filling yarn passing over the warp yarn.*

Plain weave is used to a greater extent than any other weave. Plain weave fabrics are flat with no surface interest. Diverse methods of ornamenting are employed to create surface interest. Variety can be created during weaving by varying the structural details such as yarns of different fibers, thickness (fineness), amount and direction of twist or different colors can be combined. After weaving, further variety may be produced by dyeing, printing and finishing of cloth. Appearance of plain weave fabrics may also be varied by difference in the closeness of weave.

Plain weave fabrics range in weight and compactness from thin lightweight to compact heavy weight. Fabrics are firm and durability depends on yarn count and fabric count.

**Balanced Plain Weave:** The simplest plain weave is one in which warp and filling yarns are the same size and the same distance apart so that they show equally on the surface. Balanced plain weave fabrics have wider range of end uses than fabrics of any other weave and are the most widely used type of woven fabrics. Table 1 depicts some of the balanced plain weave fabrics.
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<table>
<thead>
<tr>
<th>Fabric</th>
<th>Typical Count</th>
<th>Yarn Size</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lawn</td>
<td>88x80</td>
<td>70s (Warp) 100s (Filling)</td>
<td>Light weight opaque</td>
</tr>
<tr>
<td>Organdy</td>
<td>88x80</td>
<td>70s (Warp) 100s (Filling)</td>
<td>Light weight sheer</td>
</tr>
<tr>
<td>Print cloth (muslin, percale)</td>
<td>80x80 to 64x60</td>
<td>28s (warp) 42s (Filling)</td>
<td>Medium weight</td>
</tr>
</tbody>
</table>

*The ‘s’ after the number means that the yarn is a single yarn

**Source:** Kadolph and Langford, 2009

**Unbalanced Plain Weave/Rib Weave:** A fabric with a plain weave may have a ribbed surface. The rib however can always be detected by running a fingernail on the surface of the fabric. The rib can be produced by using heavy yarns in the warp or filling direction. The filling yarns that form the ribs may have been made bulky by having little twist or short staple fiber. Sometimes ribbed fabrics are also called unbalanced fabrics because of the size of the warp and filling yarns, as well as the number of ends and picks per inch. When the heavier yarns are used in the warp direction it is known as the warp-wise rib and when heavier yarns run in the weft direction it is known as weft-wise rib (Fig. 8.4a and b).

![Warp wise (weft-faced) and Weft wise (warp-faced)](image)

**Fig. 8.4 Warp-wise and Weft-wise Rib**

**Source:** Textile Science

Table 2 depicts some of the unbalanced plain weave fabrics.

<table>
<thead>
<tr>
<th>Fabric</th>
<th>Typical Count</th>
<th>Yarn Size</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spun Yarns</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combed broad cloth</td>
<td>144x76</td>
<td>100/2 (Warp) 100/2 (Filling)</td>
<td>Medium weight</td>
</tr>
<tr>
<td>Carded broad cloth</td>
<td>100x60</td>
<td>40s (Warp) 40s (Filling)</td>
<td></td>
</tr>
<tr>
<td><strong>Filament yarns</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tafetta</td>
<td>140x64</td>
<td>75 denier (Warp) 150 denier (Filling)</td>
<td>Medium weight</td>
</tr>
</tbody>
</table>

*The ‘s’ after the number means that the yarn is a single yarn

**Source:** Kadolph and Langford, 2009
Sometimes inferior yarns are used in their manufacture, especially when the yarns that make the rib are hidden in the thickness of the cloth. As these yarns do not show on either side of the fabric, sometimes extremely short staple yarns or yarns with insufficient twist are used. A ribbed fabric will not be durable if the ribs are too pronounced, because the coarse yarns that produce the rib tend to pull away from adjacent fine yarns. Yarn separation may occur where there is tension, such as at seams. Also, in ribbed effects, an entire yarn is exposed to friction, thus lessening the durability of the fabric.

Most ribbed fabrics are medium weight. The ribbed, compact structure generally provides greater drapability than the plain weave. The cloth may be smoother and softer, depending upon the yarn and finish used. Weft ribbed fabrics in this group include broadcloth, poplin, and taffeta, which are used for a variety of apparel. Bottom weight ribbed fabrics use heavier filling yarns of staple fiber, usually have very low twisted warp, and tend to be more compact. Typical materials are bengaline, ottoman.

Basket Weave—The variation of the plain weave known as basket weave uses doubled yarns to produce the design that resembles the familiar pattern of a basket. Two or more filling yarns with little or no twist are interlaced with a corresponding number of wrap yarns. They are woven in a pattern of 2×2, 3×3, or 4×4-regular basket weave (Fig. 8.5 a). Many variations of the yarn construction of the basket weave are possible. For example, there may be 2×1, 3×2 or 5×3, and so on-irregular basket weave (Fig. 8.5 b). The size or thickness of the combined warp yarns will, however, always equal the size or thickness of corresponding filling yarns. This provides a certain degree of balance and pattern to the fabric.

The basket weave produces an attractive, loosely woven fabric that is flexible, somewhat wrinkle resistant, and hangs well. It is therefore suitable for drapery and covering fabrics. Due to the characteristic looseness of construction and the low tensile strength of yarns that have little or no twist, this weave is not desirable for clothing purposes where the factor of durability is of primary consideration. The fabric may be in the medium to bottom weight category and include such materials as monk’s cloth, oxford, and shepherd’s cloth. Basket weave fabrics are used for suiting and outerwear.
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**Twill Weave**

Twill weave is the second basic weave. Twill order of interlacing produces diagonal lines on the cloth. Twill weave is employed for the purpose of ornamentation, and to enable a cloth of greater weight, closer setting and better draping quality to be formed than can be produced in similar yarns in plain weave. The diagonally arranged interlacing of the warp and filling provide greater pliability and resilience. As twills are frequently tightly woven, it will not get dirty as quickly as the plain weave. The yarns are usually closely beaten, making an especially durable fabric.

Twill effects can be made in various ways, but in simple twills the point of interlacing move one outward and one upward on succeeding picks. Filling yarn interlaces more than one warp yarn but never more than four, otherwise durability will be affected. Twill lines are formed on both sides of the cloth, but the direction on one side is opposite to that on the other side when the cloth is turned over. Twill lines may run from bottom left to top right, in which case the twill is said to be a right-hand twill or Z twill (Fig. 8.6 a). Likewise, twills that run from bottom right to top left are known as left-hand or S twills (Fig. 8.6 b). There is no advantage of one over the other.

![Fig. 8.6 Twill Weave](image)

Change in the direction of diagonal lines produce variation such as the herringbone, diamond, pointed, elongated, curved, entwining and other fancy twills. These produce interesting pattern effects, which can be further enhanced by yarns of different colors and textures.

Twill weaves are named according to the number of heald shafts required to make the design. Three or four shaft twill is frequently used. Twill weaves can be even (balanced) or uneven (unbalanced) according to the number of warp or filling yarns that is visible on the face of the fabric. The even twill shows an equal number of warp and filling yarns such as 2/2 twill. The 2/2 twill is most popular and is used in such end-uses as lining fabric, suiting fabrics, in dress wear. Table 3 depicts some of the even twill weave fabrics. Most twill weaves are uneven. Uneven twill may show more warp than filling yarns in the recurring design, this is called warp-face twill e.g. 3/1. If more filling than warp yarns are shown on the face, the weave is called filling-face twill e.g. 1/3. Warp face twill weaves are generally stronger than filling faced because the stronger warp yarns on the face of the fabric can take more...
abrasion and wear. Such fabrics hold their shape better and drape better due to the warps’ greater twist and resilience. Table 4 depicts some of the warp faced twill weave fabrics.

### Table 3: Even-sided Twills

<table>
<thead>
<tr>
<th>FABRIC</th>
<th>COUNT</th>
<th>YARN SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serge</td>
<td>48x34 to 62x58</td>
<td>Varies with fiber content</td>
</tr>
<tr>
<td>Flannel</td>
<td>56x30 to 86x52</td>
<td>Varies with fiber content</td>
</tr>
</tbody>
</table>

### Table 4: Warp-faced Twills

<table>
<thead>
<tr>
<th>FABRIC</th>
<th>COUNT</th>
<th>RANGE IN YARN SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denim</td>
<td>60x36 to 72x44</td>
<td>7s to 16s (Warp) 8s to 23 s (Filling)</td>
</tr>
<tr>
<td>Gabardine</td>
<td>110x76 to 130x80</td>
<td>15s to 39/2(Warp) 15s to 26s (Filling)</td>
</tr>
</tbody>
</table>

Source: Kadolph and Langford, 2009

Although there are lightweight twills, the majority of fabrics in twill weave are medium weight, and there is substantial variety of bottom weights. Depending upon fiber, yarn, construction, and finish, they are used for a wide range of apparel, such as dresses, suits and coats. They include flannel, covert cloth, denim, gabardine, jean, khaki etc. Wool type fabrics are usually right-hand twills, such as broadcloth, cashmere, flannel, gabardine, serge, tweed.

### Satin and Sateen Weaves

In pure satin and sateen weaves the surface of the cloth consists almost entirely of weft or warp float, as in the repeat of a weave each yarn passes over all but one yarn of the other series. In addition, the interlacing points are so arranged as to allow the floating yarns to slip and to cover the binding point of one yarn by the float of another (Fig. 8.7a and b). This results in the production of fabrics with a maximum degree of smoothness and luster and without any prominent weave features. Very close packing of yarns is possible and quite heavy constructions can be achieved with properly set clothes. Satin weave fabrics drape well because the weave is heavier than other two basic weaves. More heald shafts are used for satin weave, thus compressing a greater amount of fine yarn into a given space of cloth. This compactness gives the fabric more body. The quality of drapability and luster makes the satin fabrics preferable for evening wear.

The long floats found in the satin weave might be considered a disadvantage because they represent a minimum of interlacings. Furthermore, to increase the smoothness and luster of the fabric, the yarns are given a minimum of twist and are therefore relatively weak. The longer the float, the greater the chances that the surface of the fabric will snag, roughen and show signs of wear. In addition, fabric with insufficiently close yarn spacing, exhibit poor
seam strength in made up articles due to seam slippage arising on account of the excessive freedom of the threads.

![Warp-faced Satin Weave](image1)
![Filling-faced Sateen Weave](image2)

Fig. 8.7 Satin and Sateen weave

Source: Textile Science

The term satin and sateen tend to be used somewhat indiscriminately and are frequently confused one with another. Correctly, sateen indicates a filling faced construction, whilst satin is used with reference to a corresponding warp face structure. This difference is reflected in the setting of the respective cloths. Sateens are constructed with a greater number of picks per unit cm than ends per cm; conversely, satins have more ends than picks per cm in order to achieve the desired solid surface effect. Table 5 depicts some typical satin fabrics.

### Table 5: Typical Satin Fabrics

<table>
<thead>
<tr>
<th>FABRIC</th>
<th>COUNT</th>
<th>RANGE IN YARN SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satin</td>
<td>200x65</td>
<td>100 denier (Warp)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100 denier smooth filament (Filling)</td>
</tr>
<tr>
<td>Slipper Satin</td>
<td>300x74</td>
<td>75 denier (Warp)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>300 denier smooth filament (Filling)</td>
</tr>
</tbody>
</table>

Source: Kadolph and Langford, 2009

### 8.5 FANCY/COMPLEX WEAVES

Fancy weave requires more than one series of warp or weft yarns some of which may be responsible for body of fabric while some may be employed for ornamental purpose.

**Pile Weave**

In contrast to the three basic weaves that produce a flat surface on the fabric, the pile weave introduces a decorative third dimension, creating an effect of depth. The pile weave is produced by weaving an additional warp yarn or filling yarn into the basic structure. The additional warp yarn, which forms loops at regular intervals, is drawn away from the surface of the fabric. These loops may be cut or closely sheared, or let uncut if a loop surface is desired (Fig. 8.8 a and b). The pile is usually ½ inch or less in height.
When the pile is produced by an extra set of warp yarn, the result is a warp-pile fabric. When the pile is produced by an extra set of filling yarn, the result is a filling-pile fabric. The floats for filling pile fabrics are interlaced using a ‘V’ or ‘W’ method (Fig. 8.9 a and b). The ‘W’ method produces a more durable fabric and one less likely to develop bald spots because the pile is held in place by three yarns as against one yarn used in the ‘V’ method.

Cut Pile: There are several methods of producing cut pile. One technique is to weave an extra set of yarns that will float across several ground, or binder yarns to form rows of loops to be subsequently cut. For example, corduroy is woven with extra filling yarns that flow in uniform rows over in group of three or more warps to form parallel rows of loops running the lengths of the cloth. After weaving, a machine is used to lift the floats and cut them with a row of revolving knives, thus raising a pile from the ground fabric; the width of pile is determined by the length of the floats. For a close, dense pile as in velveteen, the floats are woven over the ground cloth in a manner that will cause a compact pile structure when the loops are cut and sheared for uniform height. Cut-pile fabrics maybe woven on looms equipped with wires that have knife edges to cut the extra set of warp yarns which float over predetermined numbers of filling yarns. As the wires are withdrawn across the loom, the floats are cut to produce the cut pile.

Another method of producing cut pile is by cutting apart the two layers of a double cloth. Two pile fabrics are formed simultaneously as the extra set of yarns, which hold the two clothes together, are cut by a knife traveling across the loom (Fig. 8.10). The height of the pile is determined by the distance between two clothes. This technique may be used to make such fabrics as velvet. Cut-pile fabrics have certain limitations. They catch lint and spot easily. Although the pile is constructed perpendicularly to the ground fabric, the finishing processes of singeing, waxing, and/or pressing may cause the pile to slant and give it either an up or down direction. 

You will be reading Fig. 8.9 'V' and 'W' Interlacing for Filling Pile Fabrics

Source: Textile Science
more about finishes in Block 3 of this Course). This will cause light reflection to give the material shading, depending upon how it is held or brushed. It is therefore important to note the direction of the pile for consistency of color appearance in the construction of garments. Some cut-pile fabrics may be laundered, depending upon the fiber used, but they must be thoroughly rinsed so that they will not be stiffened by soaps or detergents. If they need to be ironed, they should be pressed with a steam iron. To avoid crushing, ironing should be done on the wrong side.

Fig. 8.10 DoubleCloth Pile Weaving
A: Ground warp(top), B: Ground filling(top); C: Pile warp; D: Ground warp(bottom), E: Ground filling(bottom)

Uncut pile: There are two methods of producing uncut-pile fabrics. One is with the use of wires but without knife edge as described above. When the wires on the loom are withdrawn, the loops formed from the extra set of floats remain intact. Frisé is generally made in this manner.

The other method is to weave an extra set of warp yarns into the fabric form a warp pile beam. For example, a loom can be constructed to accommodate the extra warp pile beam and groups of three fillings to be inserted and beaten up with a single reed motion. After the second filling is inserted, the let off motion cause the yarns from the warp pile beam to slacken, while those on the ground warp beam remain under tension. Following insertion of the third filling in the set, the reed beats up firmly all three picks causing the slackened warp to form the pile loops. The height of the pile is dependent upon the distance that the first two fillings are held back from the fell of the fabric. The pile can be produced on one or both sides of the cloth. A typical fabric woven this way is terry.

Uncut pile fabrics may wear better than cut pile. However, the loops may catch and tear. They are also not as soft, warm, or absorbent as cut-pile materials.

Pile fabrics may be woven entirely of either spun or filament yarns or they may be made of spun yarn in the ground and filament yarn in the pile. Velvet and velour are examples.

Leno Weave
Leno is a weave in which the warp yarns do not lie parallel to each other but one yarn of each pair is crossed over the other before the filling yarn is inserted (Fig. 8.11). Leno weave is sometimes referred to as the gauge weave.
Leno is made with a doup attachment, which may be used with a plain or dobbey loom. The attachment consists of a thin hairpin like needle supported by two heddles. One yarn of each pair is threaded through an eye at the upper end of the needle, and the other yarn is drawn between the two heddles. Both yarns are drawn through the same dent in the reed. During weaving, when one of the two heddles is raised, the doup warp yarn that is threaded through the doup needle is drawn across to the left. When the other heddle is raised, the same doup warp yarn is drawn across to the right.

![Fig. 8.11 Leno Weave](image-url)

**Source:** Textile Science

Leno weave fabrics are characterized by sheeriness or an open-mesh effect. Moreover, this construction produces a fabric light in weight. However, their weight varies depending upon the thickness of yarns, which could be spun, filament, or a combination of these yarns. The fabrics made with leno weave are lace like in character. The crossed yarn arrangement gives greater firmness and strength than plain weave fabrics of the same low fabric count and also gives resistance to slippage of yarns. Typical materials are grenadine and marquisette which are used for blouses, summer dresses and shirting.

**Surface Figure Weaves**

Figures (designs) can be produced on the surface of fabrics with extra warp or filling yarns. Yarns of different color or size than the background yarns are used. The figure portion has warp or filling floats. When not used in the figure the extra yarns float across the back of the fabric and may or may not be cut off during finishing. In hand woven fabrics the warp yarns can be manipulated by hand and the extra yarns can be laid in where they are wanted by using small shuttles. But in power looms, an attachment that can be operated automatically must be used.

Extra warp yarns are wound on a separate beam and threaded into separate heald wires. The extra yarns interlace with the regular filling yarns to form a design and float above the fabric until needed for the repeat. The floats are then clipped close to the design or clipped long enough to give an eyelash effect. Men’s shirting fabric contains extra warp yarn to make the design.

The weaving of design by extra weft yarn requires additional small shuttles or insertion devices. A separate shed is made for them. While the fabric is
Course 2

being constructed, the row of small shuttles drops across the width of the loom, and each interweaves its separate design with a circular motion on a small area of warp. A long thread is carried on the undersurface of the fabric from one design to the next. Different colors may be used in each of the designs because each figure is woven with its own specific shuttle. Dots, circles, or other figures are interwoven on the surface of a fabric. Dotted swiss is woven with extra filling yarn.

Double Cloth Weave

In double cloth weave, two fabrics are woven on the loom at the same time, one on top of the other. The fabric may have a plain weave on one side and a twill weave on the other. Each of the fabric requires its separate sets of the warp and filling yarns. There are two main types of double cloth weave depending upon how two fabrics are combined. True double cloth is made with five sets of yarns: two fabrics woven one above the other on the same loom with the fifth yarn (warp) interlacing with both cloths. It can be used in reversible garments such as capes and skirts.

Double cloth is made with four sets of yarns woven separately on the same loom except that the warp and filling of one cloth change position with the other cloth (crisscross), locking the two clothes at intervals as required by the design.

The surface of such fabrics may show different patterns or color on each side by varying the yarns as to color and size. A true double cloth is never a pasted construction.

Because the double cloth weave produces two pieces of fabric combined into one, fabrics so woven are commonly regarded as strong and warm. Warmth is due to the bulk, thickness and presence of air layer between the two pieces of fabrics though insulative properties inherent in a fiber is one of the main factors determining warmth giving property. Also, strength cannot be judged by mere thickness or weight. It cannot be assumed that a double cloth weave will always have the qualities of warmth and strength; on the contrary, the fabric may be heavy, bulky, and needlessly expensive.

Double cloth fabrics are, by their nature, heavier weight materials. They may be made of spun yarns or of spun and filament yarns. Depending upon their composition and construction, they can be used for robes, coat materials etc.

Dobby Weave

Dobby weave is a patterned weave used to construct designs that cannot be produced by the plain, twill or satin weave. The designs are simple, limited in size, and usually geometric in form (Fig. 8.12). The dobby weave is created on a plain loom by means of a mechanical attachment, called a dobby or cam, which raises or lowers as many as twenty four to forty heald shafts containing the series of warp yarn that form the pattern. The weave pattern consists of a plastic tape with punched holes. These tapes resemble, somewhat, the rolls for a player piano. The holes control the raising and lowering of the warp yarns. Although a large number of shafts are used in this construction, the
design is always small and does not make use of long floats.

![Fig. 8.12 Dobby Weave Fabric](source: Textile Science)

The most familiar type of dobbay weave is bird’s eye, the small diamond pattern made with short floats that give the impression of an eye. Huck or huckaback has a pebbly surface made by filling floats. Fabrics made with a dobbay weave are generally of spun yarn and of medium weight.

**Jacquard Weave**

Jacquard weave produces large and intricate figured designs (Fig. 8.13). As large figured designs exceed the capacity of the harness loom, a special loom with jacquard attachment is used. Jacquard loom usually has no harness, the warp yarns being controlled by a jacquard head located at the top of the loom so that any combination of warp yarns can be raised or lowered. The jacquard mechanism controls thousands of heald wires, which lift one or more warp yarns independently of others.

![Fig. 8.13 Jacquard Fabric](source: Textile Science)

The jacquard design is first worked out on a square paper. Cards are then perforated with the design; they are laced together, looking somewhat like a chain of punched data processing cards, and placed on the jacquard attachment. The moving cards pass over a battery of needles mounted on top of the loom. Each needle controls a string, which when released, picks up the
heald wire to which it is tied. The perforation on the cards allows the needles to drop through, and lift certain strings, which, in turn, lift single heald wire and thus raise the warp yarns. Others will remain down. In this manner shed is formed for the passage of the filling yarns.

Fabrics made on a jacquard loom are damask, brocade, and tapestry. Damask has satin floats on a satin background, the floats in the design being in the opposite direction from those in the background. It is made from all kinds of fibers and in many different weights for apparel and home furnishings. Quality and durability are dependent on high count. Low count damask is not durable because the long floats rough up, snag, and shift during use. Brocade has satin floats on a plain, ribbed, or satin background. Brocade with satin ground differs from damask in that the floats in the design are more varied in length and are often of several colours.

8.6 IDENTIFYING WOVEN FABRIC DEFECTS

In the course of making fabrics, imperfections occur. There are two main types of defects in woven fabrics:

Yarn defects - A slub caused by uneven spinning or by waste caught during spinning would indicate a weak spot in the yarn as well as an area for possible fabric abrasion and wear. There could be a broken or missing end or pick, thereby resulting in fabric weakness and pattern imperfection. Sometimes there may be a mixed end or pick, which is a yarn different in size, twist, number of plies, or colour, which would affect the wear or appearance.

Weave defects - A slack yarn due to insufficient tension in weaving, or a tight end or pick caused by excessive tension is also a defect. An uneven space between ends may be caused by a misdraw, where one or more warps were incorrectly drawn through a heald shaft or the reed. There may be a mispick due to improper weaving of a filling yarn as the result of restraining the loom on the incorrect pick after an interruption.

There may be reed marks, or spaces between groups of warps at intervals or continuously, due to crowding or improper spacing of the warp yarns as they pass through the reed. A tight selvage, indicated by a puckered or wavy edge, may be caused by excessive tension in the warp yarns.

Streaks across the width of the fabric may occur. A barre mark, which gives the effect of a stripe with shaded edges, may be caused by faulty loom functioning, yarn variations, or faulty dye absorption. A filling bar, which is a pronounced crosswise band, may be due to a group of picks of a different size or a section with a different number of picks than are in the rest of the fabric, possibly due to improper restarting of the loom.

Check Your Progress II

Note: Use the space provided for your answer

1. Which of the three basic weaves is (a) more durable (b) the most
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beautiful (e) the most expensive to produce? Give reasons for the answers.

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2. Contrary to common belief, why does the leno weave embody strength?

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3. A woven fabric with jacquard design contains long floats. What possible problems could result from this construction if the fabric is used for apparel?

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4. State three reasons why fabrics with the same weave can still have different appearance.

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5. State two disadvantages of using cut pile fabrics for textile products.

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8.7 CONCLUSION

As the conclusion, weaving is one of the oldest and major methods of fabric manufacturing. Made on a machine called loom, woven fabrics are constructed using warp and weft yarns, running in the lengthwise and crosswise direction respectively, interlacing with one another at right angle. Looms can be manual or automatic but the basic principles and functions remain the same. While learning weaving, we could know how the fabric is produced and the different types of fabrics that can be created using variety of weaves.

8.8 LET US SUM UP

Woven fabrics are produced on loom by interlacing the threads running down the fabric with those lying across it. Various factors such as number of heald shafts, threading pattern of ends through the healds, number of picks laid together and lifting plan of heald shafts are regulated to obtain a wide variety of weaves. The type of weave used in a fabric depends upon the desired effect. Factors such as luster, durability, pattern, colour effect and cost are considered while choosing weave for a fabric.

Weaves are classified into basic weave and fancy weaves. Basic weave includes plain weave, twill weave, satin weave and their variations. Fancy weave includes pile, leno, surface figure weaves, dobbý, jacquard, double cloth weave.

8.9 KEYWORDS

Dobby weave: Dobby weave produces small geometrical or floral figures
Fabric count: Fabric count also known as thread count or fabric set is the number of ends and picks in a square inch or square centimeter of fabric
Jacquard weave: Jacquard weave produces elaborate patterns
Leno weave: Leno weave is characterized by an open mesh structure
Plain weave: It has maximum number of interlacing and is produced on one up and one down principle
Pile weave: Pile weave produces three dimensional fabrics by extra set of warp or filling yarns. Pile can be cut or left uncut.
Satin weave: Satin weave has extensive floats of warp or weft in the fabrics which creates smooth unbroken surface
Selvedge: A selvage is the self-edge of a fabric formed by the filling yarn when it returns to go back across the fabric
Surface figure weaves: Designs are produced on the surface of fabrics with extra warp or filling yarns
Twill weave: Twill weave shows diagonal lines on the fabric which are produced by each successive end advancing upwards or downwards one pick for each successive pick
**Weaving:** Weaving is the transformation of yarn into fabric on loom which interlaces two or more sets of yarns

### 8.10 REFERENCES AND SUGGESTED READINGS


### 8.11 CHECK YOUR PROGRESS – POSSIBLE ANSWERS

**Check Your Progress I**

1. The four fundamental weaving operations are:

   - ***Shedding*** - the separation of the warp yarns into upper and lower layers forming a shed, or a tunnel through which the weft is passed.
   - ***Picking*** - the insertion of the weft yarn through the shed.
   - ***Beating up*** - the carrying forward of the last inserted pick of weft to the cloth already woven.
   - ***Taking up and letting off*** - winding the finished fabric on the cloth beam and releasing more of the warp from the warp beam.

2. a. A selvage is the self-edge of a fabric formed by the filling yarn when it returns to go back across the fabric.
   
   b. Fabric count also known as thread count or fabric set is the number of ends (warp yarns) and picks (filling yarns) in a square inch or square centimeter of fabric.

   c. A fabric is said to be well balanced if the number of ends and picks are almost equal.

**Check Your Progress II**

1. Twill weave is more durable than plain weave and satin weave because the filling and warp yarns in a twill weave do not interlace as many times as they do in a plain weave, the yarns can be packed more tightly together making a firmer fabric.

   Satin weave is the most beautiful of all the three basic weaves as it has a smooth and shiny surface and a good drape. It is used for making wedding dresses and evening gowns, shirts, loungewear, hats, ties, upholstery, lingerie etc.

   Also satin weave is more expensive and time consuming to produce as
the fabric needs to be woven very densely and so necessitates much higher ends and picks per cm. This has the effect of making the fabric much more compact, thus using a great deal more yarn. But the high density does provide some very positive attributes, such as strength and very good tear resistance.

2. In leno weave, two or more warp threads twist around the weft threads. This crossed yarn arrangement gives greater firmness and strength to the fabric. The twisted warp yarns ensure the yarn does not move thus preventing slippage of yarns.

3. The long floats in a jacquard design can cause snagging, shifting and pilling. This can occur from the friction and mechanical action of normal wear, dry-cleaning and spotting.

4. Fabrics with the same weave can have different appearances because of the:
   - different methods used for the interlacing of groups of yarns,
   - thickness of filling and warp yarns, and
   - picks used per inch

5. The two disadvantages of using cut pile fabrics for textile products are:
   a) They catch lint and spot easily
   b) These fabrics cause light reflection and gives the surface shading, depending upon how it is held or brushed. Although the pile is constructed perpendicularly to the ground fabric, the finishing processes of singeing, waxing, and/or pressing may cause the pile to slant and give it either an up or down direction. It is therefore important to note the direction of the pile for consistency of color appearance in the construction of garments.