

Elements of knitted loop structure

5.1 The needle loop

The *needle loop* (H + L in Fig. 5.1) is the basic unit of knitted structure. When tension in the fabric is balanced and there is sufficient take-away tension during knitting, it is an upright noose formed in the needle hook. It consists of a *head* (H) and *two side limbs* or *legs* (L). At the base of each leg is a *foot* (F), which meshes through the head of the loop formed at the previous knitting cycle, usually by that needle. The yarn passes from the foot of one loop into the foot and leg of the next loop formed by it.

(NB: If the loop is the first loop knitted on that needle, its feet and legs will not be restricted and it will open out to give the appearance of a tuck loop. If the loops are knitted on a flat machine with a pressing down device and no take-down tension, the loops will be more rounded and will tend to incline due to the traversing movement of the presser.)

In warp knitting the feet may be *open* or *closed* at the base of the loop. In the latter case, the yarn guide has passed across the back of the needle across whose hook it has previously formed a loop.

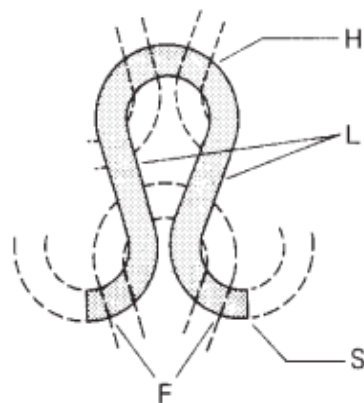


Fig. 5.1 Intermeshing points of a needle loop.

In weft knitting, the feet are normally open because the yarn continues to be supplied in one direction (except at the selvages of straight knitting machines). Exceptionally, closed loops have occasionally been produced in the past on the bearded needle sinkerwheel machine, by twisting a loop over as it is transferred to another needle, or by using a twizzle beard which closes onto the back of the needle so that, as the loop is cast-off, it twists over itself.

5.2 The sinker loop

The *sinker loop* (S in Fig. 5.1) is the piece of yarn that joins one weft knitted needle loop to the next. On bearded needle weft knitting machines, *loop-forming sinkers* form the sinker loops in succession between the needles – hence the origin of the term sinker loop. On latch needle weft knitting machines, however, the sinker loops are automatically formed as the needles, in succession, draw their new loops.

Sinker loops show on the opposite side of the fabric to the needle loops because the needle loop is drawn onto the opposite side from which the yarn was originally fed. The terms ‘sinker loop’ and ‘needle loop’ are convenient descriptive terms but their precise limits within the same loop length are impossible to exactly define.

5.3 Warp knitted laps

Loops are termed ‘laps’ in warp knitting because the warp guides lap their yarn around the needles in order to form the loop structure. The loops (overlaps) may be open or closed.

On the original warp frame (as on many present-day crochet machines), the needle bar was in a horizontal and not a vertical position, with its beards facing upwards (Fig. 5.2). To produce a needle loop it was thus necessary to swing the guide upwards and shog it over the needle hook; hence the term ‘*overlap*’ which refers both to the movement and the loop which it forms. Similarly, the guide was shogged under the needles to a new starting position for the next overlap. This movement and the lapped thread it produces is still termed an ‘*underlap*’. In the warp knitting cycle, it is always understood that the overlap precedes the underlap.

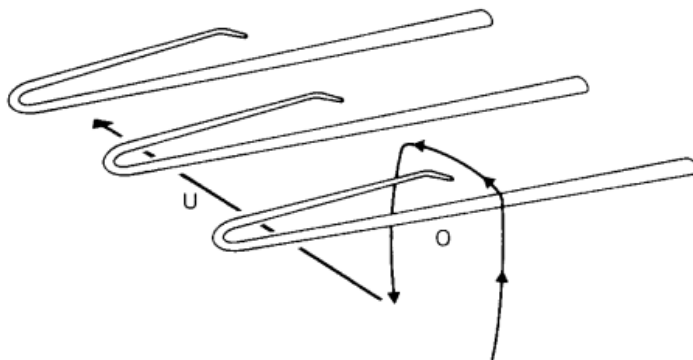


Fig. 5.2 Overlapping and underlapping (warp knitting).

5.4 The overlap

The *overlap* (Fig. 4.3) is a shog, usually across one needle hook, by a warp guide (at the back of a single needle bar machine) which forms the warp yarn into the head of a needle loop. Every needle on a conventional warp knitting machine must receive an overlapped loop from at least one guide at every knitting cycle, otherwise it will press-off the fabric.

The swinging movement of the guide to the hook side and the return swing after the overlap, produce the two side limbs of the loop which give a similar appearance on the face side of warp knitted fabric to a weft knitted needle loop.

Very rarely are overlap shogs across two needle hooks, as this produces severe tension on the warp yarn and knitting elements because the needles knock-over in unison and the needles are sharing yarns (unlike in single needle overlap warp knitted structures). Two needle overlaps also generally have a poor appearance and physical characteristics because the first overlap of the two will have a different configuration of underlap to that of the second. In the former, the underlap will be passing along the course to the second overlap in a similar manner to a sinker loop. However, the underlap from the second overlap will lap upwards to the next course in the manner of a normal underlap.

5.5 The underlap

The *underlap* shog occurs across the side of the needles remote from the hooks on the front of single-needle bar, and in the centre of double-needle bar, warp knitting machines. It supplies the warp yarn between one overlap and the next (Fig. 5.3). The underlap shog generally ranges from 0 to 3 needle spaces, but it might be 14 needle spaces or more depending upon the design of the machine and the fabric structure

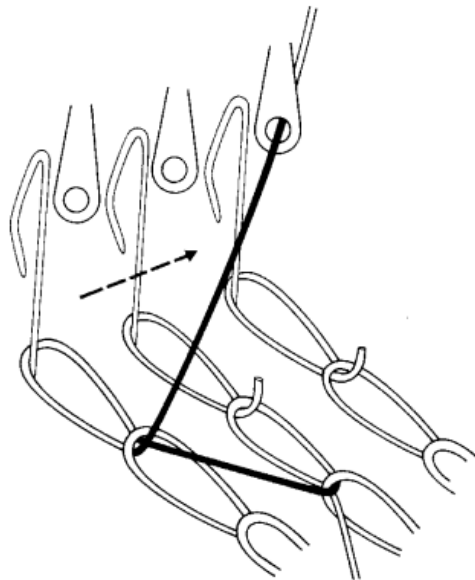


Fig. 5.3 The underlap shog.

(although efficiency and production speed will be correspondingly reduced with long underlaps).

Underlaps as well as overlaps are essential in warp knitted structures in order to join the wales of loops together but they may be contributed by different guide bars.

5.6 The closed lap

A *closed lap* is produced when a subsequent underlap shogs in the opposite direction to the preceding overlap, thus lapping the same yarn around the back as well as around the front of the needle (Fig. 5.4).

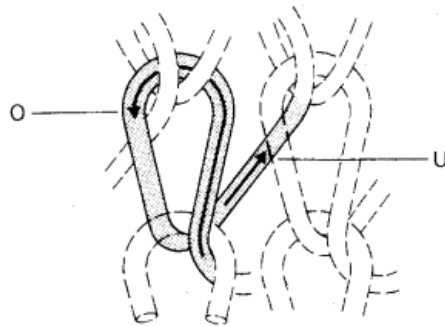


Fig. 5.4 The closed lap.

5.7 The open lap

An *open lap* is produced either when a subsequent underlap is in the same direction as the preceding overlap (Fig. 5.5) or an underlap is omitted so that the overlap of the next knitting cycle commences in the needle space where the previous overlap finished. Closed laps are heavier, more compact, more opaque, and less extensible than open laps produced from the same yarn at a comparable knitting quality.

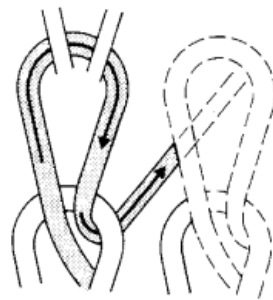


Fig. 5.5 The open lap.

5.8 Wrapping

Wrapping is a method of producing vertically-orientated patterning with warp threads on a single jersey weft knitted base structure. Specially controlled warp thread guides are used which make unidirectional warp knitted overlaps into selected needle hooks. If selected empty needle hooks rise to receive the warp yarn (as is the case on a few single jersey machines), *pure wrapping* or *warp insertion* is produced. If, however, wrapping takes place on needles, all of which already hold a ground yarn at that knitting cycle, *embroidery plating* or *wrap striping* is produced; this is a technique occasionally used on some half-hose machines.

5.9 The knitted stitch

The *knitted stitch* is the basic unit of intermeshing. It usually consists of three or more intermeshed needle loops (Fig. 5.6). The centre loop has been drawn through the head of the lower previously-formed loop and is, in turn, intermeshed through its head by the loop above it.

The *repeat unit* of a stitch is the minimum repeat of intermeshed loops that can be placed adjoining other repeat units in order to build up an unbroken sequence in width and depth.

A needle loop only has its characteristic appearance because its legs are prevented from spreading outwards by being intermeshed through the head of the loop below it. If there is no previous loop to mesh through, the legs of the new loop will spread outwards.

The term *stitch* is unfortunately sometimes used to refer to a single needle loop.

Stitch length is a length of yarn which includes the needle loop and half the sinker loop on either side of it. Generally, the larger the stitch length, the more extensible and lighter the fabric and the poorer the cover, opacity and bursting strength.

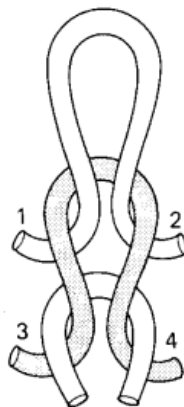


Fig. 5.6 The knitted stitch.

5.10 The intermeshing points of a needle loop

All needle loops or overlaps have four possible intermeshing points (Fig. 5.6) – 1 and 2 at the head, where the next new loop will be drawn through by the needle, and 3 and 4 at the base, where the loop has intermeshed with the head of the previously formed loop. The intermeshings at 1 and 2 are always identical with each other as are intermeshings 3 and 4 with each other. It is impossible to draw a new loop through the old loop so that its two feet are alternately intermeshed (Fig. 5.7). This could only be achieved by taking the yarn package through the old loop. Although this would produce a locked loop, the package used would not be large enough to provide a continuous supply.

A *new loop* can thus only be intermeshed through the head of the old loop in a manner that will show a face loop stitch on one side and a reverse loop stitch on the other side. This is because the needle hook is uni-directional and can only draw a new loop down through an old loop.

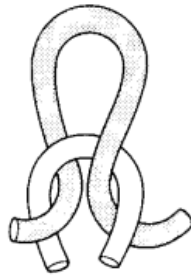


Fig. 5.7 An impossible intermeshing.

5.11 The face loop stitch

The *face side* of the stitch (Fig. 5.8) shows the new loop coming towards the viewer as it passes over and covers the head of the old loop. It is referred to as the *right side* in mainland Europe.

Face loop stitches tend to show the side limbs of the needle loops or overlaps as a series of interfitting 'V's. The face loop-side is the underside of the stitch on the needle.

5.12 The reverse loop stitch

This is the opposite side of the stitch to the face loop-side and shows the new loop meshing away from the viewer as it passes under the head of the old loop. It is referred to as the *left side* on the mainland of Europe. Reverse stitches show the sinker loops in weft knitting and the underlaps in warp knitting most prominently on the surface. The reverse loop side is the nearest to the head of the needle because the needle draws the new loop downwards through the old loop (Figures 4.4 and 5.8).

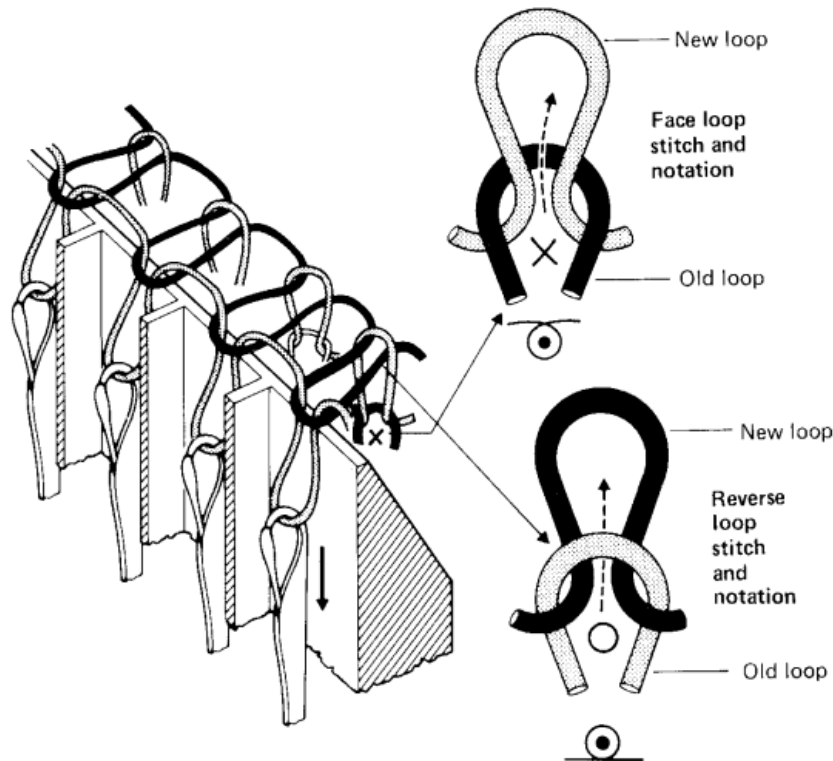


Fig. 5.8 Face- and reverse-meshed loops.

5.13 Single-faced structures

Single-faced structures are produced in warp and weft knitting by the needles (arranged in either a straight line or a circle, with their hooks facing outwards) operating as a single set. Adjacent needles will thus have their hooks facing towards the same direction and the heads of the needles will always draw the new loops downwards through the old loops in the same direction so that intermeshing points 1 and 2 will be identical with intermeshing points 3 and 4.

The under-surface of the fabric on the needles (termed the *technical face* or *right side*) will thus only show the face stitches in the form of the side limbs of the loops or overlaps as a series of interfitting 'V's. The upper surface of the fabric on the needles (termed the *technical back* or *left side*) will show reverse stitches in the form of sinker loops or underlaps as well as the heads of the loops.

5.14 Double-faced structures

Double-faced structures are produced in weft and warp knitting when two sets of independently-controlled needles are employed with the hooks of one set knitting or facing in the opposite direction to the other set. The two sets of needles thus draw their loops from the same yarn in opposite directions, so that the fabric, formed in the gap between the two sets, shows the face loops of one set on one side and the face loops of the other set on the opposite side.

The two faces of the fabric are held together by the sinker loops or underlaps,

which are inside the fabric so that the reverse stitches tend to be hidden. The two faces may be knitted from different yarns and the two fabrics thus formed may only occasionally be joined together. Sometimes the two faces are cohesively produced and are far enough apart for the connecting sinker loops or underlaps to be severed in order to produce two single-faced fabrics.

5.15 A balanced structure

A *balanced structure* is a double-faced structure that has an identical number of each type of stitch produced on each needle bed which therefore show on each fabric surface, usually in the same sequence. Balanced structures need not, however, have the same design in coloured yarn on either surface. Such structures do not normally show curling at their edges.

5.16 Face and reverse stitches in the same wale

Face and reverse stitches in the same wale are normally produced on purl weft knitting machines that have double-headed needles capable of drawing a face stitch with one hook and a reverse stitch with the other, so that intermeshing points 1 and 2 will not always be identical with intermeshing points 3 and 4. Transfer of a wale of loops from a needle knitting face loops to one knitting reverse loops (or vice-versa) will produce the same result.

5.17 Selvedged fabric

A *selvedged fabric* is one having a 'self-edge' to it and can only be produced on a straight machine whose yarn carrier reciprocates backwards and forwards across the needle bed so that a selvedged edge is formed as the yarn rises up to the next course at either edge of the fabric.

5.18 Cut edge fabric

A *cut edge fabric* is usually produced by slitting open a tube of fabric knitted on a circular machine. A slit tube of fabric from a 30-inch (76 cm) diameter machine will have an open width of 94 inches (2.38 m) (πd) at knitting and before relaxation.

5.19 Tubular fabric

Tubular fabric may be produced in double-faced or single-faced structures on circular machines; or in a single-faced form on straight machines with two sets of needles, provided each needle set only knits at alternate cycles and the yarn only passes across from one needle bed to the other at the two selvedge needles at each end, thus closing the edges of the tube by joining together the two single-faced fabrics produced on each needle set.

Tubular double faced fabrics can be produced on straight machines with two sets of needles, needle bed racking and transfer facilities, provided empty complimentary needles are always available to receive and transfer loops.

5.20 Upright loop structures

Structures with upright loops in straight wales are produced only if the tension on the yarn on either side of the needle loop head is balanced. This condition often exists in weft knitted structures because balanced sinker loops enter from either side of the needle head, but it may be disturbed by racking, by knitting twist lively yarn or by traversing pressing-down elements.

Warp knitted structures, however, seldom have perfectly upright overlaps because the underlaps, even if they enter from either side of the overlap head, rarely balance each other. When closed laps are produced, both underlaps will be on one side of the previous overlap head, causing it to incline towards that direction. Even a progressive open lap will not produce a balanced loop structure, because the underlap entering the overlap head from below will not balance the effect of the underlap on the opposite side as it leaves for the course above.

Single guide bar fabrics are thus very unstable structures. This is one of the reasons why most warp knitted structures are produced from two or more sets of warp threads. Often the guide bars supply yarn to each needle but lap in opposite directions, so that the tensions of their underlaps tend to balance each other.

5.21 Knitting notations

A *knitting notation* is a simple, easily-understood, symbolic representation of a knitting repeat sequence and its resultant fabric structure that eliminates the need for time-consuming and possibly confusing sketches and written descriptions. Figure 5.8 gives the symbols used in the two types of notation system. A method universally recognised for warp knitting lapping diagrams and which is also popular for weft knitting running thread path notations requires the use of point paper.

Each point represents a needle in plan view from above and, after the thread path has been drawn, it also represents its stitch.

Each horizontal row of points thus represents adjacent needles during the same knitting cycle and the course produced by them.

The lowest row of points represents the starting course in knitting but it must be understood that, when analysing structures, the courses are normally unroved in a reverse order to the knitting sequence.

When knitting with a single set of needles, each vertical column of points represents the same needle at successive knitting cycles or a wale in the resultant structure. For double needle bar knitting, every second row represents the back needle bar and its wales with all needle hooks facing towards the top of the paper to facilitate the drawing of a continuous lapping movement. For weft knitting with two sets of needles, it is assumed that the lower row of points represent needles whose hooks face towards the bottom of the paper and the upper row, needles whose hooks face towards the top of the paper.

A second notation method is that developed by the Leicester School of Textiles

for weft knitting only. In this method squared paper instead of point paper is employed, with each square representing a needle or stitch. An 'X' symbol is placed in a square where a face stitch occurs and an 'O' where there is a reverse stitch.

When notating each stitch, it is necessary to examine the intermeshing direction *at the base of the loop* because the intermeshing at its head determines the direction of the intermeshing of the new loop formed above it.

Computer-aided design systems have their own methods of notation which may involve realistic appearance and the use of colour.