(c) Using Two or More Extra Wefts

(1) Weaving with two argatch threads.

Fig. 192 (a) shows how the two extra wefts are carried round the argatch threads, labelled 1 and 2.

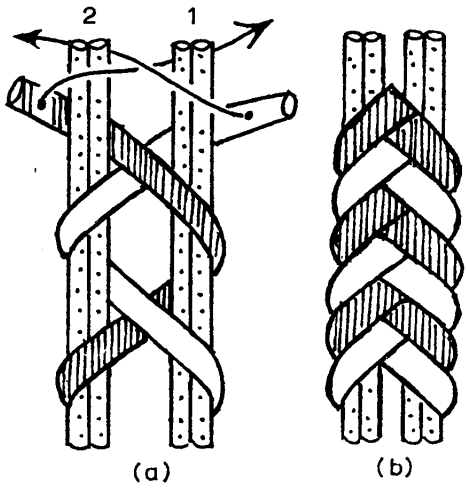


Fig. 192
Argatch. Using two extra wefts pick-and-pick
(a) Method
(b) Appearance

Beginning at the foot of the diagram, carry black over end 2 and under 1, and carry white over 1 and under 2. The normal weft (not shown) then weaves across to the selvage. Then carry white over end 2 and under 1 and black over end 1 and under 2 and follow with the normal weft.

Note that the movement of the two extra wefts always begins from the same side (in this description, from the left). Fig. 192 (b) shows the result which looks like a braid, but is in effect two wefts weaving pick-and-pick with two ends.

(2) Figure-of-eight wrapping.

There are at least two ways in which two colours can be used in this technique. Fig. 193 (a) shows three stages of one type, which are worked as follows.

In Stage 1, wrap black to the left, and white to the right and follow with the plain weave picks.

In Stage 2, wrap white to the left, and black to the right and again follow with the plain weave.

This is the whole sequence, which is then repeated. Note that the colour that moved last in one stage moves first in the next stage. Fig. 193 (b) shows the result, a raised ridge with the two colours appearing across it in oblique stripes.

Another type is seen in Fig. 193 (c) and is worked as follows.

In Stage 1, wrap white to right and to left and follow with plain weave picks.

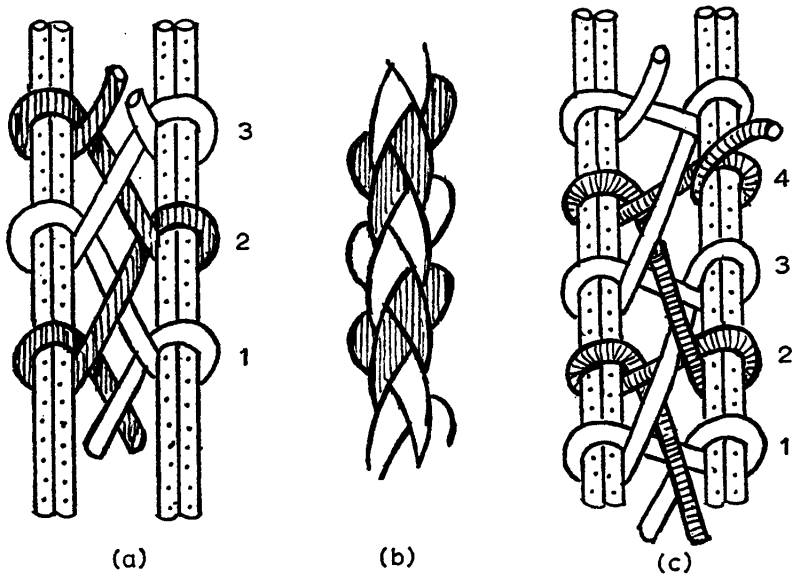


Fig. 193. Argatch. Two-colour figure-of-eight wrapping. (a) Method (b) Appearance (c) Alternative method

In Stage 2, wrap black to left and to right and follow with plain weave.

This is the whole repeat, so Stages 3 and 4 are exactly the same as Stages 1 and 2. It gives a ridge with a slightly more complex structure, with the two colours running vertically down its centre.

(3) Weaving in checks.

Fig. 194 shows a complex argatch with five ends (four of double thickness, one of quadruple thickness). There are two extra wefts (black and white) each weaving on two of the ends and a third yarn wrapping around the very thick outside warp end.

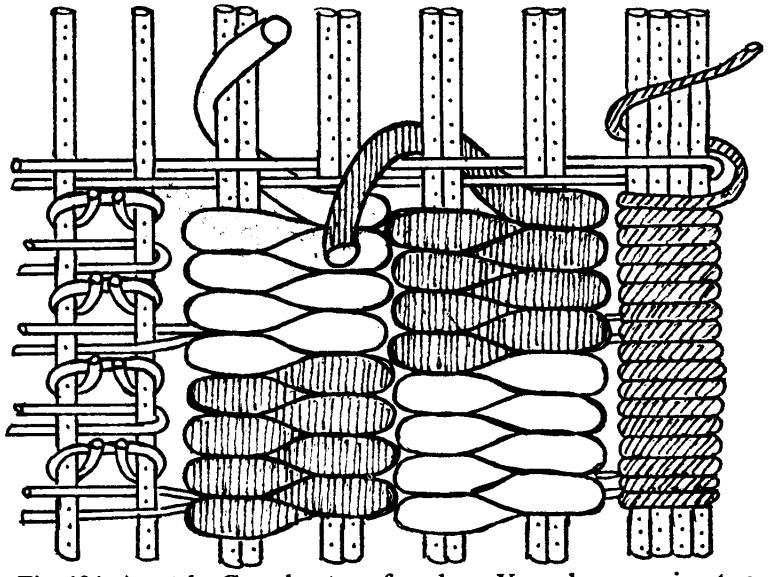


Fig. 194. Argatch. Complex type found on Yomud rugs, using two extra wefts and one wrapping weft

After every eight picks, the black and white wefts switch positions to give a check pattern. The switch is easily accomplished in the following way.

Starting with the stage shown at the top of the diagram, carry the white to the right, weaving with all four threads, then carry the black to the left weaving with the two left-hand threads and the white to the left weaving with the two right-hand threads, and continue weaving normally.

The normal plain weave weft alternately stops short of the argatch and carries right across to the selvage, as indicated at the top of the diagram.

This type of argatch found on Yomud rugs is really a strip of kilim attached to either side of a knotted pile rug, and it illustrates how decoratively an argatch can be treated.

(d) Using an Extra Weft in Kilim Fashion

Fig. 195 shows how the argatch is sometimes treated on a rya. The weaving of the extra weft is only confined to the argatch at the end of each knot row. But between knot rows, the picks reach progressively further inwards until the half-way point between two knot rows is reached, when the picks become progressively shorter again. This gives a pointed projection of the extra weft into the normal weft, as shown in Fig. 195.

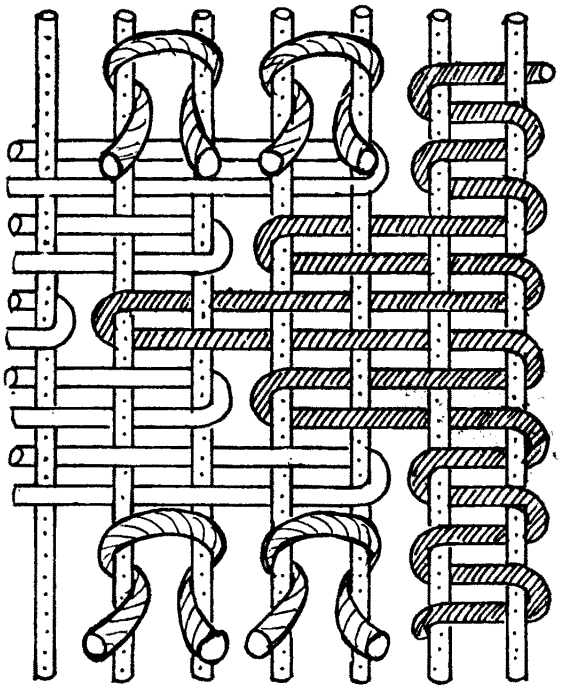


Fig. 195.
Argatch. Using extra weft to weave in kilim fashion

Note—That here, the extra weft is the same thickness as the normal weft, not thicker.

—That the extra weft, where it weaves, completely replaces the normal weft, i.e., there are no picks of normal weft reaching to the selvage, as present in all other methods.

This method is generally used from the point of view of colour. The extra weft can be of a colour that suits the pile of the rug, whereas the normal weft is probably a standard one used for all rugs, no matter what the design or colouring. Or it can be of several colours in sequence to give a variegated edge to a simple pile rug. The edge can, of course, be far more complex, using two or three colours together to build up a composite kilim motif between each row of knots.

C. Double-Sided Pile Rugs

Textiles with a knotted pile on both sides have been produced in Scandinavia for at least two centuries and in the East for far longer. In Sweden and Finland, where the rya was originally a bed-covering, it was obviously done to provide extra warmth. In the East, carpets have been made with a completely different design on the two sides, presumably as a technical tour-de-force. Today rugs with a long pile on both sides are sometimes woven, both for their very luxurious feel and for the two different designs they show.

In the case of the old double-sided ryas, there were fewer rows of pile knots on the back than on the front, and the pile on the back was consequently left longer than at the front. Figs. 196 (a) and (b) show, in cross-section, two of the ways in which the pile knots were arranged on the back and front. Fig. 197 (a) shows such a rug in longitudinal section. In both Figs. 196 (a) and (b), the front pile (white) has been tied on an open shed, using two adjacent raised ends. The back pile (black) has been tied

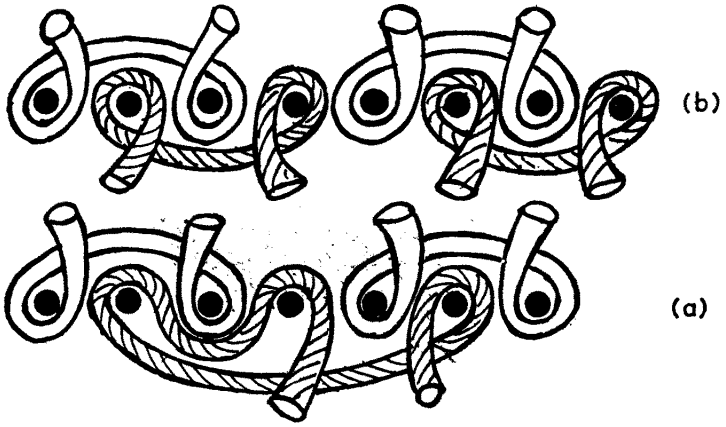


Fig. 196. Double-sided Pile Rugs. (a) and (b) Cross-sections showing two methods of arranging the knots

on the ends missed by the front pile, i.e., on the lowered ends of the same open shed. In Fig. 196 (b), the back pile uses two adjacent ends and in Fig. 196 (a) three adjacent ends. Tying the back pile thus is difficult on a horizontal loom, so presumably these rugs were woven on a vertical frame. The weaver had then only to walk round to the back of the loom to tie the back pile knots. This would only have to be done after every second or third row of front knots.

The method in Fig. 196 (b) is also the one used in Eastern rugs, but in this case there would be a row of back pile knots combined with every row of front pile knots. In this connection, a vertical rug loom pivoted at top and bottom, has been described, so that the weaver stayed stationary and the loom was turned to and fro to present him the two sides of the rug for knotting.

On a horizontal loom it is simpler to weave a double-sided rya by arranging the back and front pile knots in separate rows.

Make a row of knots on the front, using all the warp threads, followed by half the normal amount of plain weave. Then make a row of knots on the back, using all warp threads, again followed by half the normal amount of plain weave.

This can be repeated or the back row of knots could be omitted between the next two rows of front pile. The first of these alternatives is seen in longitudinal section, see Fig. 197 (b).

It is easiest to tie a back pile knot with a cut length of yarn. Fig. 198 (a) shows one method.

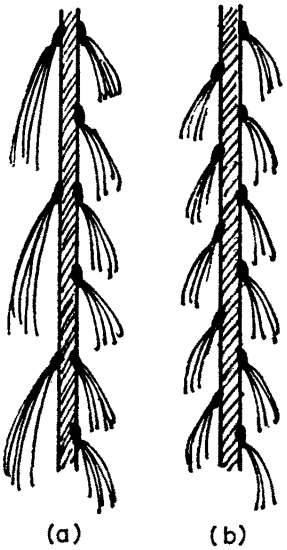


Fig. 197. Double-sided Pile Rugs. (a) and (b) Longitudinal sections showing two methods of arranging rows of knots

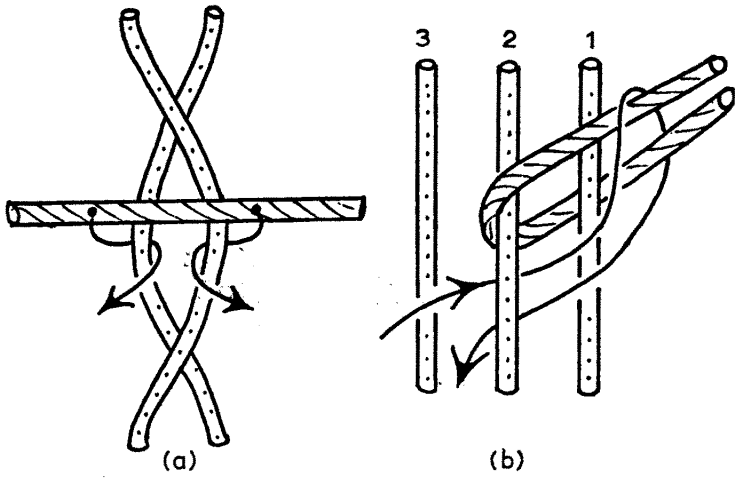


Fig. 198. Double-sided Pile Rugs. (a) and (b) Two methods of tying a Ghiordes knot to show on back of rug

Cross the two warp ends that are to carry the knot. Lay the pile yarn over them and then wrap its two extremities under them as shown by the arrows. Tighten the knot and push the pile through to the back.

Another way is shown in Fig. 198 (b).

Loop the pile yarn around the two warp ends concerned (1 and 2), and hold it towards the right. Put a finger of the left hand down between ends 2 and 3 and up between ends 1 and 2 (top part of arrow). Then catch the pile yarn on this finger and draw it back under end 2 (as bottom part of arrow). Tighten and push the pile through to the back.

Naturally, the pile at the back can only be trimmed when the rug is finished and off the loom.

D. Design

Knotted pile is the rug technique giving the greatest freedom of design. Theoretically, every single knot can be tied with a different coloured yarn. And if the knotting is close enough, i.e., if there is a high knot count, every conceivable shape, line and curve can be produced. But the majority of weavers today favour the long pile rug of the rya type, both for the speed of production and for the opportunities it affords to exploit rich colours and textures. This type has definite design limitations which increase with the length of the pile and consequent distance between knot rows.

(i) DESIGN LIMITATIONS IN RYAS

One of the limitations is illustrated in Fig. 199, where (a) shows two lines at different angles on the paper design and (b) shows how they will appear on the rug. The dotted lines indicated the spacing of the knot rows. It will be seen at once that the nearly vertical line can be fairly faithfully reproduced; its yarn is shifted one or two knots to the right in each successive row. But the nearly horizontal line is distorted into a series of steps.

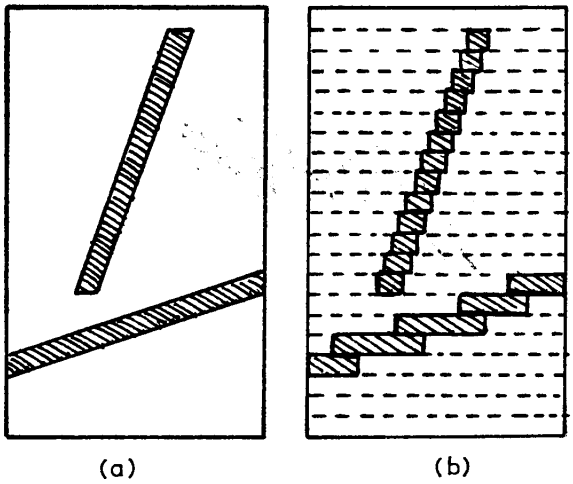


Fig. 199
(a) Two lines as designed
(b) The same two lines as they appear on a rya rug with widely spaced knot rows

So if a rya with really long pile is being woven, avoid lines and curves that approach the horizontal. Conversely if a design with lines and curves that approach the horizontal has to be knotted, make it a short-pile rug with a small distance between knot rows.

The difficulty is due to the fact that in a rya there are more knots in the weft than in the warp direction. Take, for instance, a rug with a warp set at 6 e.p.i. This will give three knots per inch in the weft direction. But such a rug could easily have an inch between each row of knots and therefore only one knot per inch in the warp direction. The difficulty does not arise if the knots are evenly spread over the rug, i.e., as many per inch in the warp and weft directions. In this case, the two lines in Fig. 199, could be produced with equal accuracy.

Another design limitation in ryas is more obvious and concerns size of motif. Due to its length, the pile lies in a haphazard manner on the finished rug. So any carefully knotted motif which is too small in scale becomes lost, e.g., several vertical stripes of different colour, each being only two knots wide, will probably read as a blur instead of as distinct lines. But if knotted on a short pile rug, they will appear as definite stripes.

(ii) COLOUR BLENDING IN RYAS

From the point of view of colour, the rya has one great advantage. Because many threads (e.g., four to twelve) go into each knot, and because each thread could be of a different colour, there is a great opportunity for blending. This can lead to a very rich effect if several colours of the same tone are used together in a knot. It also means that the passage from one colour to another can be so gradual that no hard boundary can be seen between them. This is more true of a colour change across the rug, i.e., in the weft direction, due to the higher number of knots in this direction, than in the warp direction, It is colour changes across the rug which are now considered.

Take, for instance, the extreme case of moving from black to white and assume that knots consisting of six threads are being tied. Knots with five intermediate mixtures of black and white can be placed between the knots of solid black and of solid white, thus giving seven possible colours for the knots, labelled A to G below.

6 Black	A
5 Black, 1 White	B
4 Black, 2 White	C
3 Black, 3 White	D
2 Black, 4 White	E
1 Black, 5 White	F
6 White	G

The transition can be sudden if only one knot of each mixture is tied, or gradual if

many knots are tied. It can be made still more gradual by elaborating the sequence of the mixtures, as below.

A,B,A,B,C,B,C,D,C,D,E,D,E,F,E,F,G,F,G

With two colours not as disparate as black and white, fewer intermediate mixtures need be used. With two close colours (Y and Z) no mixtures are necessary, for by switching two knots at the colour boundary, the latter can be successfully blurred. So instead of knotting in the sequence, Y,Y,Y,Z,Z,Z, use the sequence Y,Y,Z,Y,Z,Z. The haphazard way in which the pile lies naturally helps in blurring such colour boundaries.

The pile of a flossa rug usually contains only one or two threads per knot and these are often both of the same colour. So if a gradual passage from one colour to another is wanted, it can only be achieved by dyeing the intermediate colours.

From the foregoing remarks it will be understood that a long pile rug lends itself to large-scale motifs, rich colour mixtures and indefinite boundaries, whereas a short pile rug is more suited to clear cut (and, if desired, small) motifs and solid unmixed colours.

(iii) RELATING THE PAPER DESIGN TO THE KNOTTED RUG

There are two main ways of relating the paper design to the knotted rug.

(*a*) *Using a Knot Diagram*

In this method it is assumed that the knot rows occur at very exact intervals and a diagram indicating the colour for every knot is made from the original design. The weaver then reads the colour for each knot directly from the diagram.

If the rug has as many knots in the warp as in the weft direction, then the knots will appear as squares on the diagram. If there are more in the weft than the warp direction, they will appear as oblongs. Fig. 200 (a) shows the diagram for a rug with four knots per inch in each direction. Each square is coloured or marked with a number indicating a colour. Fig. 200 (b) shows the diagram for a rug with three knots per inch in the weft direction and one per inch in the warp direction. Each oblong is marked with a number which corresponds to a mixture of colours, as indicated by a key placed somewhere on the diagram.

In this method the weaver becomes a mere technician whose only virtue is the accuracy with which he follows the knot diagram.

(*b*) *Using a Coloured Sketch*

In the second method, a coloured sketch of the rug is made to perhaps half, or quarter, scale. This is mounted on a board as shown in Fig. 201 between two scales in inches. A

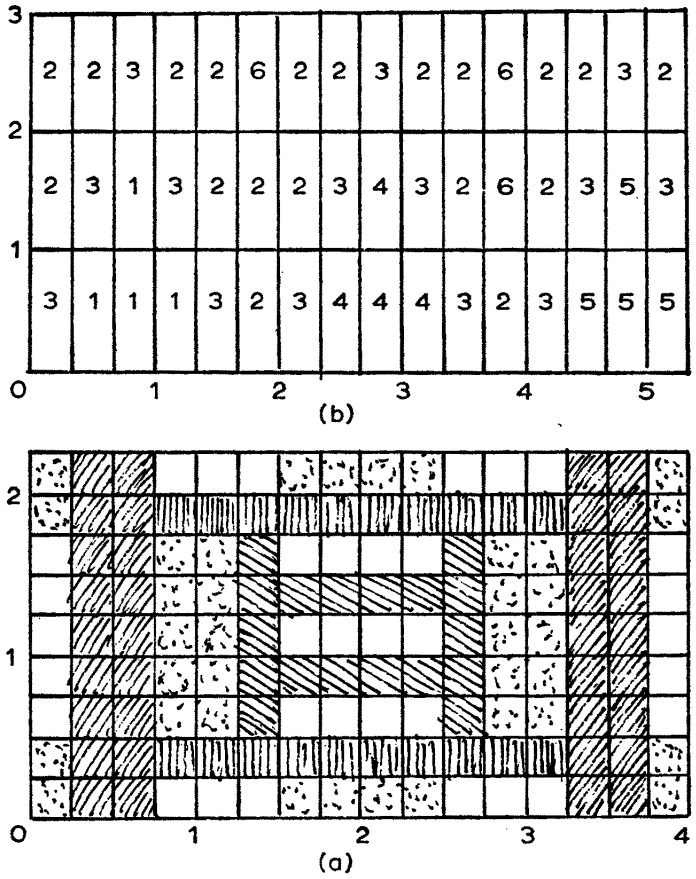


Fig. 200. Knot Diagrams. (a) For rug with equal number of knots in warp and weft direction (b) For rug with three times as many knots in weft than warp direction

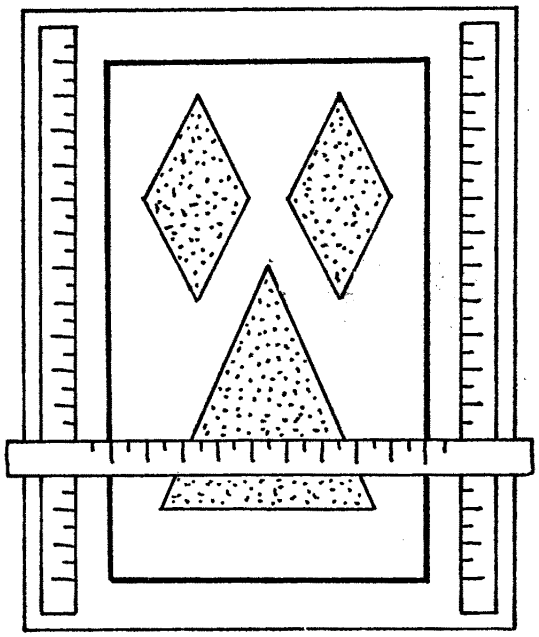


Fig. 201
Method of knotting rug direct from coloured sketch

strip of card is cut which also bears a scale in inches, corresponding to the width of the rug, i.e., from 0 to 36 inches for a yard-wide rug. This strip is fastened in some way across the board, so that it can be moved up and down.

Before each row of knots is tied, the length of rug so far woven is measured. Say this is 10½ inches, then the horizontal strip is moved up until its top edge is level with the 10½ inch mark on the two vertical scales. Then how far each colour area extends can easily be read from this strip and the knots tied accordingly.

For example if the colour for the central triangle in Fig. 201 is seen to extend from 16 inches to 24 inches, then knots of the triangle's colour are tied from a point 16 inches from the right selvage, to a point 24 inches from this selvage, taking these measurements from a tape lying at the fell of the rug or fixed to the batten.

A simpler way is to draw a grid of inches directly onto the sketch, but this spoils the sketch and makes it difficult to use the same design for a rug of similar proportions but different size. In the method described above, this could easily be accomplished by changing the scales.

In both these methods, the weaver has to decide how to translate the colours on the sketch into knots of dyed wool. This involves considerable thought and skill in blending the available wools to produce the desired result. Usually with Finnish ryas, the designer and weaver are two separate people, but they work in close collaboration, as an unsympathetic or unskilled weaver could spoil an excellent design. The knots are tied from wool previously cut to the correct length, and the component threads for each knot are selected from a tray.

(*c*) *Some Eastern Methods*

Several methods of following a pattern are used in the weaving of Eastern rugs. These consist of following a knot diagram, copying a sample specially woven by a master weaver and copying an old rug. An interesting and now almost extinct method is the singing of the pattern. This was done by a *ma'allem*, or carpet conductor, who intoned the colours of each knot in a row, beginning at one selvage and working all the way across to the other. He was sometimes blind, but in any case had an excellent memory and might hold over a hundred designs in his head. The intoning of each row was done without a break, so there was no time to correct a mistake. Any mistake had to be adjusted as well as possible in the succeeding row.

(*d*) *General Points*

(1) After each row has been knotted and before the ground weave is added, stand back and make sure nothing needs altering. A knot can be removed from a completed rug and another of different colour substituted (using a large needle threaded with the yarn) but it is much easier during the weaving.

(2) If a rug is considered in longitudinal section, it will be seen that the pile in each row lies at an angle, see Fig. 202. This is because it is pushed forward where it overlaps the pile in the preceding row. The thickness of the rug at any point is also due to this overlapping of succeeding rows. But the first knot row in a rug (arrowed in Fig. 202) has nothing to overlap, so its pile tends to lie very flat and the rug is thinner at this point. To overcome this admittedly minor failing, some weavers increase the number of threads in each knot of the first row, as indicated in Fig. 202.

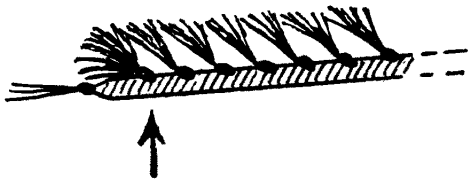


Fig. 202. Increasing amount of yarn in first row of knots

(3) It is sometimes helpful to have an odd number of ends in the warp. Then according to the requirements of the design, the knots of one row can either be on the same pair of warp ends as the preceding row or they can shift along one end to right or to left. The latter arrangement allows a very fine movement of a motif line in a nearly vertical direction.

E. Variations in Knotted Pile Rugs

So far, rugs with an all-over knotted pile have been dealt with, but there are other types.

(i) COMBINING FLAT-WOVEN WITH KNOTTED PILE AREAS

This is a well-established way of making rugs especially in Scandinavia. It is called half-flossa when a short pile is used, and half-rya when a long pile is used. The rug is formed by areas of knotted pile and pileless areas where the ground weave constitutes the surface. So the knotted areas stand out in relief against the flat ground weave areas. Such a rug is often made in one colour only, relying on the contrasts of level and texture, and the shapes of the knotted areas, to give sufficient interest. So the pile yarn and the ground weave yarn are often of the same colour.

If the knots are tied on every available warp end in the areas concerned, the ground weave has to take a compensatory zigzag course to make up for the thickness of the knots absent from the intermediate areas, see Fig. 203. But if the knots are tied on the raised ends of an open shed, this is not necessary and the ground weft can be thrown from selvage to selvage in the normal way.

When designing such a rug, especially if it is to be long, consider what is going to happen on the cloth beam. For instance, a rug consisting of wide warpway stripes of

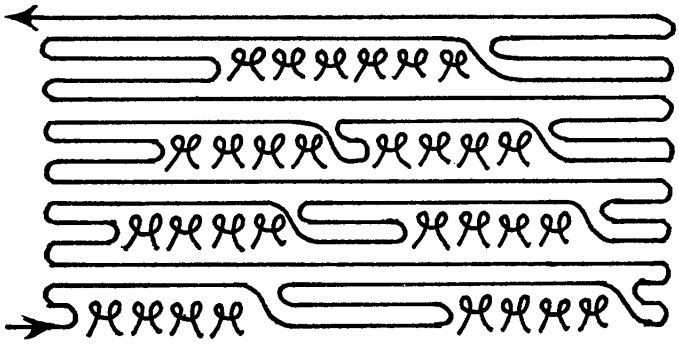


Fig. 203
Course of weft when weaving knotted areas on plain weave background

knotted pile and ground weave will build up very unevenly on the beam, see Fig. 204. Unless rags or paper are wound in to pad out the ground weave stripes, the warp tension will become impossibly uneven. But if the stripes are at an angle or the design is in checks, this problem will not arise.

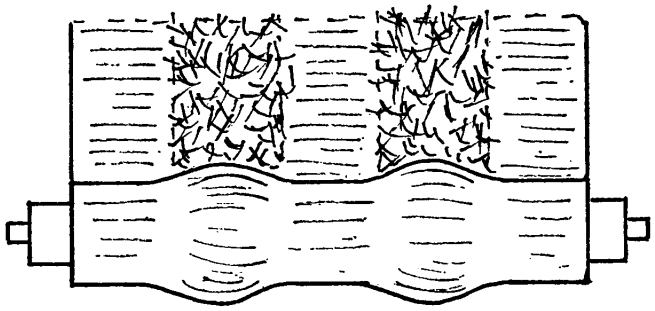


Fig. 204
Build-up of rug on cloth beam if weaving warpway stripes of pile

(ii) COMBINING CUT AND UNCUT PILE

If Ghiordes knots are made continuously over a guide rod, as in Fig. 172, or if Sehna loops are made, there is the opportunity of cutting some loops to form cut pile and leaving others as loops. This can be done in such a way as to form a definite design, which like the preceding method, will be on two levels. If carried out in only one colour, there will not only be a contrast in texture between cut and uncut areas but also of depth of colour. The cut areas will appear much darker than the uncut.

(iii) UNCUT GHIORDES KNOTS PRODUCING A RIDGE

The Ghiordes knots can be tied continuously but without using a gauge. The loop connecting one knot with the next knot is pulled tight, so the yarn lies as in Fig. 205 (a).

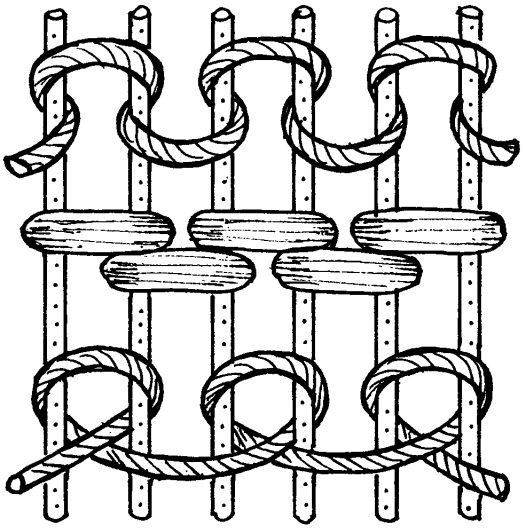


Fig. 205
Uncut Ghiordes knots forming a ridge.
(a) General view
(b) View from above
(c) Alternative method

When beaten down, this looks as in Fig. 205 (b). It gives a good, tight ridge which can be used in any of the ways described under Soumak and Weft Chaining. By the way in which successive rows are worked it can give various brick patterns. It can also be made as shown in Fig. 205 (c).

Note—That as Fig. 205 (a) shows, the uncut Ghiordes knot is structurally identical with a row of 2/1 soumak in which the locking and non-locking type has been used alternately.

—That this wrapping method is used in the Wrapped Edge, see Chapter 14.

(iv) UNCUT GHIORDES KNOTS LYING VERTICALLY OR AT AN ANGLE OR AS A BRAID

These methods have been pioneered by Mary Allard, to whose book the reader is referred, see Bibliography.

7 · Weft-face Rugs in Multishaft Weaves

PART ONE: TECHNIQUES GIVING ALL-OVER EFFECTS

INTRODUCTION

All the techniques described so far have been based on the simplest warp/weft interlacement, i.e., plain weave. They have resulted from manipulating the weft in some way, or from using many wefts, or from adding surface textures.

The techniques that follow are still weft-face but the warp/weft interlacements are more complex, needing 3–8 shafts. With the exception of the pick-up weaves, the weft is thrown without any interruption from selvage to selvage. This increases the speed of weaving but brings with it more limitations of design than exist with the earlier techniques.

These techniques have been divided into three parts.

PART 1—Techniques giving all-over effects, i.e., designs or textures which run from selvage to selvage. This group consists chiefly of twills, but also consists of double-faced weaves and texture weaves.
PART 2—Techniques giving block designs, controlled by shafts.
PART 3—Techniques giving block designs, controlled by pick-up methods.

Any classification tends to create hard boundaries where in fact none exist and the above is no exception. Mention will always be made where techniques are interrelated.

EXPLANATION OF WEAVE DIAGRAMS

For most weaves the details will be given in diagrammatic form according to the following convention, see Fig. 206.

(1) The threading draft, at the top. Starting at the right, the first warp end goes in a heald on the fourth shaft, the second end goes in a heald on the third shaft, the third end goes in a heald on the second shaft, the fourth end goes in a heald on the first shaft, the fifth end goes in a heald on the fourth shaft, and so on.

(2) Weave plan, below the threading draft. Each horizontal line represents one

pick. These are numbered on the left in the order of weaving, that is pick No. 1 is at the bottom. A filled-in or shaded square means that at this point warp crosses weft. Starting with the first pick, at the bottom of the weave plan, the weft is seen to pass over ends threaded on shafts 3 and 4 and under ends on shafts 1 and 2. The second pick passes over ends on shafts 4 and 1 and under ends on shafts 2 and 3, etc. The weave plan will normally show only one repeat of the pattern.

Note—That with a weft-face weave, a filled-in square does not mean that at this point the warp is *visible*. The weave plan is purely a diagram of the warp/weft interlacements and gives little idea of the appearance of the rug.

(3) Lifts, at the right of the weave plan. To the right of each pick is indicated the shafts that have to be lifted to obtain that pick. So for the first pick, shafts 1 and 2 have to be lifted, for the second, shafts 2 and 3, and so on. As weavers may be trying these techniques on table looms, jack looms, counterbalanced looms, countermarch looms and even dobby looms, this method has been chosen rather than tie-up diagrams or pegging plans, which would vary with the type of loom. Sometimes a colour sequence is indicated. In Fig. 206, the first pick is of colour A, the second pick of colour B, the third of A, the fourth of B.

Because there is little relationship between the weave plan and the actual appearance of the rug, in some cases an actual thread interlacement diagram will also be given.

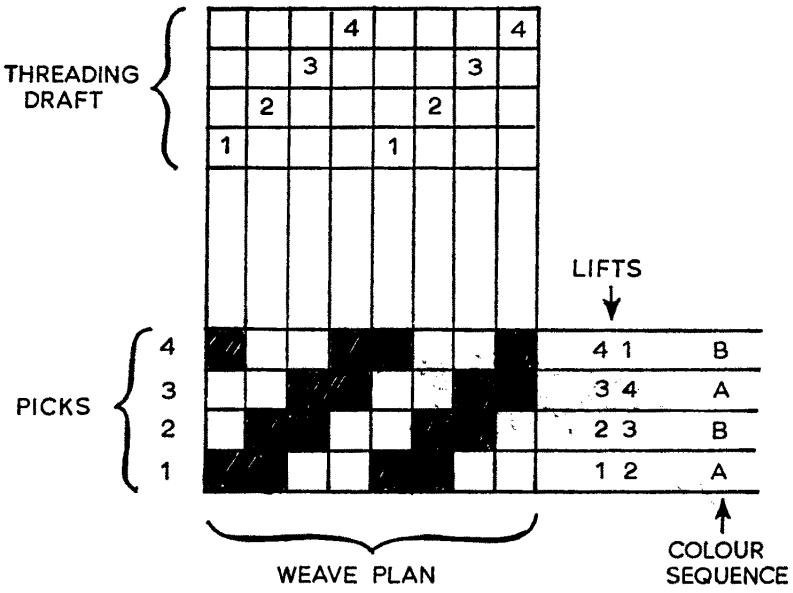


Fig. 206. Explanation of Weave Diagrams

This will show, at the top, an expanded view and, when considered necessary, at the bottom the appearance when the weft is beaten. For the sake of simplicity, these will be referred to as the expanded and beaten view.

In the text, a threading draft will be written thus (1,2,3,4), a lifting sequence will be written thus (12,23,34,41) and a colour sequence will be written thus (A,B,A,B). In each case the brackets enclose one repeat.

NOTE ON THE NOMENCLATURE OF TWILLS

Twills are referred to numerically in the following manner, e.g., 2/1, 1/2, 2/2, 3/1. Of the two figures separated by the stroke, the first refers to the number of ends each weft pick passes under in one repeat of the twill, and the second to the number of ends it passes over. In an even twill, these two numbers are the same, e.g., 2/2, and both faces of the fabric show warp and weft to an equal degree. In an uneven twill, these two numbers are different, e.g., 3/1, and one face of the fabric will show warp floats, the other weft floats.

This system can perhaps be most easily understood if the stroke between figures is made into a horizontal line, thus $\frac{2}{1}$, $\frac{1}{2}$, $\frac{3}{1}$. Then the line represents the weft pick and the figures represent the number of warp ends it passes over and under. This makes clear the fact that if a 2/1 twill is turned over, the reverse face is a 1/2 twill. In more complex twills, such as are produced on six and eight shafts, there may be more than two figures involved, e.g., 3/1/1/1, or 4/2/1/1.

Note that adding the figures together gives the total ends in the repeat, and therefore the total picks, as all regular twills have an equal number of ends and picks in a repeat. In other words their weave plan is always a square. This in turn gives a number of shafts necessary for the weaving. Thus a 2/1 twill needs three shafts, a 2/2/1/1 twill needs six shafts.

In museum usage, the stroke between the figures is angled according to the direction of the twill, i.e., ⁄ or \ (or ∧ if a warp herringbone), but this refinement will not prove necessary in this book.

1. THREE-SHAFT DRAFTS

HISTORY

It is thought that the wool-weavers in Syria at some time before A.D. 250 were the first in our half of the world to add an extra shaft to the two-shaft horizontal loom and thus make possible the simplest twill weave. The fewer warp/weft interlacements enabled them to weave a weft-face fabric with simple selvage-to-selvage shuttle throwing, whereas with plain weave the weft tension has to be very carefully adjusted to produce such a fabric.

This technique was soon developed into a pointed draft on three shafts, which enabled a simple type of double-faced cloth to be woven, the two sides of which showed

different colours. At the same time, the loom had some harness of the draw loom type added, for by the fourth century A.D., repeating patterns in two colours, using this double-faced weave, were being produced.

This interlacement, see Fig. 214, was used to make a weft-face fabric, but if the weave is turned through a right angle it gives the interlacement of a reversible warp-face weave. The latter is found in silk textiles from the Han Dynasty (205 B.C.–A.D. 220) and is seen in a simpler form in a textile from the Shang-Yin Dynasty (1500–1000 B.C.). So it is probable that the Syrian weavers were adapting to their traditional materials a silk weave imported from China.

The earliest find of a three-shaft twill in northern Europe dates from the seventh century and comes from Sweden. In ancient Peru, three-shaft twills were used in a characteristically ingenious way, producing a motif in 1/2 twill on a ground of 2/1 twill, (i.e., the weft yarn preponderated in the motif and the warp yarn in the background). True Kashmir shawls are tapestry-woven using a three-shaft twill.

A. Twills and Other Weaves Using a Straight Three-Shaft Draft

The simplest three-shaft twill is obtained with a straight draft, i.e., threaded (1,2,3), repeat, and by lifting the shafts singly in sequence, i.e., (1,2,3), repeat. The resulting twill is of necessity unbalanced, on the face of the fabric the weft floats over two ends and under one, giving a 1/2 twill, and on the reverse the warp floats over two picks and under one, giving a 2/1 twill, see Fig. 207 (a). So as normally woven, one side always

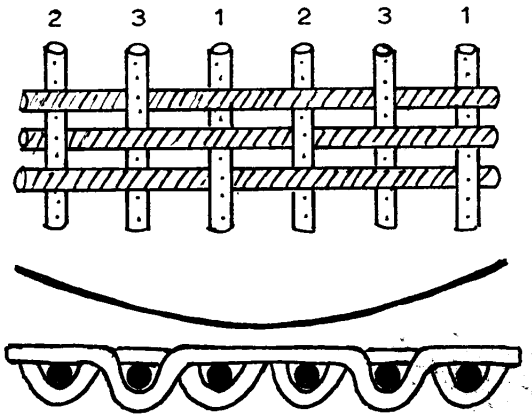


Fig. 207
1/2 Twill.
(a) Expanded view
(b) Cross-section

shows a predominance of weft and the reverse a predominance of warp. When beaten down to give a weft-face weave, the face shows weft floats passing over two ends and the reverse weft floats passing over one end, as shown in the cross-section in Fig. 207 (b). Due to the unopposed pull of the floats over two ends, this weave will have a

strong tendency to curl up as indicated by the line above Fig. 207 (b). In fact the weave is impractical for that reason except when used for narrow stripes.

But if it is woven so that a pick with floats on the face alternates with a pick with floats on the reverse, the result will be both stable and more solid. There are several varieties of this weave.

(i) DOUBLE-FACED 2/1 TWILL

This first weave is a simple pick-and-pick combination of a 2/1 and a 1/2 twill. Fig. 208 shows both the conventional diagram and an expanded interlacement view. From

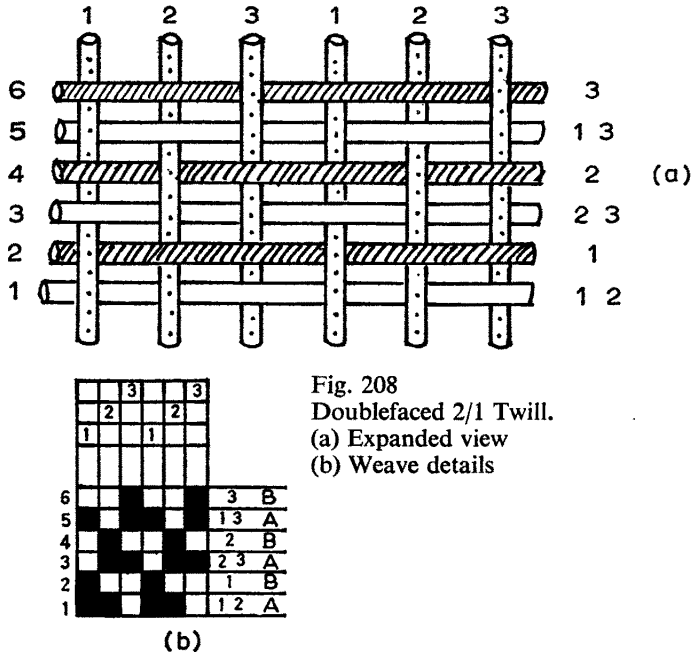


Fig. 208
Doublefaced 2/1 Twill.
(a) Expanded view
(b) Weave details

the latter it will be seen that picks 1, 3 and 5 float under two ends on the reverse of the rug and that picks 2, 4 and 6 float over two ends on the face.

It will be noticed that when beaten, the second pick will slide down in front of the first pick completely obscuring it; similarly the fourth pick will obscure the third, and the sixth obscure the fifth. So the face of the rug will be made up of the shaded picks (2, 4 and 6) and the reverse will be made up of the unshaded picks (1, 3 and 5). Thus if two wefts are used alternately a rug completely different on the two sides can be woven. Due to the twill order of lifting, both sides will show ridges running up obliquely.

This colour sequence can be simply described as (A,B,A,B), repeat, where A and B indicate any two colours. If the colour sequence were (A,A,B,B), repeat, the result

would be twill lines of colours A and B on both sides of the rug, running up to the left on the face. This can best be understood by considering the even-numbered picks only, i.e., those which form the face of the rug. Their colour sequence will be A,B,A,B, as seen in Fig. 209 at the top. When these are beaten down, the floats of A join up and

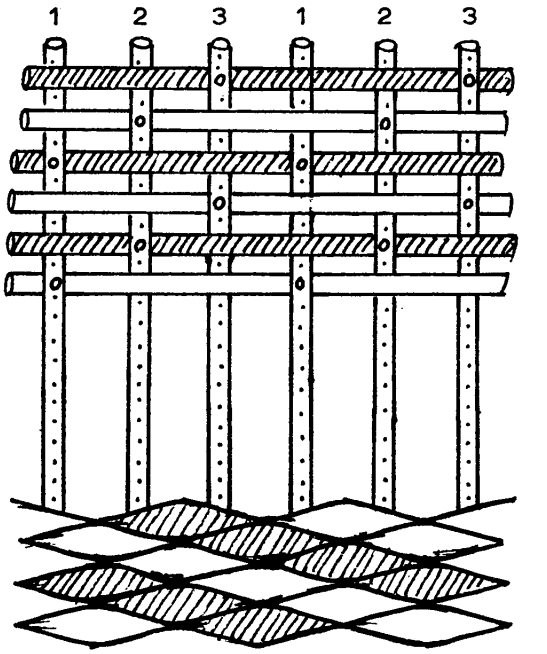


Fig. 209
Double-faced 2/1 Twill. Expanded and beaten view of even-numbered picks only

those of B join up as shown at the bottom of the diagram to give oblique lines of even thickness of the two colours. Naturally exactly the same occurs with the odd-numbered picks forming the reverse of the rug.

A four colour sequence of (A,B,C,D) will give twill lines of colours A and C on one side of the rug, and of B and D on the other. A sequence of (A,B,A,B,B,A,B,A), repeat, gives thin 'beaded' stripes of the two colours on both sides. Many other sequences can be found.

(ii) TWO RELATED DOUBLE-FACED WEAVES

These two weaves use four of the six lifts needed for the above weaves. Details of the first weave are seen in Fig. 210. The colour sequence is shown at the side, (A,A,B,B), repeat. This again gives a double-faced rug, colour B on the face, colour A on the reverse, but here the surface texture resembles hopsack not twill. Also spots of colour A show through on the face, and spots of colour B show through on the back. This weave is very like one of the double weaves used on Navajo saddle blankets.

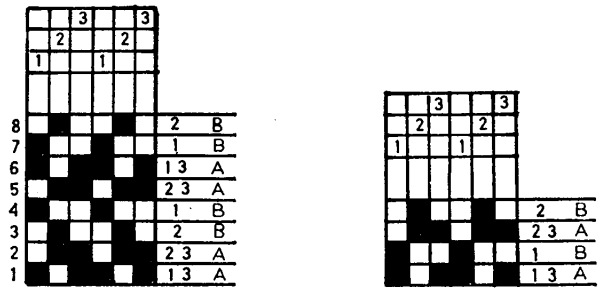


Fig. 210, 211. Weave Diagrams of two Double-faced three-shaft Weaves

The second weave which will recur later in this book is seen in its simplest form in Fig. 211 and in Fig. 212. The sequence of lifts is (13,1,23,2). If the colour sequence is (A,B,A,B), repeat, then a rug with colour B on the face and A on the reverse is produced, as indicated at the top of Fig. 212. The surface has no twill lines but the flatness of the texture is broken by depressions which run in the warp direction. These correspond to the gap between the ends threaded on shafts 1 and 2, so are evenly spaced across the warp. (Indicated by wavy lines in Fig. 212.)

By altering the colour sequence, warpway stripes (very similar to pick-and-pick stripes obtained with plain weave) can be woven, as shown at bottom of Fig. 212. For this the weft responsible for, say, the face of the rug (i.e., even-numbered picks) must be alternately of two colours. So if the colour sequence were (A,B,A,C) there would be

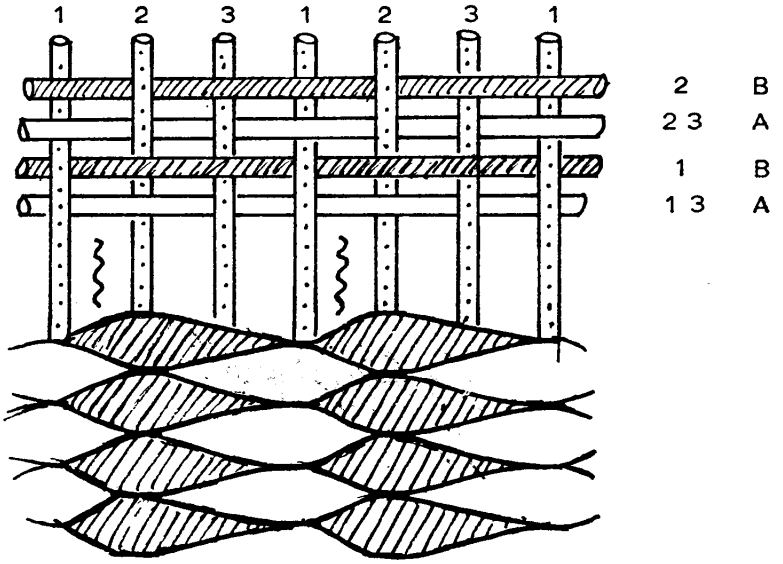


Fig. 212. Expanded and beaten view of weave in Figure 211

stripes of B and C on the face of the rug while the reverse would be of colour A all over. If the sequence were (A,A,B,B), stripes of A and B would show on both sides.

There is a tendency with this weave for the colour from one side of the rug to show through as small spots on the other side, and especially so if, say, one side is black and the other white. With closer colours the spots are hardly visible.

Practical Details for the Above Three Weaves

The three weaves above can be woven with a warp set at 4 working e.p.i. and a weft of 2-ply carpet wool used two or threefold. As with all multishaft weaves, especially when using two or more shuttles in some sequence, it is best to solve selvage problems with a floating selvage. This means that the first and last end of the warp (which will naturally be doubled or trebled to strengthen it) is not drawn through any shaft, but is treated normally in the reed. These ends therefore remain horizontal when the others rise or fall with successive sheds, i.e., they float. Every shuttle enters a shed over the floating selvage and leaves the shed under the floating selvage at the opposite side. Thus every weft is caught round the outermost end on both sides.

With the last weave described, the floating selvage is not necessary, if (a) two shuttles are always used alternately (they can of course be of the same or different colours), (b) the threading is started and ended with ends threaded on the first and second shafts.

If these two conditions are fulfilled, both wefts catch naturally at the selvage.

B. Twills and Other Weaves Using a Pointed Three-Shaft Draft

So far only a straight draft on three shafts has been considered, but there are further possibilities using a pointed draft, i.e., threading thus, (2,1,2,3) repeat, see Fig. 213. It will be seen at once that, unlike the straight draft, this can give plain weave, i.e., by lifting 2 and 13 alternately. As it is always best to start and end a rug with some firm plain weave, this is an advantage; and it is also used in some of the weave structures that follow.

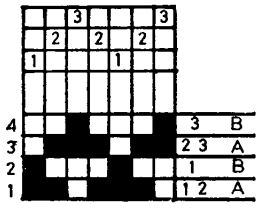


Fig. 213
Weave Diagram of Double-faced Weave based on a weft course of over 3, under 1

(i) DOUBLE-FACED WEAVE BASED ON A WEFT COURSE OF OVER THREE, UNDER ONE

This weave is the one referred to in the historical note. Fig. 213 shows that the shafts are lifted in the sequence (12,1,23,3). This gives odd-numbered picks which float under three ends and over one, and even-numbered picks which float over three ends and under one.

It would therefore seem that the former would appear predominantly on the reverse and the latter predominantly on the face of the rug. But as will be seen from the expanded view in Fig. 214, the second pick when beaten will slide down to obscure the first completely, see cross-section view at bottom of diagram, and the fourth to obscure the third. Therefore the face of the cloth is made up entirely of the even-numbered picks and the reverse entirely of the odd-numbered picks. So with two colours used alternately in the weft, a rug showing one colour on each side can be woven. The surface of such a rug is like plain weave, as shown in the beaten view in Fig. 214, but the weft floats are longer and looser, passing over three ends instead of

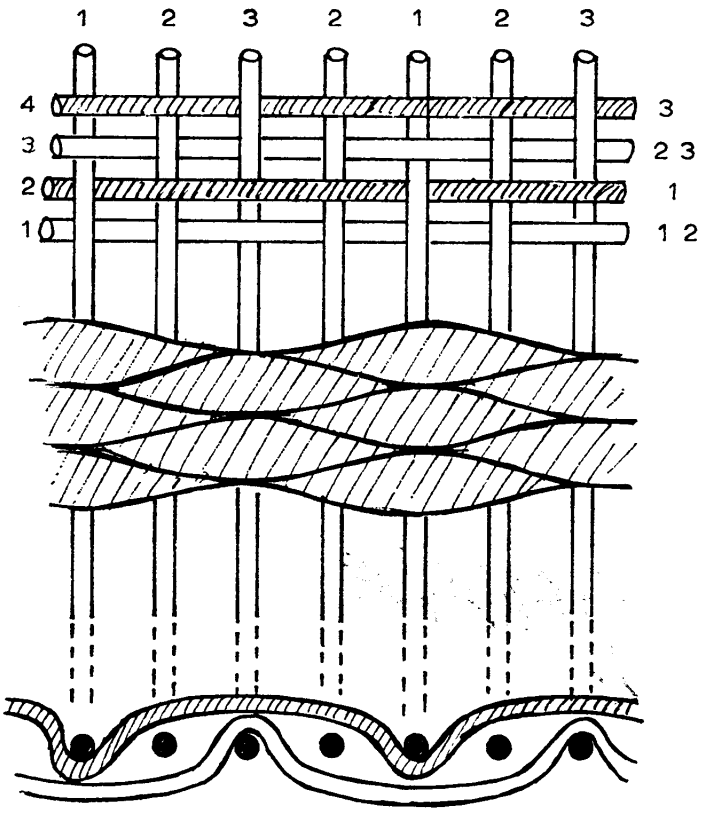


Fig. 214
Expanded, beaten and cross-section view of weave in Fig. 213

one. It will be obvious that with a colour sequence such as (A,B,A,C) or (A,A,B,B) pick-and-pick stripes can be produced on the face of the rug. In fact any of the two-weft patterns described in Chapter 4 can be woven on both sides or one side only.

The structure is not very firm and needs occasional picks of a finer weft in plain weave to strengthen it. So the sequence could be, e.g.,

Lift 12, 1	Thick weft
Lift 2, 13	Thin weft in plain weave
Lift 23, 2	Thick weft
Lift 2, 13	Thin weft in plain weave.

Or there could be just one plain weave pick between each two of the thick picks.

Practical Details

A warp setting of 5 or 6 working e.p.i. is suitable, with a weft of 2-ply carpet wool used three or fourfold for the floats and used singly for the plain weave. The plain weave picks are practically invisible being hidden by the floats. If the threading begins and ends on shaft 3 or on shaft 1, there is no need for a floating selvage (unless a complex shuttle sequence is used). The weave can be produced from many other threadings, including that normally used for Summer and Winter weave.

(ii) DOUBLE-FACED WEAVE BASED ON A WEFT COURSE OF OVER THREE, UNDER ONE, OVER ONE, UNDER ONE

The threading for this second type of double-faced rug is shown in Fig. 215. It can be thought of as a pointed draft on three shafts, though in the chapter on block weaves, it will be found that it is really the foundation of an interesting and useful threading system, that can be extended to any number of shafts. Picks 1 and 2 float over three ends on the face of the rug, and then weave with the next three ends, see Fig. 216; picks 3 and 4 behave similarly and float over three ends on the reverse of the rug and then weave with three ends. When beaten down, the floats almost completely hide the woven parts, so the face of the rug is made up of the floats of picks 1 and 2

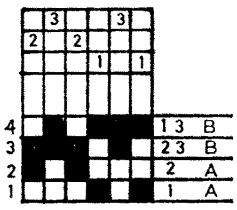


Fig. 215
Weave Diagram of Double-faced Weave based on a weft course of over 3, under 1, over 1, under 1

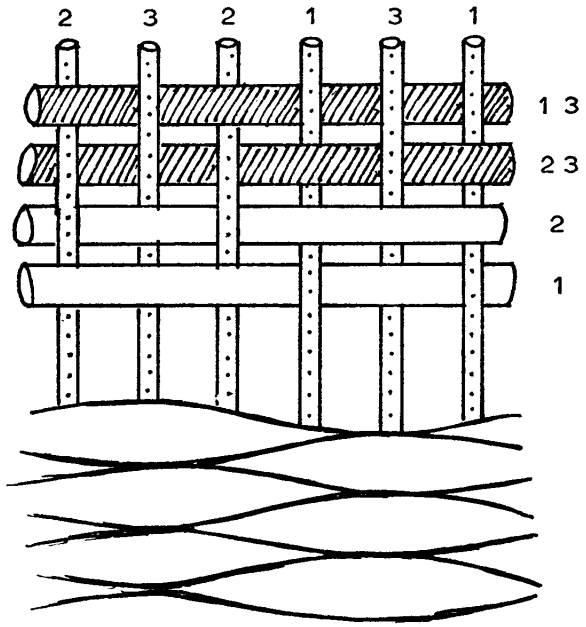


Fig. 216. Expanded and beaten view of weave in Figure 215

and the reverse of those from picks 3 and 4. If therefore the colour sequence is (A,A,B,B) the rug will be colour A on the face and colour B on the reverse.

Note—That no plain weave is necessary.
—That an alternate picking order is 1,4,2,3 with a colour sequence of (A,B,A,B) but this does not beat down so well.

The floats on either side appear in vertical rows and the weave looks very like weft-face plain weave but greatly magnified, see beaten view at bottom of Fig. 216. The interesting thing from the point of view of design is that it also behaves as plain weave in that any of the two-shuttle patterns (pick-and-pick, cross stripes and spots, see Chapter 4) weavable with weft-face plain weave, are also weavable in these floats. For instance, a colour sequence of (A,C,B,B) will give pick-and-pick stripes of colours A and C on the face of the rug and solid colour B on the reverse.

So the face and reverse of the rug can be completely different and each side can either show any of the two-shuttle patterns or just plain colour. This gives a great deal of freedom. Plate 44 shows a sample which is entirely black on the back but has pick-and-pick areas in grey and white (with some cross stripes) on the front. It will be seen that the black shows through the front colours slightly. With closer colours, this effect would be absent.

Note—That this technique allows all the two shuttle designs to be woven on a larger scale. The pick-and-pick stripes here are over ½ inch wide, those woven in plain weave would be ⅓ inch wide at the most.

—No plain weave is possible on the threading, but lifting 23 and 1 gives a two up, one down weave all the way across.

Practical Details

Warp—5 working e.p.i.

Weft—2-ply carpet wool used two or threefold.

Use a floating selvage.

See Chapter 8 for the four-shaft block weave version of this technique.

(iii) THREE-SHAFT KROKBRAGD

A more common use of a pointed three-shaft draft is the Norwegian weave called krokbragd. The shafts are either lifted in the sequence (1, 2, 3), repeat, i.e., a 1/2 twill or (12, 23, 31), repeat, i.e., a 2/1 twill. The resulting fabric with floats on one side and a tight weave like plain weave on the other, is the same in both cases, but with the former sequence the floats appear on the top as woven and with the latter they appear on the back. As it is the tight weave which is really the front of the rug, the second sequence is to be preferred.

With this sequence of lifts endlessly repeating, two or three wefts are used to give patterns of the type shown in Plate 45. The more conventional three colour krokbragd shapes are seen at the bottom and some of the many other possibilities, using only two colours, are seen at the top. As the weave plan in Fig. 217 (a) shows, every third pick is in a plain weave shed, i.e., when 31 is lifted. This has an important effect on the

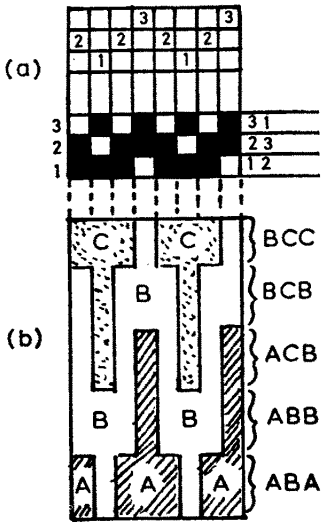


Fig. 217
(a) Weave Diagram of three-shaft Krokbragd
(b) Traditional stripes woven with Krokbragd

stability of the weave and counteracts the tendency of the rug to curl up due to the weft floats on the reverse. The plain weave pick is completely hidden by these floats, but is the most important weft on the face, coming to the surface twice as often as do the other two picks. So it is the cause of the apparently mysterious difference of design on the two sides of a krokbragd rug, see Plate 46 which shows the reverse of the sample in Plate 45. However complex and fussy a design is produced purposely on the face, there is generally something simple produced unconsciously on the reverse. Many of these krokbragd motifs can be produced with a straight draft on four shafts, but in that case they appear on both sides of the rug, see broken 2/2 twill, later in this chapter.

Note—That the design on the back looks superficially as if it is woven in plain weave.

The traditional way of using the technique is to weave interlocking stripes of the type shown in Fig. 217 (b), employing many colours, but never more than three at any one time. Thus starting at the bottom, the colour sequence would be (A,B,A). Then it would change to (A,B,B), then to (A,C,B) always keeping the lifts in the (12, 23, 31) sequence. However it is much better for the weaver to work out the colour sequences for himself at the loom, rather than follow blindly a printed sequence. As each shed is opened it is obvious where the weft in that shed will come to the surface, so simply use the colour which is wanted in that position. Working in this way, the weave will be really understood and many new possibilities will be discovered.

Practical Details

Warp—5 or 6 working e.p.i.
Weft—2-ply carpet wool used twofold.

Use a floating selvage.

The type of all-over, small scale patterning that the technique gives can be effective if confined to stripes separated by solid colour. The threading is a useful one for knotted rugs, as it gives the plain weave wanted between the rows of knots and also the opportunity for weaving a complex starting and finishing border in the krokbragd technique.

Weaving on three shafts presents no problems on most types of loom, the exception being the counterbalanced loom. The simplest but not very satisfactory method is to tie shafts 3 and 4 together and treat them as one shaft. A more complex but mechanically perfect way is shown in *The Technique of Weaving* by John Tovey (see Bibliography). It would be interesting to know how the Syrian weavers overcame this problem nearly 2000 years ago.

2. FOUR-SHAFT DRAFTS

A. Twills and Other Weaves Using a Straight Four-Shaft Draft

(i) WOVEN AS A STRAIGHT 2/2 TWILL

History

The 2/2 twill is probably the most used of all the possible twills. The earliest evidence of this interlacement dates from about 2000 B.C., and is the impression given by a floor mat on the base of a pot, found in the Balkans. The earliest surviving fabric woven in 2/2 twill is thought to be an oval cloak from Gerum, Sweden. There is some doubt over the date which is given as about 1000 B.C. Certainly by the sixth and seventh century B.C., 2/2 twill was beginning to be woven as is shown by the finds in some Swiss graves. In the Iron Age in Europe it was a popular weave for woollen garments.

Colour and Weave Effects with Weft-Face 2/2 Twill

There is an important difference between twills as normally used (with both warp and weft visible) and as used here in a weft-face technique. In the former case, see Fig. 218,

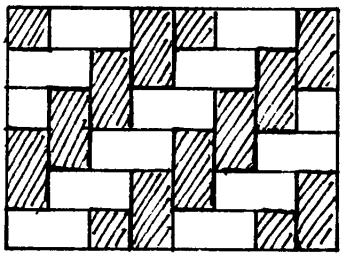


Fig. 218
Production of coloured twill lines in a normal 2/2 twill material

the twill lines are made up alternately of warp floats (shaded) and weft floats (white). Even if both warp and weft are of the same colour, the twill lines still show, though less obviously, due to the different direction in which the two sets of threads lie.

In a weft-face technique, however, the warp is completely hidden, so the twill lines must be produced without its visible aid. If only one weft is used, fine oblique ridges will be seen running across the textile in the direction of the twill. But if two or more colours are used in some special sequence, they can give rise to bold oblique lines running in the opposite direction to that of the twill lines.

This is explained in Fig. 219, where at the top the weft floats of a 2/2 twill are seen in lines running up to the right. Every third pick has been shaded (i.e., numbers 3, 6, 9 and 12). If the weft is beaten down, as at the bottom of the diagram, it will be seen that the shaded weft floats join up to form lines running up to the left. The picks are numbered correspondingly in the expanded and beaten views.

The colour sequence in the above example was (A,A,B), i.e., white, white, shaded. So it repeated every three picks. The sequence of lifts, (12, 23, 34, 41), repeated every four picks. Therefore in each lift sequence, colour B goes in a different shed.

Consider the lift and colour sequence for twelve picks. Thus

12	23	34	41	12	23	34	41	12	23	34	41
A	A	B	A	A	B	A	A	B	A	A	B

It will be seen that the pick with colour B first appears when shafts 3 and 4 are lifted
then when shafts 2 and 3 are lifted
then when shafts 1 and 2 are lifted
then when shafts 4 and 1 are lifted

After that the sequence repeats itself. So the sequence of lifts for colour B is 34, 23, 12, 41. These are the normal 2/2 twill lifts but in the opposite order to that used for the weave above. In other words colour B will appear as an oblique line, but running in the opposite direction to that of the twill it is woven in.

Taking the idea further. If the colour sequence had repeated every four picks (e.g., if it had been A,A,A,B or some such), then colour B would always have coincided with the same lift in the four-pick sequence of lifts. Hence this colour would always appear in the same spot and give not an oblique line but a vertical, warpway line. So to produce a twill colour and weave effect, the colour sequence must repeat on some number of picks other than 4, e.g., on 3, 5, 7, etc. Some of the many possibilities of this interesting technique are now described.

(*a*) *Three-pick Colour Sequences*

Using two colours this can be either (A,A,B) which gives a thin oblique line of colour B and a thick line of colour A, see Fig. 219, or (A,B,B) which gives a thick line of colour B and a thin line of A.

Many effects can be obtained by changing from one sequence to the other. Plate 47 (top) shows a sample using this idea, together with reversing the sequence of lifts to give a horizontal herringbone effect. Such reverses can be made at any point in the weave; but it is perhaps simplest to reverse at the pick of colour B in the A,A,B sequence and at the pick of colour A, in the A,B,B sequence. Thus:

					↓					
12	23	34	41	12	23	12	41	34	23	12
A	A	B	A	A	B	A	A	B	A	A

where the arrow shows the pick at which the lift sequence is reversed. If this is not done, make sure that the colour sequence and the lift sequence both reverse at the same point.

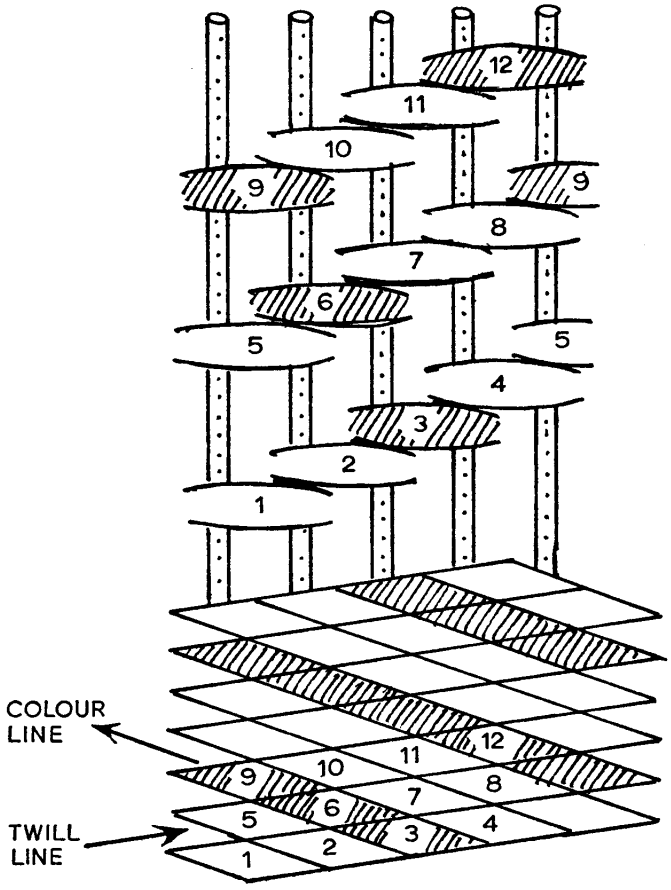


Fig. 219
Production of oblique colour lines in weft-face 2/2 twill

When three colours are used in the sequence (A,B,C), they appear as oblique lines of equal thickness. There are many variations in which the three colour sequence is thrown out by either omitting a colour, i.e., by weaving (A,B,C,A,C,A,B,C) or by adding an extra pick, i.e., by weaving (A,B,C,A,B,B,C,A,B,C) or by altering the colour sequence, i.e., by weaving (A,B,C) for several inches, then (A,C,B), see Plate 47 (bottom).

(b) Four-Pick Colour Sequences

As already explained, in whatever way colours are arranged in a four-pick sequence, they will appear in some sort of warpway stripe, not as oblique lines. These will be described in detail in the next section on broken 2/2 twill.

(*c*) *Five-Pick Colour Sequences*

The more picks in the sequence the more possibilities there are. So with five picks the colour sequence could be (A,B,A,B,A) or (A,B,B,B,A) or (A,B,C,B,A) or (A,A,B,C,C) or (A,B,A,C,A). Plate 48 shows four repeats of the second sequence alternating with one repeat of the first sequence.

(*d*) *Six-Pick Colour Sequences*

Any six-pick colour sequence is just the sum of two three-pick colour sequences and there are many possibilities.

(*e*) *Seven-Pick Colour Sequences*

These include (A,A,B,B,A,A,B) and (A,A,B,A,A,A,B), both of which give a steep jagged twill. Plate 49 shows the second sequence.

(*f*) *Nine-Pick Colour Sequences*

An interesting one is (A,A,B,A,A,B,B,B,B), which gives small diamonds of colour A. Plate 50 shows at the bottom an area of this sequence and, above, a derivative, viz. (A,A,B,A,A,B,B,B,B,A,A,B,A,A,A,A).

(*g*) *Ten-Pick Colour Sequences*

The one illustrated in Plate 51 has a colour sequence of (A,B,B,A,B,A,B,B,A,A).

(*h*) *Twelve-Pick Colour Sequences*

The one in the Plate 52 is (A,B,B,A,A,B,A,A,A,B,B,B) and it can be thought of as all the possible three-pick sequences one after the other. It gives one of the boldest patterns obtainable with 2/2 twill, resembling an area of small tapestry-woven triangles.

Practical Details for 2/2 Twills

2/2 twills can be woven with 3, 4, 5 or even 6 working e.p.i. The first gives an exceedingly thick and solid weave, using 2-ply carpet wool threefold or fourfold as th weft. It is, if anything, too spongy and if a thick but practical rug is wanted a better setting is 4 working e.p.i. The weft will then be 2-ply carpet wool used two or threefold.

For a finer rug 5 working e.p.i. is the best setting, with a weft of 2-ply carpet wool used single or double. This gives a very firm strong weave. Its only disadvantage is that it may have as many as sixty picks to the inch (compared with twenty-five to thirty for the 3 working e.p.i., and thirty to forty for the 4 working e.p.i. settings), so it is very slow to weave.

Always use a floating selvage.

The weft waves need not be so large as those used for plain weave.

(ii) WOVEN AS A BROKEN 2/2 TWILL

A 2/2 broken twill has the same four lifts as a normal 2/2 twill, but the order of the last two is reversed, thus (12, 23, 41, 34). This breaks the twill sequence, so that there are no oblique lines running up the textile. In fact, as Fig. 220 (a) shows, the first two picks begin to form a twill line running up to the right, then the next two picks start a line running up to the left, so they effectively cancel each other out.

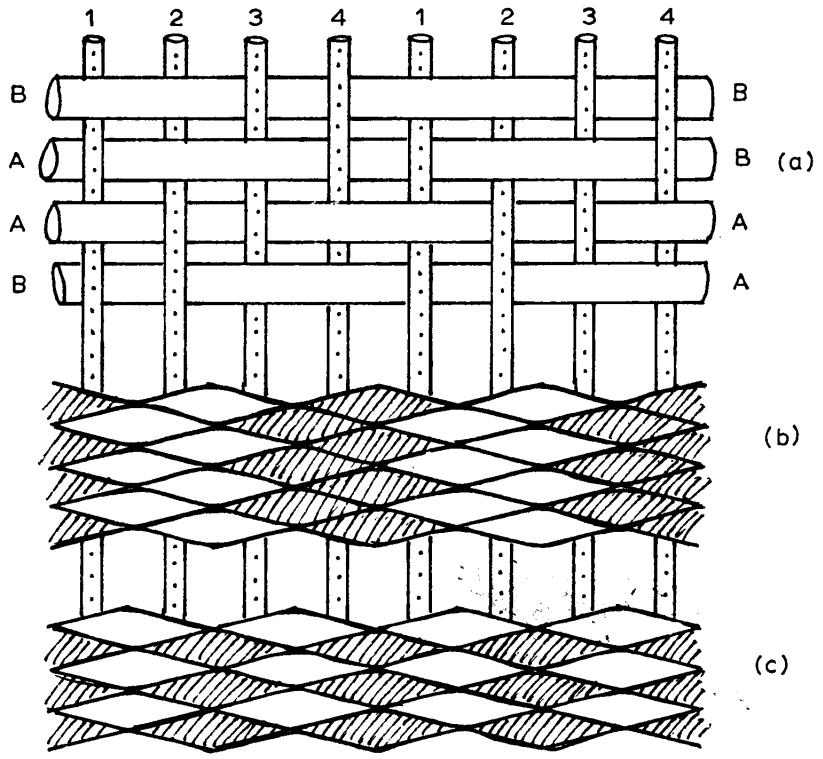


Fig. 220. Broken 2/2 Twill. (a) Expanded view (b) and (c) Beaten views when a colour sequence of (A,A,B,B) is started differently

In a normal 2/2 twill lifting, each end in succession stays up for two picks, but with a broken twill there are two points in the sequence (between lifts 23 and 41, and between lifts 34 and 12) when all the raised ends are lowered and all the lowered ends are raised. These two points of what is really hopsack weave make broken twill a very satisfactory weave for rugs; it is both firmer and better interlaced than a straight 2/2 twill.

Colour and Weave Effects

With the designs described above, it does not matter on which of the four lifts a colour sequence is begun. The result will be identical because of the regularity of the normal 2/2 twill lifts, but with a broken twill the matter is quite different. Consider the colour sequence (A,A,B,B). If this is started with the first lift in the sequence, i.e., 12, as shown at the right side of Fig. 220 (a), then thick lines of colour A and B appear in the rug, see Fig. 220 (b). But if the colour sequence is started on the second lift, i.e., 23, as shown on the left side of Fig. 220 (a), then the result is thin lines of colour A and B, as shown in Fig. 220 (c).

Thick lines will again be produced if the sequence is started on 41, and thin lines, if started on 34.

So with a broken twill the same colour sequence can have two quite different appearances, depending on how it is related to the lift sequence. This does not apply to the colour sequences repeating on an odd number of picks.

(*a*) *Three-Pick Colour Sequences*

(A,B,A) repeated gives a smaller version of (A,B,A,B,A), see (*c*).

(*b*) *Four-Pick Colour Sequences*

The possibilities are (A,A,A,B), (A,A,B,B), (A,B,B,B), (A,B,A,B) and (A,B,B,A). If any of these is repeated a few times it will give a vertical motif of some sort. Fig. 221 shows how these appear when the colour sequence begins on the first lift of the lift sequence. Plate 53 shows how these can be combined in a full-size rug and how a third colour can be introduced.

(*c*) *Five-Pick Colour Sequences*

The interesting design given by the sequence (A,B,A,B,A) is shown in Plate 54.

(*d*) *Seven-Pick Colour Sequences*

Plate 55 shows the sequence (A,A,B,B,A,A,B).

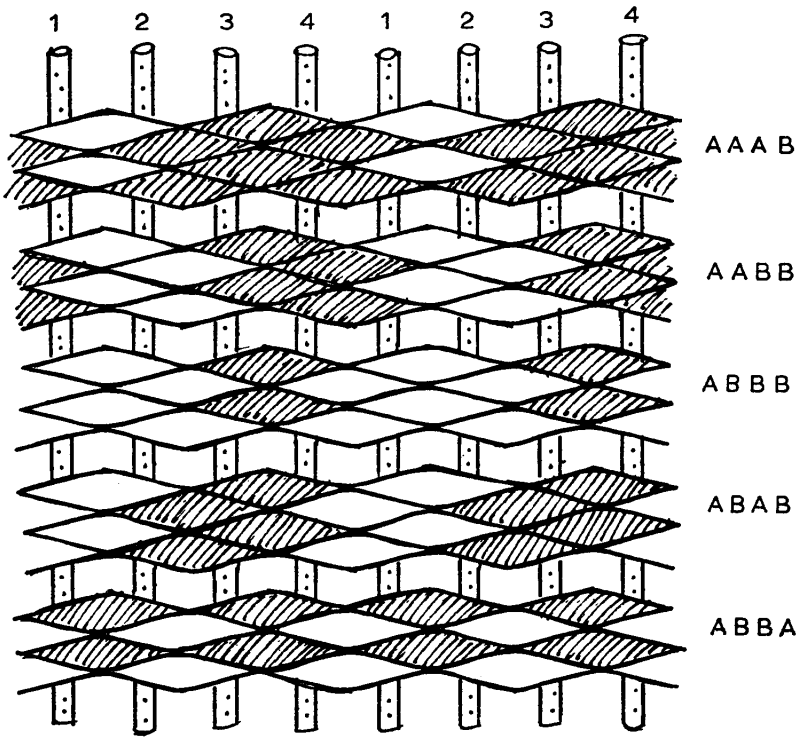


Fig. 221. Broken 2/2 Twill. Beaten view of various four-pick colour sequences

(*e*) *Eight-Pick Colour Sequences*

Combining two of the four-pick sequences viz. (A,A,A,B) and (A,B,B,B) and repeating them gives vertical rows of diamonds in the two colours. See plate 56 which is the result when the colour sequence begins with the first lift. Plate 57 shows the result when it begins on the second lift. The latter has been further varied by alternating (A,A,A,B,A,B,B,B) with (A,A,A,B,B,A,B,B).

(*f*) *Twelve-Pick Colour Sequences*

Jagged vertical stripes are produced when the colour sequence (A,B,B,B,A,A,B,B, A,B,A,B) is started on the first lift of the sequence, see Plate 58. Plate 59 shows the quite different result when the same sequence is started on the second lift. In the top half of the photo the small arrowhead motifs have been made to point to the left instead of to the right, by reversing the colours of the last two picks in the sequence.

Other Possibilities for Both Straight and Broken 2/2 Twill

These colour sequences, for both straight and broken twill, have been given to show the great variety of designs which can be obtained. But they are only the beginning. Many more variations await the enquiring weaver. These can be achieved in a number of ways.

(1) Combining colour sequences, e.g., alternating a four-pick and a seven-pick sequence.

(2) Changing from straight 2/2 twill to broken 2/2 twill and back again, while keeping the colour sequence unchanged.

(3) Reversing the lift and colour sequences at certain points, as in Plate 47. This can lead to much larger motifs and a far more lively design.

(4) Not using a straight threading draft but a pointed draft. The weft float over three ends which is associated with a pointed draft would give a weak spot in the rug so avoid it by skipping a shaft at the point of the draft. Therefore thread as in Fig. 222 (b), not as in Fig. 222 (a). This is a regular pointed draft, the threading reversing every five ends. Fig. 222 (c) shows an irregular pointed draft, the threading reverses coming after eight, six, four and six ends which could give a more varied design.

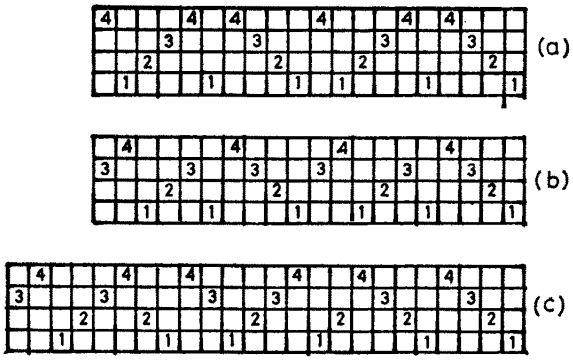


Fig. 222
(a–c) Various pointed drafts for use with weft-face 2/2 twill

(5) Using three or more colours. Colour has not been considered so far, but obviously closer weft colours will convert the blatant designs in the plates into something more subtle and so more interesting. By varying these colours and introducing a third or fourth colour, the range of possibilities is immediately widened.

(6) The most important road to discovery is to design at the loom. As each shed is opened and it is seen where the next pick will come to the surface, choose which colour is wanted in that position and weave accordingly.

Analysis of Straight and Broken 2/2 Twill

It is easy to discover the colour sequence in a weft-face 2/2 twill rug. Find the *woven* twill line and simply record the colours of the successive picks that make up this line, until the sequence begins to repeat itself, see Fig. 223. One twill line has been heavily

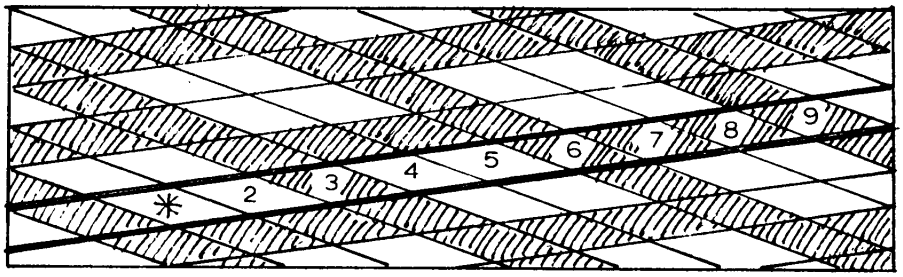
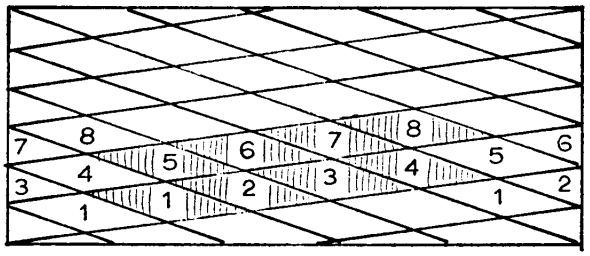


Fig. 223. Analysis of a weft-face **2/2** twill

outlined in this diagram. The colour sequence (beginning with the asterisked pick) is (A,A,B,A,A,B,B,B,B); the sequence then repeats itself. Whichever twill line had been selected and whichever pick had been used as a starting point, the same sequence would be arrived at.

It is far more difficult to analyse a broken twill as the picks do not lie in a straight line. Fig. 224 (a) and (b) show how eight picks in straight and in broken twill respec-



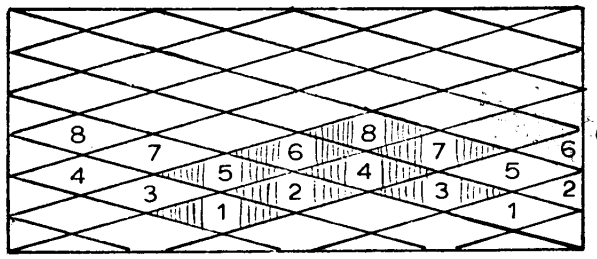


Fig. 224
Contribution made by eight picks to the surface of (a) A 2/2 straight twill and (b) A 2/2 broken twill

tively contribute to the surface of a weft-face rug. On this basis, the theoretically minded can work out on paper how a certain colour sequence will appear when woven.

(iii) 2/2 TWILL 'WOVEN ON OPPOSITES'

A twill 'woven on opposites' is based on the normal sequence of twill lifts. But after every one of these normal lifts, there is interposed its 'opposite'. By the opposite lift is mean that lift which reverses the position of the shafts existing in the normal lift. So the opposite of 12 is 34, the opposite of 23 is 41, the opposite of 34 is 12 and the opposite of 41 is 23.

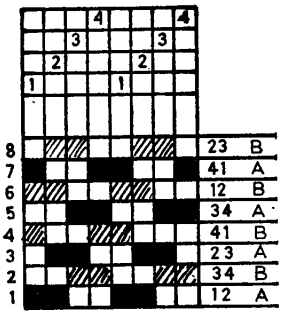


Fig. 225
Weave Diagram of 2/2 twill 'woven on opposites'

Fig. 225 shows the weave in diagrammatic form. The picks resulting from the normal lifts have been shown as solid and the picks resulting from the opposite lifts as shaded, in the weave plan. From this it will be understood that if the colour sequence in the weft is (A,B,A,B) the weave will appear as oblique lines of these two colours. They differ from the lines obtained with a normal twill in two ways,

(a) they run in the same direction as the twill lines,

(b) the lines are of equal width.

Plate 60 shows a sample combining normal twill woven on opposites with the variation below.

Variations

(a) A good zigzag twill line is the result of reversing the colour sequence after each repeat of the lifting sequence, i.e., (A,B,A,B,A,B,A,B; B,A,B.A,B,A,B,A).

(b) Any of the colour sequences described for straight and broken 2/2 twill can be tried.

(c) *Extending the Lifting Sequence*

The lifting sequence can be extended in various ways. For instance, each normal lift and its opposite can be repeated two or three times before moving on to the next lift. Thus: (12,34,12,34; 23,41,23,41; 34,12,34,12; 41,23,41,23). Another way is to lift thus: (12,34,12; 23,41,23; 34,12,34; 41,23,41), i.e., repeat the normal lift but not its opposite. Used with a colour sequence of (A,B,A,B) this gives oblique lines of the two colours of equal thickness, running in the opposite direction to the twill line. The lines are

inclined more steeply than those resulting from normal twill woven on opposites. Warpway stripes with clear cut interesting outlines are produced by using just the first half of the latter sequence and with the same colour sequence, i.e., (12,34,12; 23,41,23), repeat. This is seen in Plate 61 where the colour sequence has been varied to (A,B,A,A,B,A,A,B,A,B,A,B,B,A,B,B,A,B) just once in the centre to give a zigzag.

Twill woven on opposites (which is really the simplest form of a weave known in industry as a weft corkscrew) has a good structure for rugs. The constant alternation of normal and opposite lifts means that warp and weft are well interlaced and there will be little tendency for the weft to slip on the warp.

(iv) WOVEN AS STRAIGHT 2/2 TWILL, BUT USING ONLY THREE LIFTS

An interesting weave results from missing out one of the four lifts in the straight 2/2 twill sequence, thus (12,23,34) repeat.

If this is used with two colours, pick and pick, oblique lines of equal thickness running in the opposite direction to the twill lines are produced, even though this does not look likely from the weave plan, see Fig. 226.

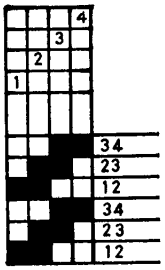


Fig. 226
Weave Diagram of weave omitting one of the 2/2 twill lifts

If the colours are used in the order (A,A,B) repeated several times and then (B,B,A) repeated several times, blocks as in Plate 62 are produced which link together in a pleasant way as shown.

(v) DOUBLE-FACED 3/1 TWILL

All the weaves described above have been constructed from the four lifts of a 2/2 twill arranged in some order, together with special colour sequences in the weft. But there are also the eight lifts of 1/3 twill and 3/1 twill which can be used.

An excellent rug weave, which combines these lifts, gives a double-faced rug with a twill texture on both sides.

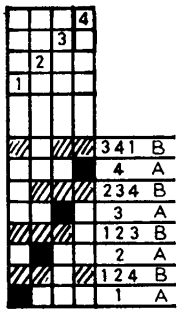


Fig. 227
Double-faced 3/1
Twill. Weave
Diagram

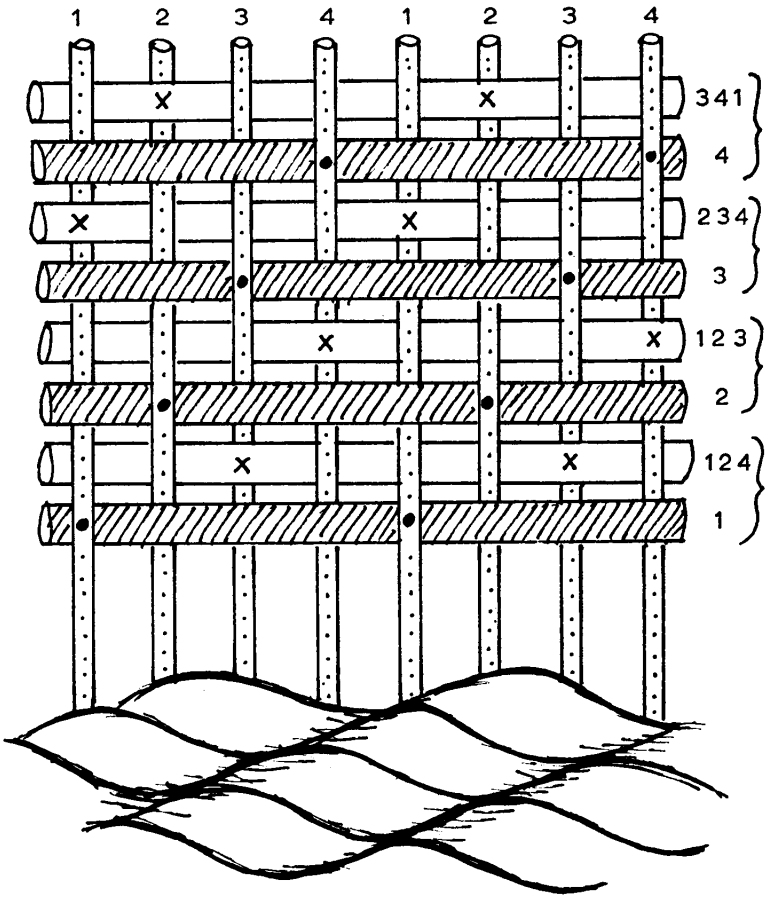


Fig. 228
Double-faced 3/1
Twill. Expanded
and beaten view

It is shown diagrammatically in Fig. 227 and in extended and beaten view in Fig. 228. From these it will be clear that the first pick floats over three ends and under one end (marked with a spot in Fig. 228) and the second pick floats under three ends and over one end (marked with a cross in Fig. 228). After each two picks, bracketed in Fig. 228, the interlacement moves along one end to the right. It will be seen that the second of these two picks will slide down behind the first, in each of the four bracketed pairs. Thus the picks woven when shafts 1, 2, 3 and 4 are raised will form the face of the rug (and it is these which are seen in the beaten view in Fig. 228) and those woven when 124, 123, 234 and 341 are raised will form the reverse of the rug. So with a colour sequence of (A,B,A,B) repeat, the face of the rug would be in colour A, the reverse in colour B.

The weave is the four-shaft version of the weave shown in Fig. 208 in the section on three-shaft twills. It will be met again as a block weave on eight shafts and as a pick-up

weave, see Chapters 8 and 9. It gives the very tough yet flexible structure ideal for a flat rug. Because of the nature of the weave the two sides of the rug can be completely different, perhaps one side striped, the other plain. The pronounced twill ridges, seen in the beaten view in Fig. 228, give a play of light and shade on the surface, absent from a plain weave rug.

The many colour and weave effects obtained with 2/2 twill are not possible with this weave. If, however, the weft forming the front of the rug changes colour every two picks, these two colours will appear as interlocking diamonds.

A simplification of this weave is to use only picks 1, 2, 5 and 6, omitting the other four. This is identical with the weave shown in Fig. 215, obtained with a pointed three-shaft draft.

Practical Details

The aspect of a weft-face rug weave most influencing the choice of warp setting is the size of weft floats it contains. So far most weaves have had floats over only two ends, but here every pick floats over or under three ends. To reduce these to a practical size, it is necessary to have a warp setting of 6 working e.p.i. The floats will therefore be about ½ inch long, i.e., the same length as those in a 2/2 twill set at 4 working e.p.i.

The correct weft thickness is 2-ply carpet wool used threefold.

Use a floating selvage.

(vi) THREE-WEFT DOUBLE-FACED WEAVES

There are various types of double-faced rugs, which use three not two wefts. The third weft appears neither on the face or the reverse of the rug, but weaves in the centre of the rug giving firmness to an otherwise loose weave structure.

Fig. 229 shows two of these weaves. Each repeats every six picks and has a colour sequence of (A,B,C) repeat. In both cases, colour A will show on the face of the rug,

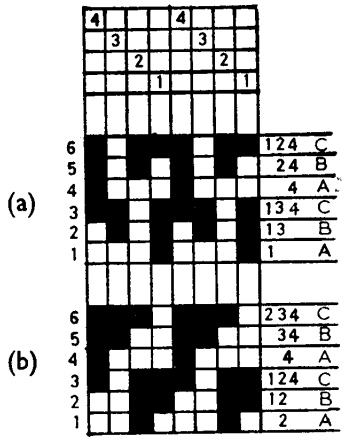


Fig. 229
Double-faced rugs with hidden weft
(a) Weave Diagram of type with hidden weft in plain weave
(b) Weave Diagram of type with hidden weft in hopsack

colour C on the reverse and colour B will be hidden. In the weave shown in Fig. 229 (a), colour B interlaces in plain weave order in the centre of the rug. This is best understood from a cross-section of the rug, see Fig. 230. The circles represent cross-sections of the warp ends, the numbers showing the shafts they are threaded on. Picks 1–3 in the sequence are shown at Fig. 230 (a) and the plain weave interlacement of the second pick, colour B, is plainly seen.

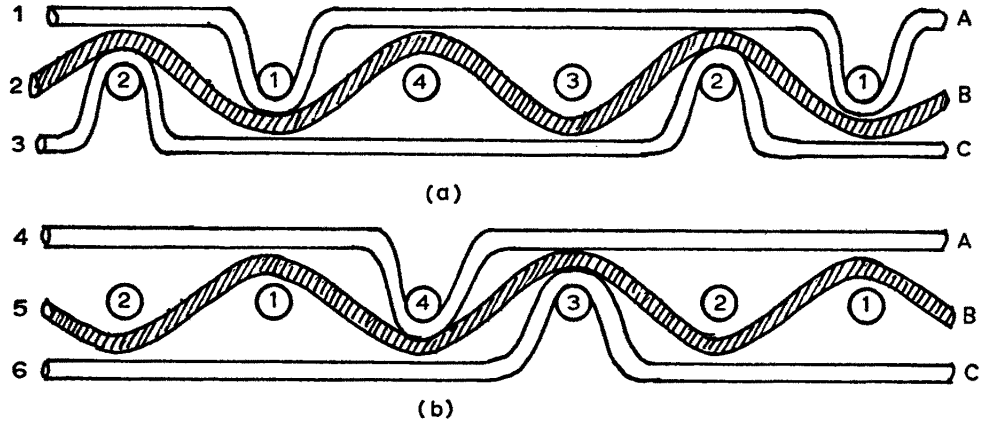


Fig. 230. (a) and (b) Cross sections of the six picks in Fig. 229 (a)

Note—How pick 1 floats over three, under one, and pick 3 floats under three over one.

—How these floats are so related to the plain weave pick that, when all three are beaten down, they will slide over each other. Pick 1 slides *in front of* pick 2 and hides it from the front, pick 3 slides *behind* pick 2 and hides it from the back.

Fig. 230 (b) shows the remaining three picks of the sequence. Notice that colour B is in the opposite plain weave shed to that used above, and that the floats of A and C are tied down at different points. The ends on shafts 1 and 2 tie down the floats of A and C in the first three picks, the ends on shafts 3 and 4 tie them down in the second three picks. So all ends are responsible for tying down one of the floating picks and there will therefore be equal warp take-up across the rug.

The weave shown in Fig. 229 (b) is very similar except that the hidden weft interlaces in hopsack order. Fig. 231 shows a cross-section of the first three picks.

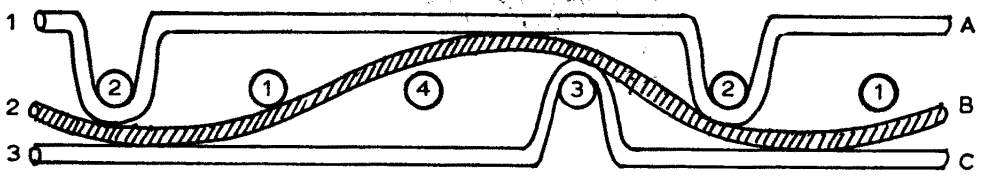


Fig. 231. Cross section of first three picks in Fig. 229 (b)

Practical Details

The wefts float over three ends, so a warp set of 6 working e.p.i. is necessary. The two wefts that form the face and the reverse of the rug are of 2-ply carpet wool used threefold. The third hidden weft can be of varying thicknesses. If it is of 2-ply carpet wool used singly, it will be completely hidden; if used twofold it will show slightly; if used threefold it will show more prominently. So its thickness depends on whether it is to be merely structural or whether it is to contribute to the colour of either surface of the rug. A floating selvage will be necessary. Start all three wefts from the same side.

The eight-shaft block weaves developed from the above two weaves are described in Chapter 8, where is also described a further four-shaft reversible weave using three wefts.

(vii) OTHER WEAVES

(*a*) *Treating a Straight Four-Shaft Draft as a Pointed Three-Shaft Draft*

It will be seen from Fig. 232 that there is only one small difference between a straight draft on four shafts and a pointed draft on three shafts. This is the position of the fourth, eighth, twelfth end, etc., which has been indicated by a circle. Use can be made of this similarity, and a four-shaft straight draft can be regarded as a three-shaft pointed draft simply by lifting the second and fourth shafts together. Thus three-shaft krokbragd can be woven as shown in Fig. 232 (b) by lifting (124, 234, 13). Compare with the normal lifts shown in Fig. 232 (a) and note that wherever a 2 appears in Fig. 232 (a), a 2 and a 4 appear in Fig. 232 (b). This principle will appear again with weaves on six and eight shafts.

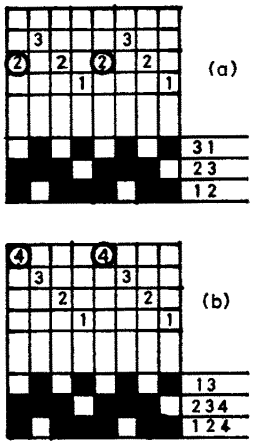


Fig. 232
Treating a straight four-shaft draft as a pointed three-shaft draft

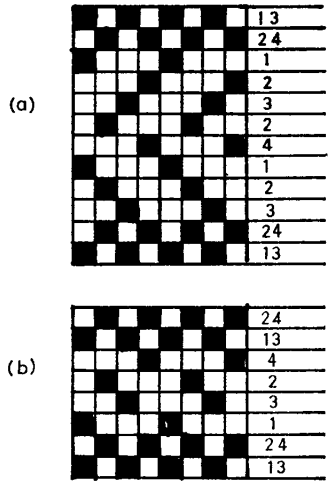


Fig. 233. Two weave diagrams of a woven ridge

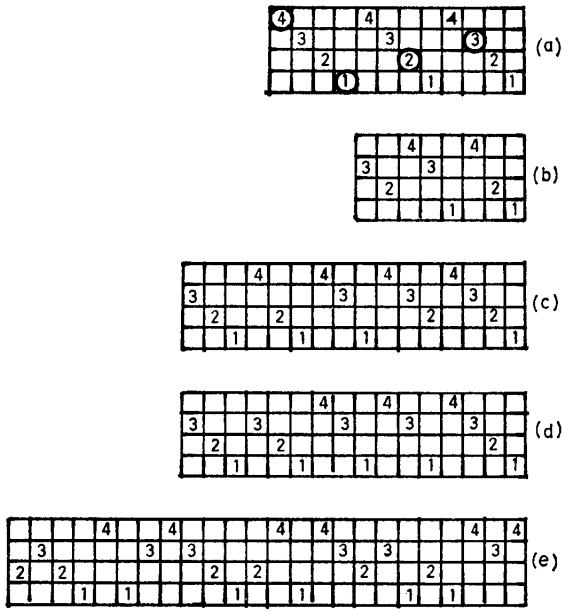


Fig. 234. (a) Straight four-shaft draft (b–e) Skip Twills derived from (a)

(b) Woven Ridge

A ridge can be made across a plain weave rug, by weaving several picks which float over three ends, i.e., by using the lifts of a 1/3 twill in some sequence. Fig. 233 shows two ways this can be done. In the upper weave, the floats form a horizontal herringbone and when beaten down slightly resemble two rows of soumak. In the lower weave the sequence is that of a broken 1/3 twill.

The ridge will stand up more boldly if a thicker weft is used for it than for the plain weave preceding and following it.

B. Four-Shaft Skip Twills

Skip twill drafts can be thought of as normal straight or pointed drafts from which certain ends have been excluded in some regular order. Fig. 234 (a) shows a normal straight draft on four shafts. If every third end is excluded (i.e., the encircled ends) the draft becomes as in Fig. 234 (b). This is the simplest skip twill there is. Fig. 234 (c) shows a draft constructed by excluding every fifth end and Fig. 234 (d) shows another in which the sixth and fourth ends alternately are excluded. Fig. 234 (e) is more complex. The initial draft is a pointed one which reverses after every fourth and fifth end alternately. From this, every seventh end has been excluded

The general effect of a skip draft on the designs obtained is that they are extended sideways compared with similar designs woven on a straight draft. So an oblique line becomes wider and lies at a flatter angle and vertical lines become broader and more widely spaced. In other words, the scale of the motifs is increased but only in the weft direction, not the warp direction. In the following descriptions only a few of the many possible colour and weave effects are mentioned.

(i) SKIP-TWILL REPEATING ON EIGHT ENDS

Fig. 235 shows that when this weave is lifted as for a 2/2 twill the weft does not only

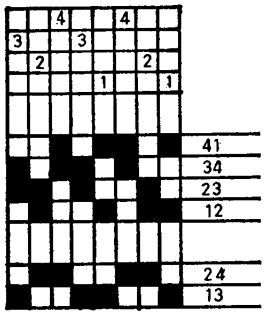


Fig. 235
Weave Diagram of Skip
Twill repeating on eight ends

pass over and under two ends, in places it passes over and under one end. So in the first pick, the weft passes under two, over one, under one, over two, under one, over one; and subsequent picks are similar. So there is more interlacing of warp and weft than with a straight draft, thus giving a good firm weave for rugs. Also the surface has a more interesting texture than has a normal 2/2 twill rug. By its very nature a skip draft cannot give plain weave, but as shown at the bottom of Fig. 235, this particular one can give hopsack by lifting 13 and 24.

Colour and Weave Effects

(*a*) *With Straight 2/2 Twill Lifts*, i.e. (12, 23, 34, 41)

(1) Colour sequence of (A,A,B) repeat or (A,B,B) repeat.

This gives oblique lines of the two colours. See Plate 63.

(2) Colour sequence of (A,A,A,B) repeat or (A,B,B,B) repeat.

It will be noticed how similar these are to the motifs obtained with a straight draft and similar colour sequences, but the scale is much bigger. See Plate 64.

(3) Colour sequence of (A,B,A,B,A).

This gives a vague but large-scale oblique line.

(*b*) *With Broken 2/2 Twill Lifts*, i.e. (12, 23, 41, 34).
Colour sequence of (A,B,A,B,A) or (A,B,A,B,A,B,A).

(*c*) *With Lifts of a 2/2 Twill Woven on Opposites*

Using two colours pick-and-pick, this gives oblique lines of the two colours with a pleasant stepped appearance quite unlike the dead straight lines obtained with a normal straight draft.

If between each pair of lifts in the above sequence, the two lifts, 13 and 24 are inserted, and the colour sequence of (A,B,A,B) is maintained, the irregular warpway stripes seen in Plate 65 are the rather surprising result. No trace of the twill on opposites is visible. So the lifting order becomes (12,34,13,24; 23,41,13,24; 34,12,13,24; 41,23,13,24).

If the inserted lifts are reversed, i.e., changed to 24, 13, but the pick-and-pick colour sequence preserved, the stripe moves over to the intermediate position. See top of Plate 65.

Practical Details

As for other twills, a warp set at 4 working e.p.i. and a weft using 2-ply carpet wool three or fourfold is suitable.

(ii) SKIP-TWILL REPEATING ON SIXTEEN ENDS

From Fig. 236, it will be seen that the 2/2 twill lifts make each weft go under two ends and over one for a short distance, then over two ends and under one for a similar

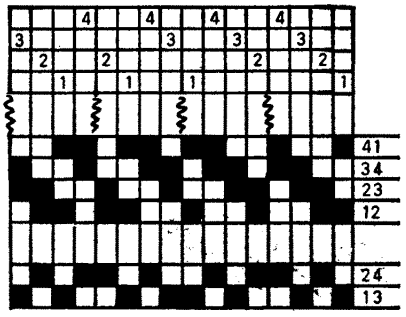


Fig. 236
Weave Diagram of Skip Twill repeating on sixteen ends

distance. Lifting 13 and 24 gives a combination of plain weave and hopsack. Slight grooves run down the surface of the weave corresponding to the points in the draft where an end has been excluded, see wavy lines in Fig. 236.

Colour and Weave Effects

(*a*) *With Straight 2/2 Twill Lifts*

(1) Colour sequence of (A,A,B) or (A,B,B).

This gives oblique wavy lines, see Plate 66. The waviness is more obvious at the centre of the Plate where the weave has been reversed.

(2) Colour sequence of (A,B,B,A,A,B,A,A,A,B,B,B)

A very striking warpway stripe results from this sequence. See Plate 67 and compare with the motif produced by a similar colour sequence on a straight draft shown in Plate 52.

(3) Colour sequence of (A,A,B,A,A,B,B).

This gives a jagged twill line, the boldest so far obtained. See Plate 68.

(*b*) *With Broken 2/2 Twill Lifts*

Colour sequence of (A,A,B,B,A,B,A,B,A,B,B,B) starting with a lift of 12.

Another warpway stripe is the result of this sequence. See Plate 69 and compare with Plate 58 which shows the result of the same colour sequence worked on a straight draft.

Practical Details

A warp set at 4 working e.p.i. and a weft of 2-ply carpet wool used threefold is suitable.

(iii) SKIP-TWILL REPEATING ON TWENTY-FOUR ENDS

The 2/2 twill lifts in Fig. 237 show that the weft in this weave takes a very irregular course passing over and under one and two ends as before, but also over and under three ends. When it is remembered that this skip-twill is derived from a pointed draft, these larger weft floats are to be expected. They are the cause of weaving this draft at 5 working e.p.i., not 4.

Lifting 13 and 24 gives a mixture of plain weave and hopsack. The wavy lines in Fig. 237 show where longtitudinal grooves run down the surface of the rug.

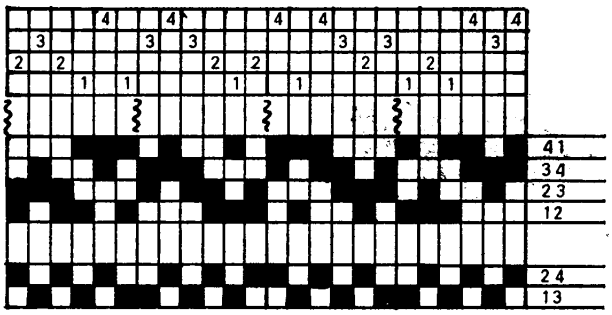


Fig. 237. Weave Diagram of Skip Twill repeating on twenty-four ends

Colour and Weave Effects

(*a*) *With Straight 2/2 Twill Lifts*

(1) Colour sequence of (A,A,B).

This gives oblique lines which have a tendency to break as they cross the grooves mentioned above.

(2) Colour sequence of (A,B,B, A,A,B, A,A,A,B,B,B).

As Plate 70 shows this gives a similar motif to that obtained with a straight draft and the same colour sequence, but much increased in scale.

(3) The bold, stepped stripes shown in Plate 71 were the result of the following colour sequence, starting on the 12 lift.

(A,A,B,B)×5
(A,B,B,B)×5
(A,B,B,A)×5
(B,B,B,A)×5
(B,B,A,A)×5
(B,B,A,B)×5
(B,A,A,B)×5
(B,A,B,B)×5

Repeat the above sequence.

Note an interesting subtlety in the design which results entirely from the threading. The black and white stripes are of single or double-thickness, e.g., at bottom of Plate 71 there is a double-thick black stripe at the right corner and another to the left of the centre. Whereas the stripes all step upwards to the left, these double-thick black stripes appear on a diagonal going up to the right.

Practical Details

A warp set at 5 working e.p.i., with a weft of 2-ply carpet wool used two or threefold is suitable.

The rather astonishing possibilities of these weaves (most of which can be found in an industrial weave book or can be invented by the weaver) suggest that there may be many others waiting for a similar conversion into weft-face weaves. Here is a fruitful and almost limitless field of investigation.

When experimenting with such a weave, first try the simplest colour and weave effect, i.e., a lifting sequence of (12,23,34,41), and a colour sequence of (A,A,B). If this gives a twill line of some sort, then all the other colour and weave effects described above will also be worth trying.

Try also the effect of combining these lifts with 13 and 24, as was done in the simplest skip-twill above. This can completely transform a design.

There are also the possibilities of using three colours, reversing the lift sequences and reversing the threading drafts to be investigated.

C. Twilled Overshot Blocks

There are many twill derivatives, but only one will be described in detail here. This is shown in Fig. 238 and can be described as 'four-end overshot blocks in twill order'. It

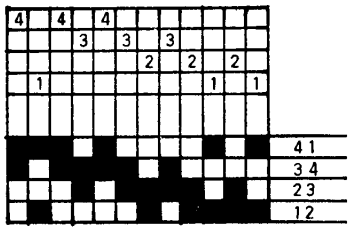


Fig. 238
Weave Diagram of four-end overshot blocks in twill order, lifted as for 2/2 twill

is the simplest member of a class of threading which forms the basis of the double corduroy technique and so will be met with later.

As the weave plan shows, when lifted for a straight 2/2 twill, it gives weft floats over and under four ends. Because of this, plain weave picks are essential to give strength to the weave and these are obtained by lifting 13 and 24.

(i) TWILL RIDGES

Using a thick weft (2-ply carpet wool used fourfold) for the twill lifts (shown in bold type) and a thin weft (2-ply carpet wool used twofold) for the plain weave lifts, then the following sequence could be used: **12**, 13, 24; **23**, 13, 24; **34**, 13, 24; **41**, 13, 24. If the two wefts are of different colours then the ridges and intermediate flat areas will be of different colours. In the bottom of Plate 72, the ridges are a mixture of grey and white and the plain weave is black. As will be seen this weave gives a twill with a very gentle angle.

However, if, in the above sequence, the first three picks are repeated twice, then the next three picks repeated twice, and so on, a much bolder and steeper ridge is produced. This is seen in the middle of Plate 72.

Note that these twill lines are quite different from all the previous ones described. Here there is a series of floats of one colour on a plain weave ground of another colour. These floats form a ridge standing above the level of the surrounding plain weave. In the other twills, the whole surface of the rug was made up of small floats of two or more colours, and the twill lines resulted from the sequence in which these colours were used. There were no ridges.

(ii) WARPWAY STRIPES

The stripes at the top of Plate 72, were produced with this sequence of lifts:

12, 14—Thick weft (white)
13, 24—Thin weft (black)
34, 14—Thick weft
13, 24—Thin weft.

Then the whole sequence was repeated. If two thick wefts of different colours had been used, the stripes could have been made more complex. As before, the thick weft can be 2-ply carpet wool used fourfold and the thin weft 2-ply carpet wool used twofold.

A simpler form of stripe can be woven just by repeating over and over again the first four picks of the above sequence. Plate 73 shows a sample in this weave. The threading here was the normal double corduroy one. The thick weft was 2-ply horsehair used sixfold and the thin weft was either black or white 2-ply carpet wool used singly. Due to the thickness of the horsehair, the warp could not be covered and its appearance contributes considerably to the interest of the stripes.

Practical Details

4 working e.p.i. is a good setting for this threading but 5 or 6 working e.p.i. can be used. The latter settings naturally reduce the length of the weft float which is a point in their favour, but against this is the fact that they make it harder for the weft to cover the warp completely.

D. Four-Shaft Shadow Weave

The shadow weave system worked out by Mary Atwater is designed for a fabric with an approximate equal number of ends and picks per inch, the design depending on the interplay of the colours of the two elements. But it can be adapted as a weft-face weave (and also as a warp-face weave, see Chapter 11) in which case it is only the two *weft* colours which contribute to the design.

In Fig. 239 (a), three repeats of the eight-end threading unit are shown. The sequence in the third repeat has been reversed to give a point draft. The normal lifts are those of a 2/2 twill woven on opposites as shown, with a pick-and-pick colour sequence, i.e., (A,B,A,B). The weave this gives, as shown in the weave plan, is a large scale twill which looks as if it needs more than four shafts.

The draft for the sample in Plate 74 was reversed in the centre. The bottom section is the weave as shown in Fig. 239 (a) and it is seen to give a rather small scale flattened diamond. The scale can be made more interesting in the following way.

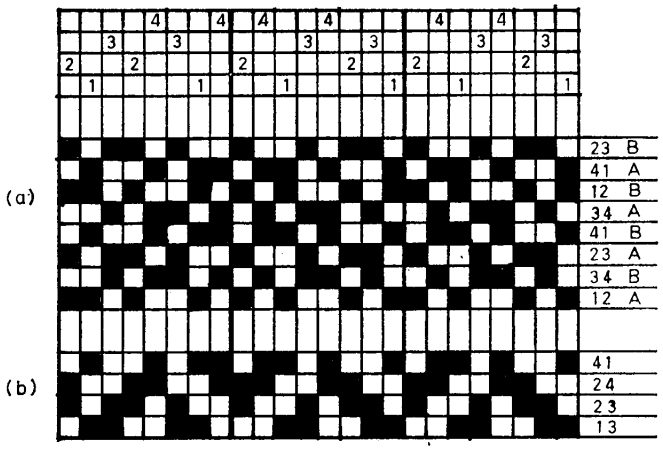


Fig. 239
Four Shaft Shadow Weave.
(a) Weave plan when lifted as 2/2 twill 'woven on opposites'
(b) Weave plan when lifted as 2/2 twill

Fig. 240 (a) shows the eight lifts written out. These have been bracketed in fours, and the brackets labelled 1–4. Repeat the lifts in each bracket twice. As the brackets overlap, the last two lifts of one bracket become the first two lifts of the next. Keep the pick-and-pick colour sequence. Plate 74 (top) shows that this weave gives strongly stepped oblique lines.

Another variation is to bracket the lifts in pairs as in Fig. 240 (b) (i.e., in pairs of opposites) and repeat each pair, say, four times, then move on to the next pair. Plate 75 shows a sample in this technique and it will be seen it gives oblique lines of very complex character.

The lifts and weave plan in Fig. 239 (b) show that the threading can be used to give a 2/2 twill. The direction of twill reverses after every fourth thread, and the twill line 'clean cuts' at each reversing point. So any of the 2/2 twill colour and weave effects can be tried out on this threading. The sample in Plate 76 shows some of the many possibilities. It includes two weaves used in unequal stripes:

(1) The lifts as shown in Fig. 239 (b) with an (A,A,B) colour sequence.

(2) The lifts for a 2/2 twill woven on opposites with a pick-and-pick colour sequence. The diamonds in the design occur naturally at the junction between one weave and the other.

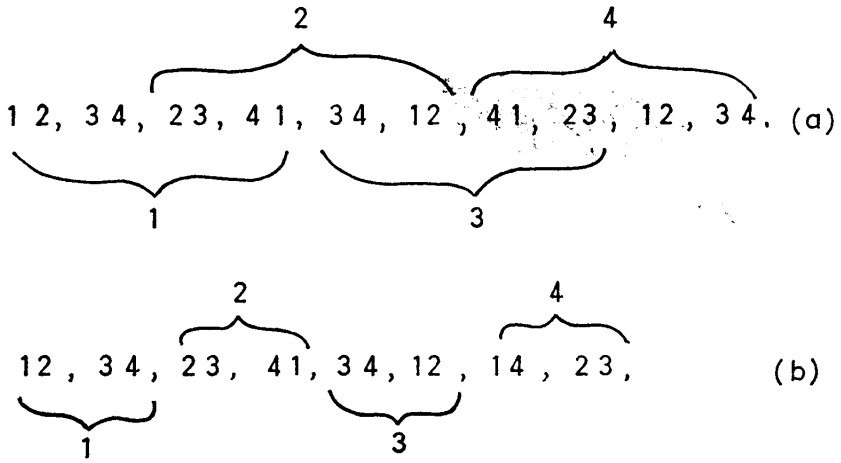


Fig. 240. Various lift sequences for four-shaft shadow weave

E. Four-Shaft Honeycomb

The cellular weave known as honeycomb is normally woven as a balanced weave. Long floats of warp and weft outline each square cell. This structure can be magnified and adapted as a rug weave and it appears in Chapter 12. But it can also be woven as a completely weft-face fabric, by interposing two picks of plain weave between each of the normal honeycomb picks. So the long weft floats appear as in a normal honeycomb but the long warp floats are hidden by the plain weave weft. The latter increases the stability, but decreases the cellular nature of the fabric which, however, still has a very deeply textured surface, see Plate 77.

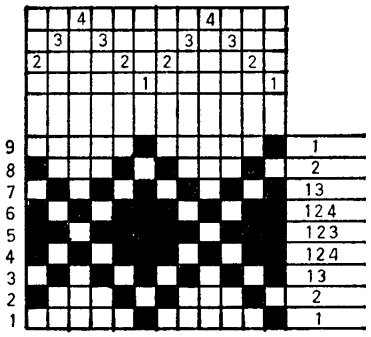


Fig. 241
Four-Shaft Honeycomb.
Weave Diagram

Fig. 241 shows the details. The weave plan only shows the normal honeycomb picks; between each one of these, two picks of plain weave (on lifts 13 and 24) are woven. Two wefts are used, a thick one for the honeycomb picks and a finer one for the plain weave picks. It will be noticed that the third and seventh picks are woven with shafts 1 and 3 lifted, i.e., in a plain weave shed. So both the honeycomb and the plain weave weft lie together in this shed. This often results in the warp not being completely covered at this point, see the white spots in Plate 77.

The weave is shown up well if the plain weave weft is a different colour or tone from the honeycomb weft. It was darker in the sample photographed, in which there is also another slight variation. This is the use of a separate weft of a much brighter colour for the fifth pick of each repeat, so that it appears as a spot. Such variations in colour can make this into a very interesting weave.

Practical Details

Warp—5 working e.p.i.
Weft—For plain weave, 2-ply carpet wool used singly.
For honeycomb, 2-ply carpet wool used fourfold.

F. Single End Spot Weave

In the *Domestic Manufacturer's Assistant* written by J. and R. Bronson and published at Utica, U.S.A. in 1817, eleven out of the thirty-five weaves described are of one special type. As this is a spot weave the threading system is generally known as Bronson Spot Weave. The characteristic of this weave is warp and weft floats spanning five threads. These are too long for a rug weave, so for the present purpose the threading has been reduced and is shown in Fig. 242. It is an adaptable threading for rugs and can also be developed as a block weave, see Chapter 8.

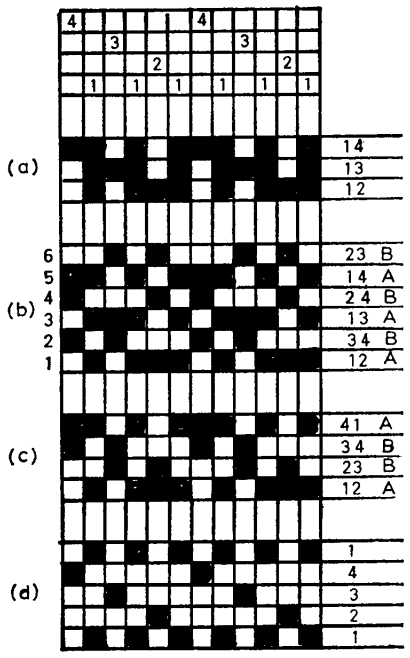


Fig. 242
Single End Spot Weave.
Weave Diagram with several weave plans

(i) At Fig. 242 (a) is shown the weave plan when the shafts are lifted in the sequence (12, 13, 14). This gives a very simple twill, but it only becomes feasible for a rug weave when woven as a twill on opposites, i.e., as in Fig. 242 (b) where the sequence is (12,34; 13,24; 14,23). This gives weft floats over three ends, forming oblique ridges, on both sides of the rug. If the colour sequence is (A,B,A,B) repeat, as shown in Fig. 242 (b), then the ridges on the face will be in colour B and those on the reverse in colour A. The ridges are separated by spots of the colour from the opposite side of the rug. This is seen in Plate 78. In the centre section, the sequence has been altered to (A,B,A,B,B,A) repeat, which makes the vertical stripes appear. The firm flexible weave obtained looks far more complex than it really is.

(ii) A development of the above weave is only to use the first four picks of the sequence but to keep to the pick-and-pick colour sequence. So the sequence is lift 12 colour A, lift 34 colour B, lift 13 colour A, lift 24 colour B. The result on the face of the rug is warpway stripes of colour B separated by thin lines of colour A; on the reverse of the rug the same applies, but with the colours interchanged.

Naturally the colour sequence could be (A,B,A,C) in which case the warpway stripes would be composed of colours B and C.

Exactly the same effect would be obtained by weaving picks number 3, 4, 5 and 6 repeated, or picks number 5, 6, 1 and 2 repeated; the stripe would merely appear in a different position, slightly shifted over to the left.

(iii) The last sentence suggests another weave in which the stripe, reduced to a small unit, is made to appear in all three positions in succession. So the sequence becomes

$$\left.\begin{array}{l}(12,34;\ 13,24)\times 2\\(13,24;\ 14,23)\times 2\\(14,23;\ 12,34)\times 2\\(14,23)\end{array}\right\}\text{Repeat}$$

With a pick-and-pick colour sequence, this gives a stepped twill.

(iv) Another stepped twill can be woven by taking the picks of the twill woven on opposites in pairs and repeating them several times, e.g.,

$$\left.\begin{array}{l}(12,34)\times 3\\(13,24)\times 3\\(14,23)\times 3\end{array}\right\}\text{Repeat}$$

Plate 79 shows how this appears with a pick-and-pick colour sequence.

(v) When this weave is lifted as for a straight 2/2 twill, it does not give any twill lines, but it yields a good firm weave very much like the weave described under (ii) above. If the colours are arranged thus, lift 12 colour A, lift 23 colour B, lift 34 colour B, lift 41 colour A, then the warpway stripes of B, and the thin lines of A will appear as in (ii). The only difference is that the thin lines appear more as a succession of spots. Plate 80 shows this weave. A black, grey and white mixture has been used as the main weft, but there are two sections, one where an all-white and one where an all-black weft has been combined with it, as in the above sequence, to give the vaguely showing white and black thin lines.

(vi) An unexpected possibility of this weave is the production of pronounced ridges across the rug. Two of the possible lifting sequences are: (1,2,3,4,1,2,3,4,1) see Fig. 242 (d) and (1,2,3,4,1,4,3,2,1). In both cases the picks with lifts 2, 3 and 4 form the floats of the ridge and so can be in a thicker yarn. These ridges could be combined with one of the above weaves or with plain weave, obtained by lifting 1 and 234, alternately.

To make a ridge on both sides of the rug lift thus, (2, 123, 3, 134, 4, 124). If continued, these lifts produce a double-faced twill weave. As the weft floats span five ends, the warp would have to be set closer than normal to make this into a practical weave.

Fig. 243 (a) shows how this threading can be developed as a pointed draft, reversing twice on the fourth end (arrowed).

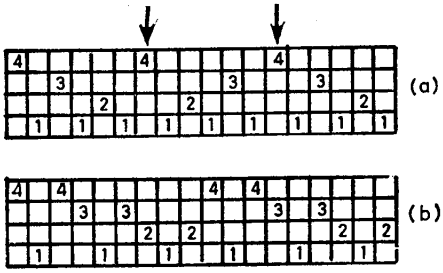


Fig. 243
Single End Spot Weave.
(a) Method of reversing threading draft
(b) Expanded version of draft

The original Bronson Spot Weave can be extended onto any number of shafts, each additional shaft giving one more controllable 'spot' in the design. Single End Spot Weave can be extended, but as it is woven quite differently this does not bring any great increase in its scope. The weave can be expanded slightly as shown in Fig. 243 (b). This gives similar effects to Single End Spot Weave, but without the possibility of plain weave.

Single End Spot Weave is one of the weaves which can be produced on a straight six-shaft draft, as it repeats every six ends, see Fig. 252.

Practical Details

A warp of 5 working e.p.i. is suitable, due to the many floats over and under three ends. A weft of 2-ply carpet wool should be used twofold, though it can be used threefold if the rug is beaten very hard.

G. Alternated Two-Shaft Blocks

A very simple rug weave consisting of plain weave and floats can be woven on any of the threadings in Fig. 244. A double-faced weave can be woven on the threading shown at Fig. 244 (a).

As the weave plans show, they all give plain weave when shafts 13 and 24 are lifted alternately and weft floats in two positions when shafts 12 and 34 are lifted. The length of this float depends on the number of ends on the front two or back two shafts in each group.

A floating pick with a thick weft is followed by one or two picks of plain weave with a finer weft. As the latter has to cover the warp, there cannot be more than about 6 e.p.i. This warp setting would make the weft floats in the threading in Fig. 244 (a) $\frac{1}{2}$ inch long and in the threading in Fig. 244 (b) $\frac{2}{3}$ inch long, both of which are within practical limits.

There are basically two ways to weave this.

(i) To alternate one of the floating picks, say, on lifting 12, with two picks of plain weave. This will give warpway stripes consisting alternately of the floats and of plain

weave. Even using the same colour for both wefts, the stripes show up strongly, because the floats bulge forwards, forming prominent warpway ridges in contrast to the intervening stripes of flat plain weave. Using different colours, the contrast between the two stripes can of course be emphasized. Plate 81 shows a sample in black and white.

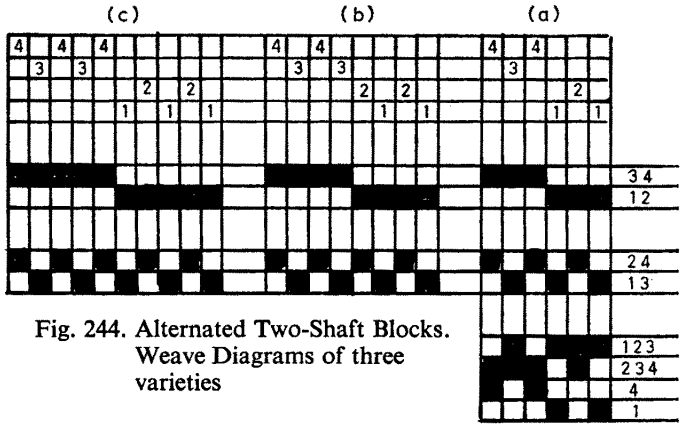


Fig. 244. Alternated Two-Shaft Blocks. Weave Diagrams of three varieties

(ii) To weave the two floating picks alternately, with two plain weave picks either after every one floating pick or after every two floating picks. So the lifting sequence could be (12,13,24; 34,13,24) repeat or (12,34; 13,24) repeat. The floats will here cover the surface of the rug, hiding the plain weave completely. By using two colours alternately for the floating picks, warpway stripes or checks can be produced. This is probably best woven with the threading shown in Fig. 244 (a), i.e., with the shortest floats.

Practical Details

Warp—5 or 6 working e.p.i.
Weft—For the floats, 2-ply carpet wool used three or fourfold.
For the plain weave, 2-ply carpet wool used singly.

The double-faced weave referred to above is obtained by lifting (1, 4, 234, 123), see Fig. 244 (a) at bottom. This is identical with a weave described in the section on Three-Shaft Weaves. Note that the threading shown in Fig. 244 (a) is simply another form of the draft used for Four-Shaft Honeycomb, i.e., a pointed four-shaft draft, see Fig. 241. So using the same lifts, the threading used for honeycomb will serve equally well. The use of this weave for warp- and weft-face rugs is described in Chapter 12.

3. SIX-SHAFT DRAFTS

Weavers tend to ignore six-shaft weaves; if they do have a multishaft loom they jump straight from four-shaft to eight-shaft weaves. But especially in the field of colour and weave effects with twills, six shafts have a great deal to offer. Only a few of the possibilities will be described but maybe they will be enough to encourage the reader to venture into this territory.

A. Using a Straight Draft

(i) 2/2/1/1 TWILL

This is the first multiple twill met in this book. According to the nomenclature of twills, it will be understood that in each pick the weft goes under two ends, over two, under one, over one, hence 2/2/1/1. So the interlacing is a mixture of hopsack and plain weave, but in twill order, see Fig. 245 (a). Due to this close interlacing, no plain

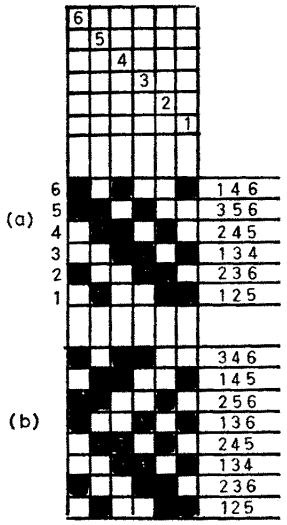


Fig. 245
2/2/1/1 Twill. Weave Diagrams.
(a) Straight twill
(b) Broken twill

weave is needed to strengthen the fabric, thus distinguishing this from other six-shaft twills. The weft floats over two ends form oblique ridges running up to the left, as would be expected from the weave plan. These give an interesting, though small scale, surface texture and together with the good interlacing make this an ideal rug weave. A few of the many colour and weave effects are described below.

Colour and Weave Effects

(*a*) *With Straight 2/2/1/1 Twill Lifts*

A colour sequence of (A,A,B,B) gives oblique toothed lines running in the opposite direction to the twill ridge, see Plate 82. A colour sequence of (A,A,A,B,B) and (A,A,B,B,B) is seen in Plate 83, where the former sequence is shown at the top. Another colour sequence that produces good results is (A,A,B,A,A,B,B,B); and another is (B,B,B,B,B,A,B,B,B,B,A,A,B,B,B,A,A,A,B,B,A,A,A,A,B,A,A,A,A,A) repeat, but there are many others to be discovered.

(*b*) *With the Lifts of a 2/2/1/1 Twill woven on Opposites*

Between each lift as shown in Fig. 245 (a) the opposite lift is inserted. So the sequence now becomes:

125 A
346 B
236 A
145 B
134 A
256 B
245 A
136 B
356 A
124 B
146 A
235 B

If two colours are used pick-and-pick as indicated, the oblique lines shown in Plate 84 are the result. Note the spots of black and white running up between each black and white line. This is a very firm weave.

(*c*) A rather similar weave has two wefts weaving pick-and-pick. They both work on the six lifts of the 2/2/1/1 twill but whereas one weft begins on the first pick of the cycle, i.e., with a lift of 125, the other weft begins on the fourth pick, i.e., with a lift of 245. So the sequence is:

125 A
245 B
236 A
356 B
134 A
146 B
245 A
125 B

356 A
236 B
146 A
134 B

This gives oblique lines of equal thickness, without the spots found with the above weave. In Plate 85, the pick-and-pick sequence has been occasionally altered to show some of the possibilities of this weave.

(d) With Broken 2/2/1/1 Twill Lifts

A broken twill could be made just by weaving the picks in Fig. 245 (a) in the order 1,2,3,6,5,4. However, the three samples in Plate 86 were woven on a slightly more elaborate broken twill shown in Fig. 245 (b) with the following colour sequences.
Bottom sample—(A,A,B,B).
Middle sample—(A,B,A,B,B,A.B,A) starting on pick 1.
Top sample—(A,B,A,B,B,A,B,A) starting on pick 3.

The difference between the last two shows how important it is to start a broken twill on the correct pick of the lifting sequence.

Practical Details

Warp—4 working e.p.i.
Weft—2-ply carpet wool used threefold.

(ii) 1/3/1/1 TWILL

Whereas the face and the reverse of all the above weaves was identical, this weave is quite different on the two sides. It has weft floats over three ends on the front which do not appear on the reverse, see Fig. 246 (a). It is best woven with two picks of plain weave (lifting 135 and 246) between each twill pick. If the plain weave weft is a different colour from the twill weft, it will show up the twill lines. See Plate 87, where a white plain weave weft was used. The reverse of the rug is also interesting showing twill lines made of the plain weave weft and spots of the twill weft.

Practical Details

Warp—4 or 5 working e.p.i.
Weft—For plain weave, 2-ply carpet wool used singly.
—For twill, 2-ply carpet wool used three or fourfold.

An interesting double-faced rug can be woven based on this weave, 1/3/1/1 twill,

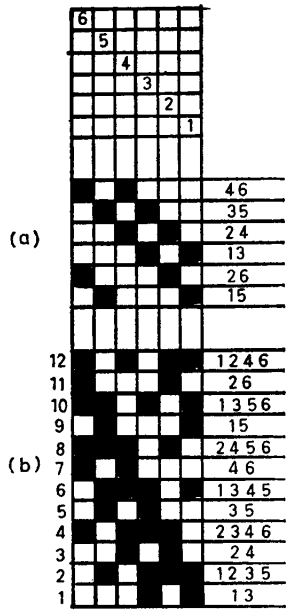


Fig. 246
1/3/1/1/ Twill. Weave Diagrams.
(a) Straight twill
(b) Twill formed by combining 1/3/1/1 twill with 3/1/1/1 twill

which gives floats on the front of the rug, together with a 3/1/1/1 twill which gives identical floats on the reverse of the rug. A pick of 1/3/1/1 twill alternates with a pick of 3/1/1/1 twill throughout, see Fig. 246 (b). Two wefts are used pick-and-pick. The result is a rug with marked oblique ridges on both sides; on the face they are of colour A (with spots of colour B also appearing) and on the reverse of colour B. As Plate 88 shows, stripes and other effects can be obtained by altering the pick-and-pick sequence of the two colours.

The warp should be set at 5 working e.p.i. and the weft should consist of 2-ply carpet wool used three or fourfold. This gives a thick but flexible rug.

The same result is obtained if the picks, as numbered in Fig. 246 (b), are woven in the following order, 1,3,4,6,5,7,8,10,9,11,12,2, and the colours used in an (A,A,B,B) sequence instead of pick-and-pick.

(iii) 3/3 TWILL

This is the most obvious six-shaft twill but due to the small amount of interlacing between warp and weft it is not very suitable for rugs. There has to be a plain weave weft, which shows up prominently between the twill weft floats. Two picks of plain weave are used between each twill pick. This gives an opportunity for small scale effects by using two differently coloured wefts for the plain weave and arranging them in pick-and-pick or 2-and-2 order, see Plate 89.

Practical Details

Because of the long floats a setting of 5 working e.p.i. is best with a weft of 2-ply carpet wool, used three or fourfold for the floats and used singly for the plain weave. For a heavier but looser weave, set the warp at 4 working e.p.i. and use 2-ply carpet wool fourfold for the floats and twofold for the plain weave.

(iv) COMBINATION OF 3/3 TWILL WITH 2/2/1/1 TWILL

An interesting weave often results from combining two other weaves, so that a pick from one alternates with a pick from the other. This can be done by combining 3/3 twill and 2/2/1/1 twill, see Plate 90 and Fig. 247. In Fig. 247, the odd-numbered picks are taken from a 2/2/1/1 twill and are in colour A, and the even-numbered picks are taken from a 3/3 twill and are in colour B. The different way the two weaves are filled in on the weave plan helps to clarify this. In the plate, the white weft corresponds to colour A.

As will be seen this gives oblique lines of the two colours, colour B giving a thicker line. Note how the character of the lines alters when they slope up to the left; their edges become broken and less smooth. This is because only the 3/3 twill was reversed in direction, the 2/2/1/1 twill continued on unaltered. So where the lines slope up to the right, the two twills are working in harmony, in the same direction (as in Fig. 247), but where the lines slope up to the left they are working against each other.

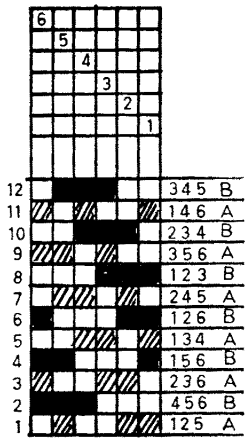


Fig. 247
Weave Diagram of twill formed by combining 3/3 twill with 2/2/1/1 twill

Practical Details

Warp—4 working e.p.i.
Weft—2-ply carpet wool used fourfold for the 3/3 twill picks and used threefold for the 2/2/1/1 twill picks.

(v) WEAVE BASED ON A THREE-SHAFT WEAVE

Fig. 248 shows a weave based on a three-shaft weave described earlier in this chapter, see Fig. 211. When lifted as for the lower weave plan, i.e., 2356, A; 36, B; 1245, A; 14, B; the rug will be colour B on the face and colour A on the reverse. But when lifted as in the upper weave plan, there will be narrow warpway stripes of the two colours, the colour B stripes will lie over the ends threaded on shafts 4, 5 and 6 and the colour A stripes over the ends threaded on 1, 2 and 3, see Plate 91. The wavy lines at the top of Plate 91 were the result of lifting as for the stripes but changing the colour sequence to (A,B,A,A,B,A,B,B). There are probably many more possibilities here with varied colour sequences.

Practical Details

Warp—4 working e.p.i.
Weft—2-ply carpet wool used threefold.

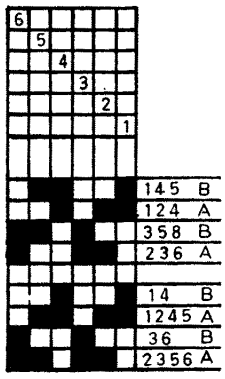


Fig. 248
Weave Diagram of weave based on three-shaft weave in Fig. 211

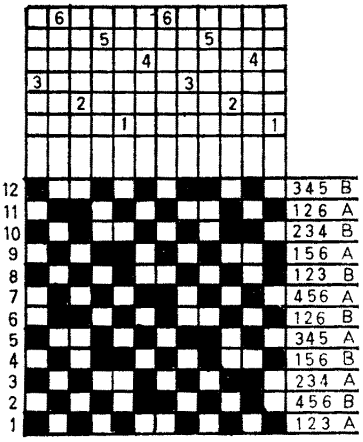


Fig. 249. Six-Shaft Shadow Weave. Weave Diagram

B. Six-Shaft Shadow Weave

The threading for a six-shaft shadow weave is shown in Fig. 249. An end on one of the front three shafts is always followed (shadowed) by an end on one of the back three shafts. There are twelve ends in one unit of the threading. The lifts are as for a 3/3 twill woven on opposites, and the colour sequence is (A,B,A,B) repeat. As the weave plan shows, the structure is rather similar to that of a four-shaft shadow weave, and the woven result is also similar, though more complex.

Plate 92 shows a sample which has a reverse in the threading in the centre. At the

bottom is seen the weave as shown in Fig. 249. Above this is seen a sample in which the numbered picks were taken in the following order, the colour sequence remaining the same.

1, 2, 1, 2, 1, 2
3, 4, 3, 4, 3, 4
5, 6, 5, 6, 5, 6
7, 8, 7, 8, 7, 8 } Repeat
5, 6, 5, 6, 5, 6
3, 4, 3, 4, 3, 4

At the top of Plate 92 is a sample in which the picks were woven in the following order

1, 2, 3, 4, 5, 6, 7, 8,
3, 4, 5, 6, 7, 8, 9, 10,
5, 6, 7, 8, 9, 10, 11, 12, etc.

These three examples show the range of possibilities this threading can give.

Practical Details

Warp—4 working e.p.i.
Weft—2-ply carpet wool used threefold. Use a floating selvage. No plain weave is possible.

C. Six-Shaft Skip Twills

There are many skip twills possible on six shafts. Fig. 250 (a) shows one on which two

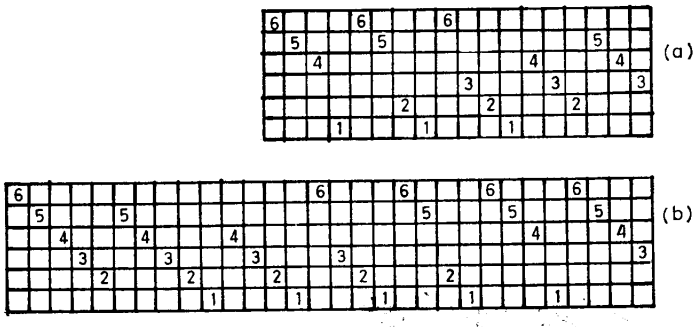


Fig. 250. Two six-shaft skip twills

ends are excluded after every three included. Because two consecutive ends are excluded, plain weave is possible with this skip twill. Plate 93 shows two of the many possibilities. At the bottom is a 2/2/1/1 twill woven on opposites using two colours, pick-and-pick, and at the top a broken 2/2/1/1 twill using a colour sequence of (A,B,B,A,B,A,A,B). Compare these with the results that similar lifting and colour

sequences give with a straight draft. As these weaves contain weft floats over one, two and three ends, it is a little difficult to find a correct warp setting; probably 5 working e.p.i. is the best with a 2-ply carpet wool weft used three or fourfold.

Fig. 250 (b) shows another skip twill in which two ends are excluded after every five ends included, and there are many more to be investigated.

D. Six-Shaft Honeycomb

The longest weft floats in four-shaft honeycomb, which are over or under five ends (picks 1 and 5 in Fig. 241), limit the usefulness of this weave, for the weft at these points can very easily be caught by furniture or feet. So it is only suitable for a bedroom rug, which does not have much heavy traffic over it.

But if honeycomb is woven on a six-shaft straight draft, each of these floats over five ends can be replaced by two separate floats over four ends, see picks 1 and 2, and 6 and 7, in Fig. 251 (a). This makes a more practical weave. As Plate 94 shows there is little difference in the texture of the two types of honeycomb.

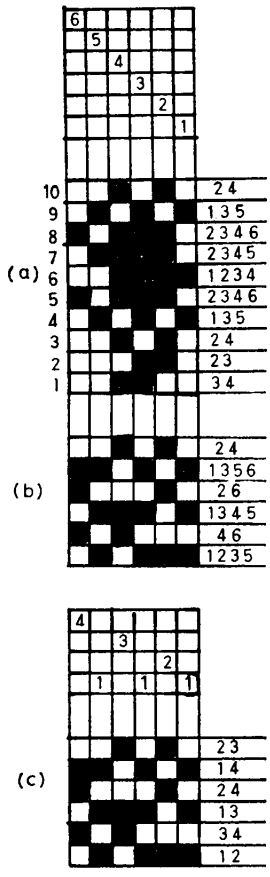


Fig. 251. (a) Six-Shaft Honeycomb. Weave Diagram
(b) Producing any weave that repeats on six ends with a straight six-shaft draft

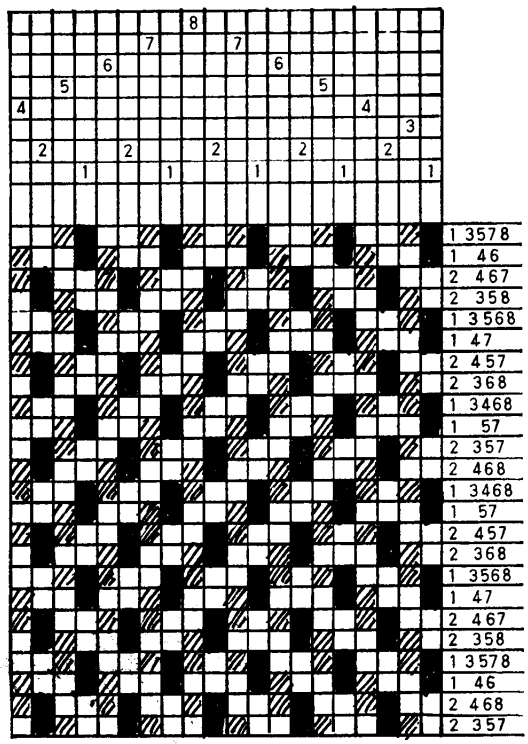


Fig. 252. Double Two-Tie Unit Weave. Weave Diagram

In this example, the plain weave weft and the honeycomb weft for picks 9, 10, 1, 2, 3 and 4, are both white. The honeycomb weft for the remaining four picks (which form the base of the 'cell') is grey, which has the effect of emphasizing the depth of the cell.

Practical Details

Warp—5 working e.p.i.
Weft—For honeycomb, 2-ply carpet wool used fourfold.
For plain weave, 2-ply carpet wool used singly.

E. Other Weaves

Any weave that repeats every six ends can be woven on a straight six-shaft draft. Fig. 251 (b) and (c) show the identical weave produced both from the Single End Spot Weave threading and from a six-shaft straight draft, with the respective lifts. The same applies to a pointed four-shaft draft, i.e. (2,3,4,3,2,1) repeat. So a simple honeycomb weave or a 2/2 twill vertical herringbone can both be woven on a straight six-shaft draft. Obviously such a draft would not be chosen for producing these various four-shaft weaves. But knowing these perhaps, unexpected, possibilities of a six-shaft draft, certainly widens its scope.

4. EIGHT-SHAFT DRAFTS

It is not proposed to deal in detail with eight-shaft twills and their numerous variations, as the subject is practically endless. A weaver who has understood the principles involved in the twills on three, four and six shafts will be equipped to find his own way among those on eight shafts. It is always wise to avoid weft floats that pass over more than three ends, so a good one to start with might be 2/1/1/2/1/1 twill or 2/2/1/1/1/1 twill. Always try and find a weave that has characteristics not present in weaves on fewer shafts, otherwise there is no point in using the extra shafts.

Double Two-Tie Unit Weave

An interesting interlacement system is shown in an eight shaft version in Fig. 252. Every other end is alternately on shafts 1 and 2. The other ends which can extend over any number of shafts (here on shafts 3–8), can be arranged in a straight order or in a pointed order as in Fig. 252.

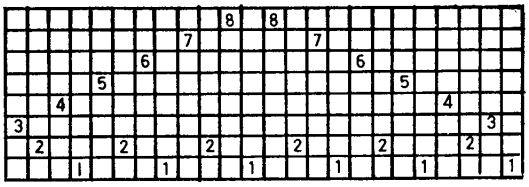


Fig. 253
Alternative method of threading for Double Two-Tie Unit Weave

This system gives a large range of weaves, including complex designs in 2/2 twill and it is the latter which are relevant here. As will be seen from the lifts, the ends on shaft 2 stay up for two picks and then the ends on shaft 1 stay up for two picks, throughout the design. The corresponding parts of the weave plan have been filled in with solid squares. On this skeleton of marks on point paper, a design such as the one shown can be built up, in which the areas differ from each other only in the direction of the twill lines. The other squares (representing warp controlled by shafts 3–8) have been shaded.

To show up this design as a weft-face fabric it is probably best to weave it on opposites, with two colours used pick-and-pick. This means that every lift shown in Fig. 252, using colour A, is followed by the opposite lift, using colour B. So starting at the bottom, the first few lifts are:

2357 A
1468 B
2468 A
1357 B
146 A
23578 B
13578 A
246 B, etc.

So the actual sequence of lifts numbers forty-eight, twice the twenty-four lifts shown. Plate 95 shows a sample woven in exactly this manner.

The same sequence of lifts but with other colour sequences will lead to more complex patterns but always contained in diamonds. Other lifts will give areas of the two directions of twill, but arranged in squares or triangles, not diamonds.

If the reverses in the threading draft had been arranged as in Fig. 253, a different type of diamond would have been produced, as using the lifts given above will show. There is almost endless scope here.

The only drawback is the large number of lifts. The above design would need fourteen pedals, two of them just controlling shafts 1 and 2, and the other twelve controlling the twelve different combinations of shafts 3–8 that need to be lifted. Both feet would be in action all the time. It is really a type of design more suitable for weaving on a dobby loom.

Plain weave can be obtained by lifting 12 and 345678, and hopsack by lifting 1357 and 2468.

Practical Details

Warp—4 working e.p.i.
Weft—2-ply carpet wool used threefold. Use a floating selvage.

8 · Weft-face Rugs in Multishaft Weaves

PART TWO: TECHNIQUES GIVING BLOCK DESIGNS CONTROLLED BY SHAFTS

INTRODUCTION

All the weaves in the preceding chapter gave small scale motifs that repeated themselves across the rug, i.e., twill lines, small warpway stripes, and others. The size of these motifs could not be increased, except to a very slight extent by setting the warp more openly. Only with skip twills were motifs of larger scale produced. In fact some of the skip-twill threadings are closely related to those of the block weaves.

The block weaves are generally woven with two colours and give rectangular blocks of these two colours, the colours reversing on the back of the rug. The important point is that the width of these blocks, i.e., their weftway dimension, is the direct result of the threading plan. So depending on the threading plan, blocks of any width can be woven. This immediately increases the design possibility of these weaves. They offer great scope for two-colour designs of almost any type.

Block weaves are of two types:

(i) THE TWO-TIE UNIT CLASS

In this class, shafts 1 and 2 control the 'tie-down' warp ends, i.e., the ends that tie down the weft floats, which form the face and the reverse of the rug.

The remaining shafts (3 and 4 in the case of a four-shaft weave) control the pattern blocks, i.e., they determine whether at any point in the weave a certain weft shall float on the face or on the reverse of the rug.

By using more of these block-controlling shafts, more design blocks can be woven and it is a characteristic of this class that each new such shaft introduced into the draft gives one more controllable design block. So with four shafts, two blocks can be woven; with five shafts, three blocks can be woven; with six shafts, four blocks can be woven and so on. There are many weaves of this type Three are described here and they have been named according to the number of ends in one threading block. Other weaves can be constructed using three tie-down shafts.

(ii) The other block weaves do not have the above property of giving an extra pattern block for each extra shaft used. Most of them have to be extended onto eight shafts to increase the blocks they can control.

1. FOUR-SHAFT BLOCK WEAVES

Part 1. Two-Tie Unit Drafts

A. Three-End Block Draft

The simplest block draft is a development of the double-faced three-shaft weave shown in Fig. 212, in the last chapter. The blocks are produced by threading units of (1,2,3) repeated ad lib. for one block, and then threading units of (1,2,4) repeated ad lib. for the next block. This is repeated right across the rug. Fig. 254 shows a very simple example threaded (1,2,3) × 2, (1,2,4) × 2, (1,2,3) × 2. Note the additional 1,2 added at the left after the final 1,2,3 block. This is important, as it causes both wefts to catch properly at the selvages. The weave plan at Fig. 254 (a) and the corresponding ex-

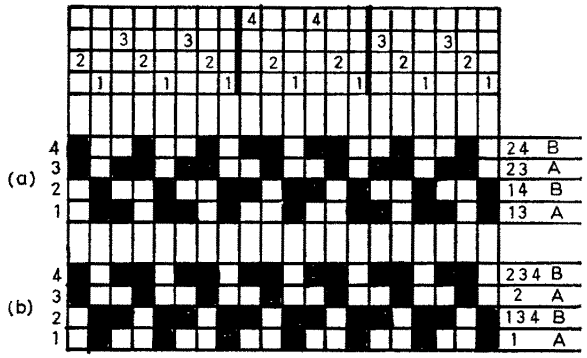


Fig. 254
Block Weave using Three-End Block Draft. Weave Diagram

panded thread diagram at Fig. 255 show that the wefts are either passing over two ends and under one, or under two ends and over one. In the former case the weft will only show on the face of the rug, in the latter case it will only show on the reverse of the rug.

Looking at pick No. 1 (white weft in Fig. 255) it will be seen that in the two outer blocks, threaded on 1,2,3 it passes under two and over one end, so it will appear on the reverse. But in the central block, threaded on 1,2,4, it passes over two and under one end and thus it will appear on the face.

Pick No. 2 (black weft) does exactly the opposite, i.e., it passes over two and under one end in the two outer blocks and so appears on the face, but passes under two and over one end in the central block and so here appears on the reverse. When beaten, these two picks slide over each other, black sliding down in front of the white in the outer blocks and sliding down behind the white in the central block.

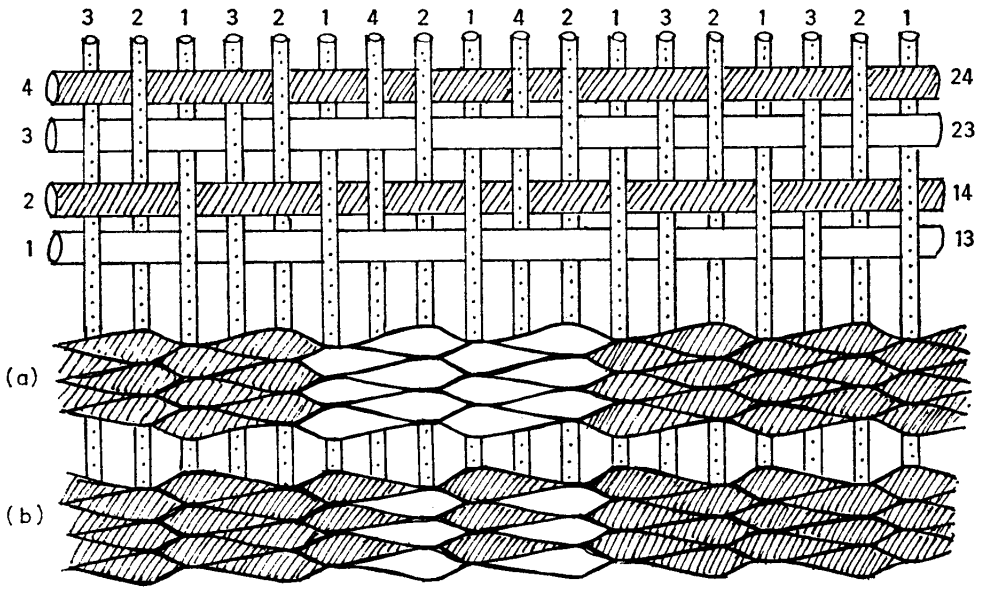


Fig. 255. Expanded and beaten views of Block Weave using three-end Block Draft

Pick 3 is similar to pick 1, but with the floats shifted one end to right or left. Pick 4 is similar to pick 2 with the floats similarly shifted. Picks 3 and 4 slide over each other in a similar way to picks 1 and 2. So when all four picks of the repeat are beaten down, there are two outer black blocks corresponding to the 1,2,3 threading and a central white block corresponding to the 1,2,4 threading, see beaten view at Fig. 255 (a). So simply by lifting (13,14,23,24) and weaving two colours pick-and-pick, the blocks appear automatically.

Note—That the floats of picks 2 and 3 are tied down by ends on shaft 1, and those of picks 1 and 4 by the ends on shaft 2. Hence their shift in position.

If the same colour all the way across, back and front of the rug, is wanted, then weave as for the blocks, but with two shuttles of the same colour. If only one shuttle is used the selvages will not catch properly.

To weave one colour all across on the front, but another colour all across on the back, lift as in Fig. 254 (b) and use two wefts pick-and-pick. So the sequence is:

1 A,
134 B,
2 A,
234 B.

The front of the rug will then be of colour A, floating over two ends, under one all the way across, and the back will be of colour B, floating under two ends, over one all the way across

These two weaves can of course be combined in the same rug. Only change from one to the other after the four pick sequence is completed.

If the foregoing has been understood it will be seen that any number of blocks of any width can be woven. As the threading predetermines the placing and width of the blocks, a large part of the designing of a rug in this technique is in the threading draft.

A warp setting of 4 e.p.i. is normal for this technique, so each repeat of the (1,2,3) or (1,2,4) threading unit takes up $\frac{3}{4}$ inch of warp width. If a sample rug 12 inches wide is to be woven, this will therefore have $\frac{4}{3} \times 12 = 16$ repeats of either (1,2,3) or (1,2,4). So design the blocks on squared paper, using an area sixteen squares wide, so that each square represents either a (1,2,3) or a (1,2,4) unit. See Fig. 256, which shows three possible arrangements. From this diagram the threading can be read directly as the

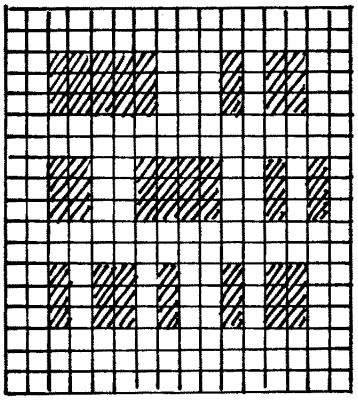


Fig. 256
Possible arrangement of design blocks

shaded blocks represent the (1,2,4) threading units, and the white intervening areas represent the (1,2,3) threading units. Thus (a), starting from the right, reads

(1,2,3)×2
(1,2,4)×2
(1,2,3)×1
(1,2,4)×1
(1,2,3)×3
(1,2,4)×5
(1,2,3)×3

Note—That no plain weave is possible with this threading. Lifting 12 and 34, gives a two up, one down weave all across, similar to picks 2 and 3 in Fig. 255 (a).

VARIATIONS

(1) *Using Two Colours but Varying their Sequence*

So far only a pick-and-pick colour sequence has been considered. This gives blocks of solid colour. But consider the result of changing the sequence from (A,B,A,B) to

(A,B,B,B). This will change pick 3 in Fig. 256 from white to black. Now the picks which appear on the front of the central block in Fig. 255 are numbers 1 and 3. So this central block will now have alternately white and black picks forming its surface. These when beaten down will give warpway stripes of the two colours, see the beaten view in Fig. 255 (b). There will of course be similar stripes on the back of the two outer blocks. So simply by altering the colour sequence, a block of solid colour can be changed into an area of warpway stripes. Plate 96 shows the use of these stripes at either end of a block of solid colour. Plate 97 shows how they can be used within a block.

Note—Once the pick-and-pick weft sequence is broken, the selvage will not automatically weave correctly with each pick. So use a floating selvage, if any other sequence is employed.

(2) *Using Three or More Colours*

It is only one step from the above idea to using three colours in a sequence of (A,B,C,B). Pick 1 and 3 will now be of colour A and C alternately, so the central block in Fig. 255 will consist of warpway stripes of colour A and C, flanked as before by blocks of solid colour B. This provides a useful way of introducing variation into a block. If colour A and C are fairly close, then the occasional change from (A,B,A,B) to (A,B,C,B) will give slight striations in the colour of the block. These striations can of course be shifted to one side by using a sequence of (C,B,A,B), a further refinement.

A further possibility is a colour sequence of (A,B,C,D) which would convert each block into stripes of two colours, and suggests a different type of non-block design.

(3) *Varying Weft Thickness*

If both wefts are of the same thickness (which is the normal condition), they each tend to appear slightly as spots showing through the blocks of the other colour, i.e., in the central block of Fig. 255 which is white, there will be small spots of black showing through. This is only obvious when the colours are as different as black and white; with closer colours, the spots blend into the surrounding colour. They can always be obliterated with very heavy beating of the weft.

A feature can, however, be made of them by using wefts of different thickness. If in Fig. 255 a thick white and a thin black weft were used, then in a white block there would be no black spots, but in a black block there would be quite prominent white spots.

(4) *Altering Lifting Sequence*

The order of the lifts can be changed to (13,23,14,24). The weft does not beat down quite so well with this sequence. With a colour sequence of (A,A,B,B), blocks are produced but they are vague and less solid-looking than the blocks obtained with the normal lifting sequence. It has one advantage, in that, to make one colour show all across on back and front, only a single shuttle need be used, as it catches at both selvages (due to the alternation of shafts 1 and 2 in the lifts).

PRACTICAL DETAILS

The following warp formula is suitable, 6 e.p.i., alternately single and double in the heald, therefore 4 working e.p.i. 2-ply carpet wool used threefold is the correct weft thickness for this warp setting. Remember to add an extra 1,2 after the final 1,2,3 block, as mentioned above. Begin and finish the threading with a treble thickness warp end (i.e., three in a heald). If sleyed in an 8 reed, arrange the right selvage as in Fig. 257 (d) and finish at the left selvage in a similar manner.

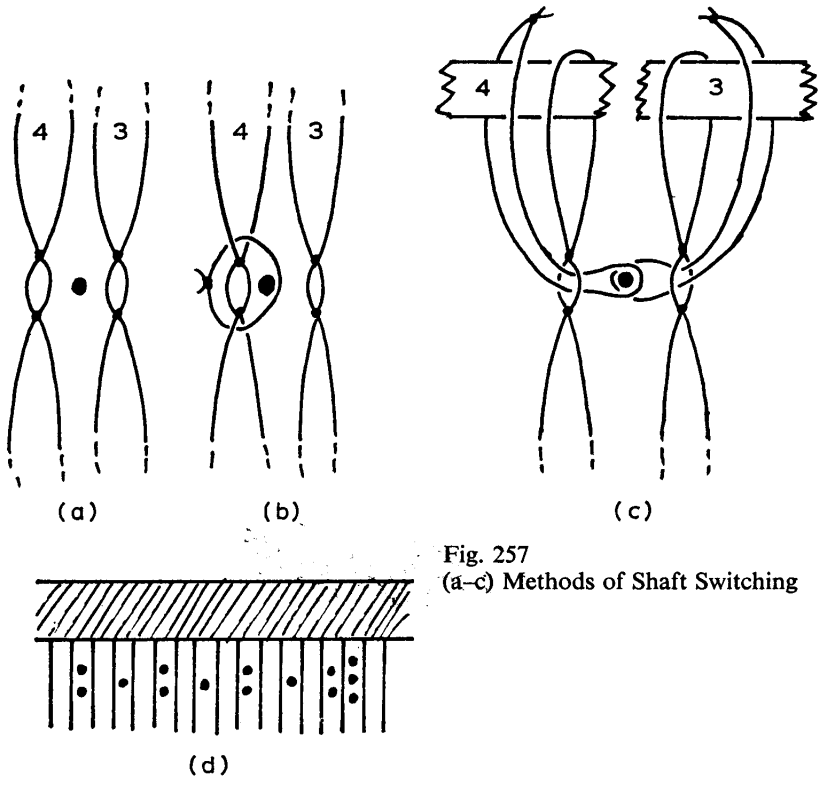


Fig. 257
(a–c) Methods of Shaft Switching

Only use a floating selvage if some other weft sequence than pick-and-pick is wanted. Begin the two wefts from opposite selvages, i.e.:

lift 13—throw weft A from right to left.
lift 14—throw weft B from left to right.
lift 23—throw weft A from left to right.
lift 24—throw weft B from right to left.

So after each repeat of the four lifts, the two shuttles are back at the sides they started from.

There is another way of making the two pick-and-pick wefts catch at both selvages. This is to start the threading at the right with 2,3 before the first 1,2,3 block, and to end at the left with an extra 1, after the final 1,2,3 block. The advantage of this method is that the face colour completely covers the reverse colour at both selvages, whereas with the normal method described above both colours are visible as they turn round the selvage threads.

If the threading units are taken as (2,3,1) and (2,4,1), not as (1,2,3) and (1,2,4), then this type of selvage occurs automatically, without adding extra ends.

If very long rugs in this technique are to be woven (i.e., over 12 feet long) it may be necessary to use two warp beams. This is because the ends threaded on shafts 3 and 4 tend to become slacker than those threaded on the front two shafts, due to the weave structure. So these two sets of ends are beamed separately.

DEVELOPMENTS OF THIS TECHNIQUE

(1) *Shaft-switching*

In this simplest of block weaves, it will be noticed that the only difference between the threading of the two blocks is the presence of an end on shaft 3 or 4. If these ends are mentally extracted from Fig. 255, it will be seen that plain weave on ends 1 and 2 is left, with two picks in each shed, one black and one white. In other words the function of the ends on shafts 3 and 4 is to separate the two picks in each shed and so allow the second to slide down in front or behind the first. But however they achieve the result, it is obvious that it is the ends on shafts 3 and 4 which control the weft's appearance either on the face or on the reverse of the rug.

So if some way could be found for, as it were, switching ends from shaft 3 to shaft 4, or vice versa, *during* the actual process of weaving a rug, then much freer designs than simple blocks could be woven. In fact, if the switching were simple enough, a completely free design could be woven.

There are several ways of doing this:

(a) Do not thread an end on shaft 3 or 4, but enter it between an empty heald on shaft 3 and an empty heald on shaft 4, see Fig. 257 (a). Then the end can be tied to one or other heald, as the design demands with a small loop of warp yarn. See Fig. 257 (b)

where it has been tied to a heald on shaft 4. This is a rather primitive method, and is not suitable if many changes of many ends are required by the design.

(b) A slightly more sophisticated method is based on the floating selvage idea, see Fig. 257 (c). Loops of yarn threaded through the empty healds on shafts 3 and 4 surround the unthreaded warp end, and then go up to their respective shafts and are knotted. Now if the loop attached to shaft 4 is tightened (either with a slipknot or a button as suggested for the floating selvage) and the loop on shaft 3 allowed to hang loose, then the warp end will move as if actually threaded on the shaft 4. Similarly if the loop on shaft 3 is tightened and the loop on shaft 4 loosened, the end will move as if threaded on shaft 3. Though the preparation of loops takes time, this is a much easier method to operate, as all adjustments are made on top of the shaft, not amongst the healds at warp level, as in the first method.

The most economical use of methods (a) and (b) is in rugs designed specially for them. Such a design can be based on blocks, but may have variations in it resulting from shaft-switching. For instance, it only needs one switch to convert a block into two smaller ones, see Fig. 259 (a); two switches to convert a solid block into a hollow one, see Fig. 259 (b); and three switches to convert a block into an H-shape, see Fig. 259 (c). Such variations requiring only a little switching, rob a block design of its regularity, and so add much to its interest. If the design is planned carefully on paper beforehand, only those ends which are going to change shafts need be threaded in this special way. See Plate 98 for a rug with a few changes.

(c) A very simple addition to the loom makes the above method of shaft switching so easy that completely free designs can be woven with speed and accuracy. As will be seen, it is only possible on a loom in which the shafts are raised by cords, not on a jack loom in which they are pushed up from below.

Two strips of wood are needed as long as the shafts are wide. They should be about $\frac{1}{4}$-inch thick and about 3 to 4 inches wide. These are suspended above shafts 3 and 4 as shown in Fig. 258. A short length of cardboard tube is threaded on the cords which raise shaft 3 and one strip of wood (A) is passed between the cords above the tube, so that it lies above the shaft and parallel to it. A full-length tube is threaded similarly on the cords of shaft 4 and the other strip of wood (B) put above it. See Fig. 258, where the tubes are shown spotted.

The string loops controlling the shaft-switching are attached to these two strips of wood in the following way. Along the top edge of each strip, small nails are inserted every $\frac{3}{4}$ inch, and along the bottom edge, small screw eyes are similarly spaced, see Fig. 258. The spacing is related to the warp setting. Every third end of this particular weave can be switched and assuming the warp to be set at 4 working e.p.i., this means these ends are $\frac{3}{4}$-inch apart and hence the nails and screws are similarly spaced.

String loops are made of two sizes, short ones to be used between strip A and shaft 3 and long ones between strip B and shaft 4. Each has to be of such a size that when threaded through the screw eye, with its knotted end over the nail above (see Fig. 258),

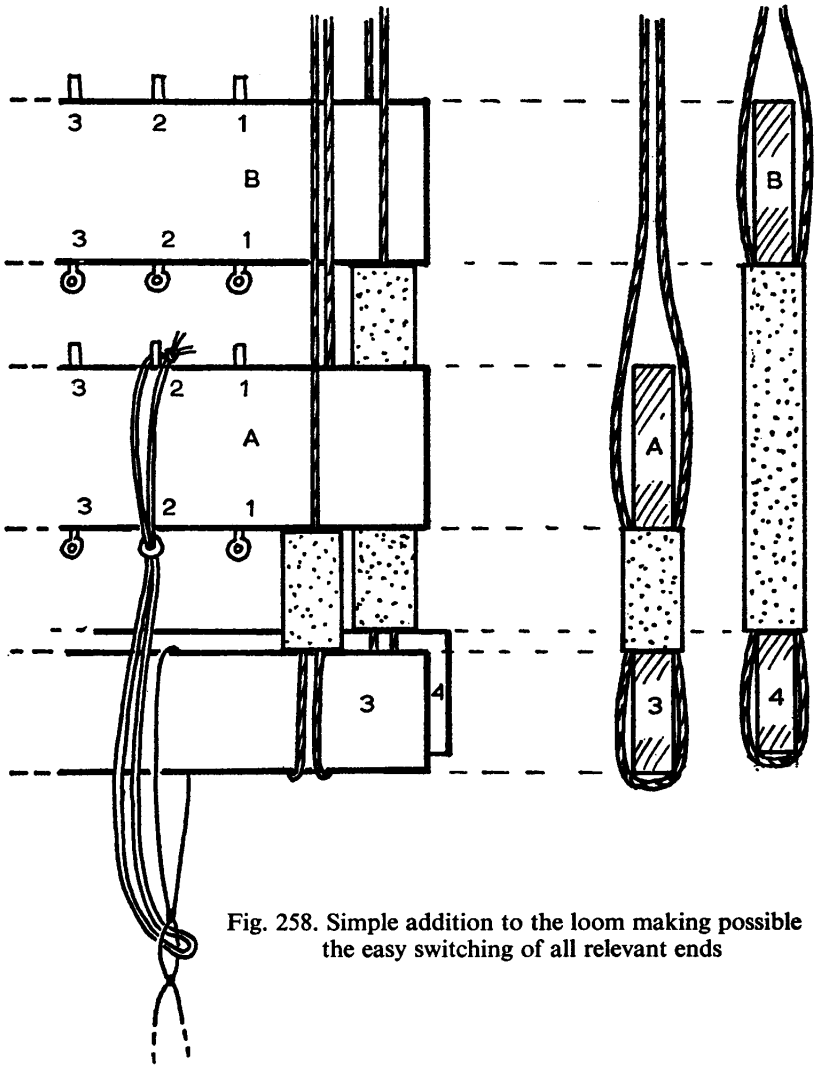


Fig. 258. Simple addition to the loom making possible the easy switching of all relevant ends

its lower looped end just reaches the heald eye below. This is the tight position of the loop. To loosen a loop, just lift it off its nail; its knotted end prevents its slipping through the screw eye. Number each nail and screw eye similarly on both strips of wood, see Fig. 258. Then when a loop is *on* nail 6 on strip A it must be *off* nail 6 on strip B. Switching a shaft only entails lifting a loop off its nail on one strip and replacing the corresponding loop on its nail on the other strip, a procedure which takes a few seconds. It will be obvious that the two strips A and B are placed at different heights so that they are both within full view and easy reach of the weaver as he switches the shafts.

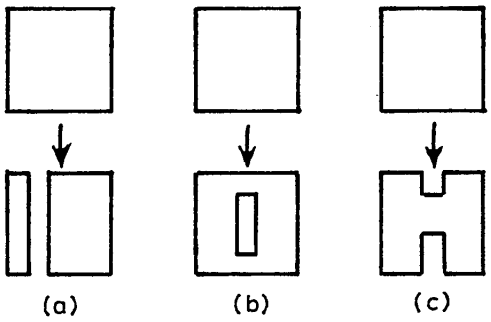


Fig. 259
(a–c) Changes of design due to switching 1, 2 or 3 times

The string loops should be accurately made or the shed will be of uneven depth. If all the loops on one strip prove to be too long or too short, make the adjustment by altering the length of the cardboard tube. It is easier to thread the warp with all the loops in the tight position. Once this simple piece of equipment has been made, it can be used for any number of rugs or lifted out of the loom when not required and kept for future use.

Note—Only switch an end from one shaft to the other after the completion of the lifting sequence, i.e., after a pick on the 24 lift has been thrown.

(d) There is a simple pick-up technique based on this weave, in which the pick-up stick, as it were, switches ends from shaft 3 to shaft 4, and vice versa, for every throw of the shuttle. This is described in Chapter 9.

(2) If several rugs in this technique are to be woven, it is a good idea to thread in such a way that adjustments can easily be made to the design after each rug is cut off. This is managed by leaving an empty heald on shaft 4 beside every filled heald on shaft 3, and an empty heald on shaft 3 beside every filled heald on shaft 4. Then when a rug is cut off, an end is simply changed from shaft 3 to 4, or vice versa, before the next rug is begun. This means of course that the design could be changed completely by rethreading at most only a third of the warp.

Other Weaves Using this Block Draft

It will be obvious that if shafts 3 and 4 are always lifted together, this threading draft can be treated as a straight draft on three shafts. So the weaves described for the latter in Chapter 7 can all be woven with this draft. Wherever a 3 occurs in the lifting sequence of these weaves, add a 4. So the lifts for the double-faced 2/1 twill weave in Fig. 208 change from (12, 1, 23, 2, 13, 3) to (12, 1, 234, 2, 134, 34). Another way is to tie shafts 3 and 4 together and lift exactly as for the three-shaft weaves.

B. Four-End Block Draft

This threading system is well known as it is the one used for Summer and Winter weave. The analysis of two Coptic double-faced fabrics from the fourth century A.D. shows that they could have been woven on such a threading. It is interesting that they were woven as weft-face fabrics, exactly as one of the rug techniques to be described.

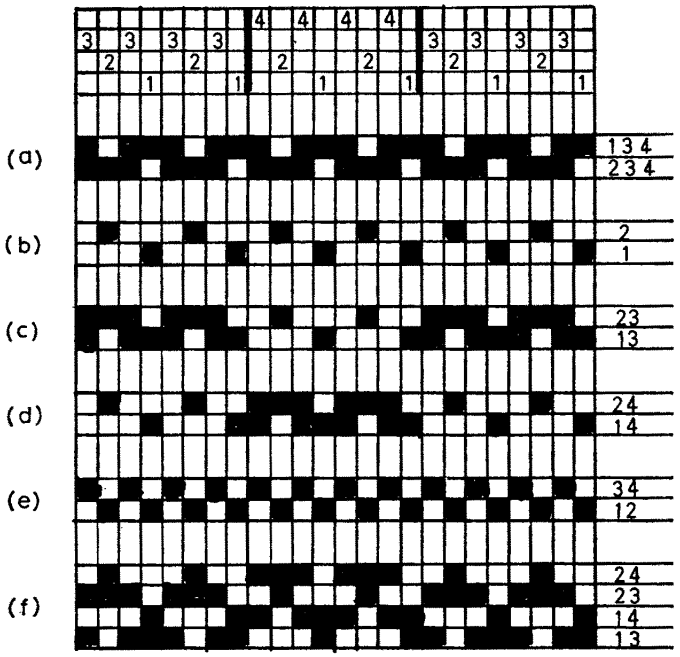


Fig. 260
Block Weave using Four-End Block Draft. Weave Diagram with various weave plans

Fig. 260 shows at the top how the blocks are threaded. Two repeats of the four-end threading unit have been used in each block. It will be noticed that it is very similar to the three-end block draft. The addition of an extra 3 or 4 to each unit has two effects, (1) it makes plain weave possible and (2) it make the weft float over or under three ends, instead of two.

Below the threading draft is shown how warp and weft interlace with various lifts. In all of them it will be seen that the weft either passes over three and under one end, or under three and over one end. One of these interlacings can either go right across as at (a) and (b) or the interlacing can change from block to block as at (c) and (d).

Note—As with the previous weave, the floats forming the surface in each block can be placed in two positions. This is due to the two tie-down ends on shafts 1 and 2.

—That at the junction between two blocks the weft floats over only two ends or

under two. This can be converted into a float of three ends by threading two ends on the first shaft at the beginning of each block, as was apparently done in one of the Coptic fabrics referred to above.

(i) BLOCK WEAVE NOT REQUIRING PLAIN WEAVE

Fig. 260 (f) shows this simple block weave. By lifting (13, 14, 23, 24) and using an (A,B,A,B) colour sequence in the weft, blocks of colours A and B are produced. The colours reverse on the back. This is the weave found in the double-faced Coptic textiles; it was also used in one type of checked Navajo blanket. It makes a thick weave, but it is not a very good construction for rugs. Other colour sequences can be used, e.g., (A,B,C,B) or (A,B,A,B,C,B,C,B); the first gives warpway stripes in block 2, the second weftway stripes.

To produce the same colour all across the rug, lift (1, 134, 2, 234) again with an (A,B,A,B) colour sequence. The face of the rug will then be entirely of colour A, the reverse of colour B.

(ii) BLOCK WEAVES REQUIRING PLAIN WEAVE

In all the following weaves two picks of plain weave, on 12 and 34, follow every pattern pick. A thinner weft is used for the plain weave, see Practical Details.

(a) The simplest weave in this group is obtained by repeating one of the lifts in Fig. 260 (c) or (d), followed by plain weave. So the sequence could be: (**13,** 12,34) repeated ad lib for one block, (**14,** 12,34) repeated ad lib for opposite block.

Note—That the lift for the pattern weft is in bold type in this and other sequences.

One of the blocks then appears as vertical ridges of floats which completely hide the plain weave and the other block as predominantly plain weave but with vertical rows of spots, see Plate 99 (top). So it is the difference in colour between the pattern weft and the plain weave weft that makes the two blocks more or less distinct from each other.

This is not a very satisfactory weave, all the pattern floats in a block are tied down under the same end which can lead to warp tension troubles. So it is better to use the two possible positions of floats for each block. Thus the sequence could be:

(**13,** 12,34)×4
(**23,** 12,34)×4 } Repeated ad lib for one block.

(**14,** 12,34)×4
(**24,** 12,34)×4 } Repeated ad lib for the other block.

There could, of course, be more or less than four repeats. As in the first weave above, this weave can be obtained all the way across the rug. If lifted (**1,** 12,34)×4;

(**2,** 12,34)×4, the pattern floats will appear all across the face of the rug. If lifted, (**134,** 12,34)×4; (**234,** 12,34)×4, the floats will appear all the way across the reverse of the rug.

By combining some of these lifts, a motif can be woven as in Plate 100. It also shows another possibility. At the junction between the two possible float positions within a block, the two picks of plain weave are distorted into a wavy line. If different colours, in this case white and black, are used for the plain weave in these positions, a feature can be made of the waviness of these lines. The plain weave picks to be differently coloured are underlined in the following sequence: **13,** 12,34; **13,** 12,34; **23,** 12,34; **23,** 12,34. (Note that the warp in this sample has been set too close and so the weft does not beat down completely and cover it.)

(b) A sequence of (**14,** 12,34, **13,** 12,34) repeated ad lib with two colours pick-and-pick for the pattern weft, gives two blocks each consisting of vertical ridges of floats of one colour, see Plate 99 (bottom). A sequence of (**24,** 12,34, **23,** 12,34) gives a similar weave, but the junction between blocks is a little different. To obtain one colour all across on the front and another on the back, lift (**1,** 12,34; **134,** 12,34) or (**2,** 12,34; **234,** 12,34). The crossbars in the Plate were woven thus.

(c) A slight variation is the sequence (**14,** 12,34, **23,** 12,34) repeat or (**24,** 12,34, **13,** 12,34) repeat, with a pick-and-pick pattern weft sequence.

Here the ridges of floats in one block are separated by spots of the colour from the opposite block, see Plate 101. For one colour all across on the front and another on the back, use the sequence (**1,** 12,34; **234,** 12,34) repeat, or (**2,** 12,34; **134,** 12,34) repeat. As the Plate shows, one of these sequences has been used at the top and bottom of the sample shown.

In both the above weaves, the surface of the rug on both sides is covered by floats. The colours of the blocks are changed simply by altering the weft sequence from (A,B,A,B) to (B,A,B,A).

(d) Probably the best block weave on this threading for rugs is the following: (**13,** 12,34, **23,** 12,34) repeated ad lib for one block; (**14,** 12,34, **24,** 12,34) repeated ad lib for the other block. It gives one block in which the pattern weft floats completely hide the plain weave and an alternating block predominantly plain weave but with spots of the pattern weft showing through in vertical rows. By using one colour for all the pattern picks, a solid block of floats is produced which alternates with a block of spots of the same colour.

But if two wefts of a different colour are used for the pattern picks, there are many more possibilities. Using these two colours alternately, their floats appear as warp-way stripes (just like pick-and-pick stripes in plain weave) within the block. See Plates 102 and 103, where the effect has been enhanced by the plain weave weft being the same colour (black in 102, white in 103) as one of the pattern wefts. Thus the black areas in the right-hand block in Plate 102 are made up partly of the black plain weave and partly of the spots of black pattern weft, the two combining visually into a single

area. Note how in the alternating blocks there are corresponding warpway stripes of spots (these blocks appearing like the ghosts of the main blocks). Plate 104 shows a black and white rug in this technique.

Any of the other two-shuttle patterns described in Chapter 4, can be produced in the main blocks, i.e., cross stripes and spots, with a corresponding ghost of the pattern in the alternating blocks. This is a very firm weave and excellent for rugs; its only disadvantage is the number of plain weave picks, which make it much slower to weave than the three-end block draft weaves.

PRACTICAL DETAILS

A warp setting of 5 working e.p.i. is suitable. Of the two wefts, the plain weave weft should be 2-ply carpet wool used singly and the pattern wefts should be the same yarn used fourfold.

Always use a floating selvage. This is for the benefit of the pattern weft not the plain weave weft. Assuming there is an even number of working ends in the warp, take care at the beginning of the rug to start the plain weave weft from the correct side in relation to the shed used. This is the side at which the last *threaded* end (the one nearest the floating end) is raised. The shuttle is then inserted between this raised end and the floating end and it is withdrawn at the opposite side between the lowered end and the floating selvage. If the shuttle starts from the wrong side, the plain weave weft will weave over two, under two at both selvages. For weave (a), the block weave not needing plain weave, a setting of 6 working e.p.i. is probably better, with a weft of 2-ply carpet wool used three or fourfold.

C. Six-End Block Draft

This weave is a development of one of the double-faced three-shaft weaves described in Chapter 7.

The threading draft is shown in Fig. 261, where two repeats of the six-end unit are used in each block. Note how the ends on shafts 1 and 2 are regularly spaced across the threading. The draft can be lifted in two ways, either to give the same colour all across (and another colour all across on the back) or to give blocks of two colours.

Fig. 261 (a) shows the first possibility. Picks 1 and 2 alternately float over three ends, and weave with three ends, all the way across the face of the rug, picks 3 and 4 behave similarly on the back of the rug, floating under three ends, then weaving with three ends all the way across. With a colour sequence of (A,A,B,B) the rug will be colour A on the face and colour B on the reverse.

Fig. 261 (b) shows the lifts that give a block weave. Picks 1 and 2 float over three ends in Block 1 and under three ends in Block 2, therefore colour A will show on the front in Block 1 and on the back in Block 2. In picks 3 and 4, the opposite happens, so colour B shows on the back in Block 1, and on the front in Block 2.

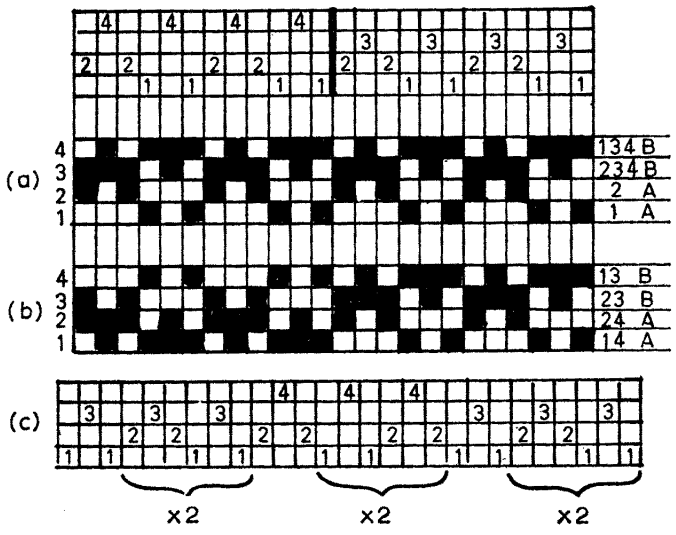


Fig. 261
Block Weave using Six-End Block Draft
(a) and (b) Weave Diagrams
(c) Method of joining threading blocks when $2\frac{1}{2}$ repeats of draft are used

So a colour sequence of (A,A,B,B) will give two blocks, each of a solid colour. But as was explained in the three-shaft version, any of the two-shuttle designs possible in weft-face plain weave can be woven in the surface floats of these blocks. So one or both blocks can have any of these two-shuttle designs in any combination. This gives great possibilities of design.

The three Plates hint at these. In Plate 105 blocks of pick-and-pick stripes and blocks of cross stripes alternate in chequer fashion, the colour sequence would be: (A,B,A,A)×4, (A,B,B,B)×4, repeat, for the first row with pick-and-pick blocks on the outside; and (A,A,A,B)×4, (B,B,A,B)×4, repeat, for the second row which has a single pick-and-pick block in the centre.

In Plate 106, the design has been limited to pick-and-pick stripes all across, but by using three colours a great deal of variety is introduced. Sometimes a colour appears all the way across, sometimes it is confined to one block.

In Plate 107, a block of solid colour alternates with blocks of two-shuttle designs. Three colours were used again.

The blocks in all these samples consisted of $2\frac{1}{2}$ repeats of the threading unit. This was done so that there were an odd number (five) of pick-and-pick stripes in each block and a motif could therefore be easily centred in the block. When the threading unit is split in this way, the sequence of ends on shafts 1 and 2 must not be broken between blocks; so the second block has to begin on 2,4,2 instead of 1,4,1. This is shown in Fig. 261 (c).

DEVELOPMENT

This weave can be developed exactly as the three-end block draft by means of shaft-switching. For the pick-up version see Chapter 9.

PRACTICAL DETAILS

The warp should have 5 working e.p.i., and the weft should be 2-ply carpet wool used two or threefold. Use a floating selvage. No plain weave is possible, but lifting 12 and 34 gives a two up, one down weave all the way across the rug.

FOUR-SHAFT BLOCK WEAVES

Part 2. Other Drafts

A. Draft Based on Single End Spot Draft

An interesting block weave can be based on the Single End Spot draft described in Chapter 7. As shown in Fig. 262, the first threading block is exactly as the Single End Spot draft and is repeated ad lib. There is then a 'linking' end on shaft 1 (encircled). The second threading block is threaded (3,4,3,1,3,2) repeated ad lib, followed by a 'linking' end on shaft 3 (encircled). Block 3 is exactly like Block 1, Block 4 is exactly like Block 2, etc. Each block has only two repeats of the threading in Fig. 262. It will be seen that the threading of Block 2 is of the same type as Block 1, except that here every other end is on shaft 3, not shaft 1.

The weave plans in Fig. 262 show that the weaves are a combination of plain weave

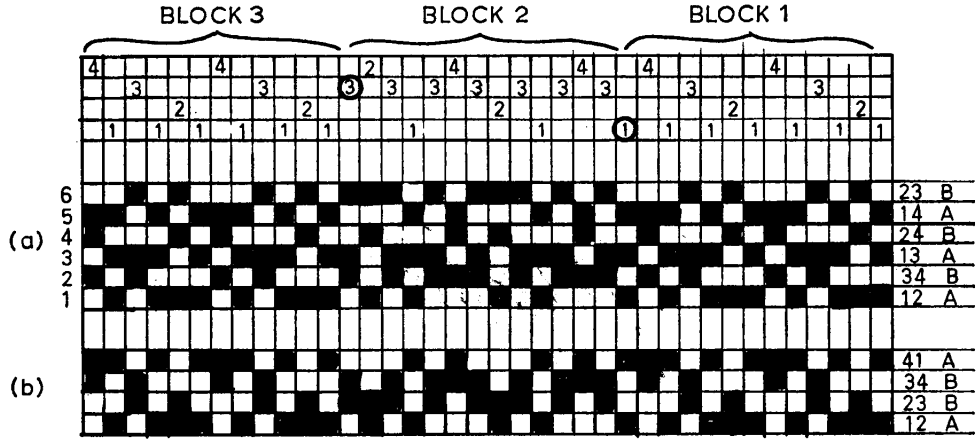


Fig. 262. Block Weave based on Single End Spot Draft. (a) and (b) Weave Diagrams

and floats over and under three ends. The latter floats more or less cover the portions in plain weave. So the surface of the rug is formed by these floats. Obviously a weft shows on the surface when floating over three ends and on the back when floating under three ends.

The blocks can be woven in various ways.

(i) Fig. 262 (a) shows the weave plan when the lifts are as for twill woven on opposites, see Chapter 7. If the colour sequence is (A,B,A,B,A,B) colour A will show on the face, in the central block (Block 2), and on the reverse in Blocks 1 and 3 (picks 1 and 5); and colour B will show on the face in Blocks 1 and 3 and on the reverse in Block 2 (picks 2 and 6).

But picks 3 and 4 are of a different type. Pick 3 gives floats all the way across on the reverse and pick 4 gives floats all the way across on the face of the rug. So colour A will appear only on the reverse on pick 3 and colour B will appear all the way across the face on pick 4.

This means that whereas Blocks 1 and 3 will show floats of colour B only (appearing in twill order), Block 2, though mainly of colour A, will have spots of colour B appearing on it. These spots join together to form a vertical stripe.

Alternatively the colours on pick 3 and 4 can be reversed, so that Block 2 is solid colour A and Blocks 1 and 3 though predominantly colour B will have spots of colour A. By combining these two colour sequences (A,B,A,B,A,B) and (A,B,B,A A,B), the blocks can be made more interesting. See Plate 108, where the alternative sequence has been twice used to give dark spots on the white blocks.

(ii) When lifted as for a 2/2 twill with a colour sequence of (A,B,B,A), see Fig. 262 (b), Blocks 1 and 3 are of colour B with thin warpway lines of colour A running down them, and Block 2 is of colour A with thin lines of colour B. See Plate 109.

A variation of this is to lift as for a broken twill with a colour sequence of (A,B,A,B). This gives a very similar result except that the thin line is more continuous and less like a succession of spots. Plate 110 shows this block woven with an (A,B,C,B) colour sequence.

(iii) If picks 1 and 2 of the twill woven on opposites are repeated up to four times, then picks 5 and 6 repeated similarly, a block with very interesting characteristics is produced. So the sequence is:

$$\left.\begin{matrix}(12,34)\times 4\\(14,23)\times 4\end{matrix}\right\}\text{repeated ad lib}$$

The pick-and-pick sequence of colours A and B is maintained throughout. Plate 111 shows these blocks. This is the least firm of the weaves, which is why it is suggested that each pair of picks should only be repeated four times.

If a rug is woven using several of these different blocks, use the 2/2 twill weave as the ground weave. Always connect the ground weave with a block weave and vice

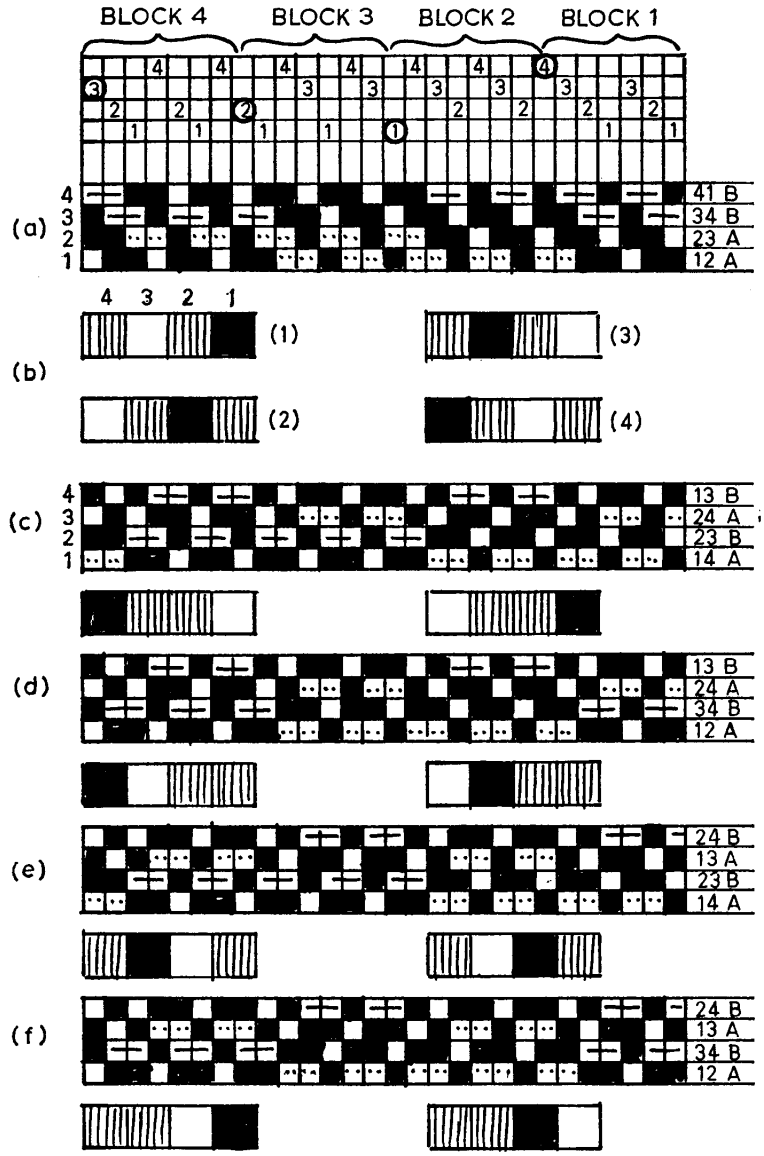


Fig. 263
Block Weave based on straight three-shaft draft. Weave Diagrams and diagrams of colour arrangement in the four blocks

versa in the way that least affects the lift sequences. For instance, to change from the last weave to the ground weave, weave thus:

14, 23, 14, 23, 34, 41, 12, 23, 34, 41.

i.e., after the final 23 of the block weave, start the ground weave on the lift that normally follows 23 in *its* sequence. This is not always simple to do.

RIDGES

As the threading stands, ridges all the way across the rug are not possible. If the positions of the ends on shafts 2 and 4 are reversed in Block 2 (so threading becomes 3,2,3,1,3,4) then lifting 1,2,3,4 will give a ridge, but this upsets the block weaves. With the threading in Fig. 262, lifting shaft 1 gives long floats in Block 2, and lifting shaft 2 gives long floats in Blocks 1 and 3 and these could possibly be worked into the block weaves.

PRACTICAL DETAILS

These are exactly as for the Single End Spot draft, i.e., a warp with 5 working e.p.i. and a weft of 2-ply carpet wool used twofold.

B. Draft Based on a Straight Three-Shaft Draft

This draft is based on a straight three-shaft threading. In each threading block, the draft is started on a different end so, as four shafts are being used, there are four threading blocks. As shown in Fig. 263, Block 1 is threaded (1,2,3) ad lib, followed by a 'linking' end on 4, Block 2 is threaded (2,3,4) ad lib, followed by a 'linking' end on 1, Block 3 is threaded (3,4,1) ad lib, followed by a 'linking' end on 2, Block 4 is threaded (4,1,2) ad lib, followed by a 'linking' end on 3. Only two repeats of the threading are shown in each block. (Note that if only one repeat of each block is threaded this becomes identical to the skip twill in Fig. 234 (c) in the last chapter.)

The special feature of this weave is that it not only gives blocks of two solid colours but a third block consisting of warpway stripes of these two colours. The relative position of these three areas can be changed at will, as the following details will show.

(i) WITH STRAIGHT 2/2 TWILL LIFTS

Fig. 263 (a) shows the weave plan when the lifts are (12,23,34,41).

Note—That for all four picks the weft passes under two ends, over one for two adjacent blocks, then over two ends and under one for the next two blocks. It will appear on the face of the rug in the latter part and on the reverse of the rug in the former part. Thus pick 2 will appear on the face in Blocks 3 and 4, and on the reverse in Blocks 1 and 2.

—That in each block, two of the picks (of the four pick repeat) appear on the surface and the other two on the back but which picks in the sequence do which varies from block to block. Thus, in Block 1, picks 3 and 4 come to surface, in Block 2, picks 1 and 4 come to the surface, in Block 3, picks 1 and 2 come to the surface, in Block 4, picks 2 and 3 come to the surface.

Now consider what happens if a colour sequence of (A,A,B,B) is used. Block 1 whose surface is formed by picks 3 and 4 will appear as solid colour B. Block 3 whose surface is formed by picks 1 and 2 will appear as solid colour A. But in Block 2 and Block 4, colours A and B will alternately come to the surface. When these are beaten down they will form warpway stripes, exactly like pick-and-pick stripes in plain weave.

To make this easier to understand, the weft floats (which form the surface of the rug) have been marked in Fig. 263 (a). Dotted lines represent the floats of colour A, and straight lines those of colour B. If these floats alone are concentrated upon (being the only visible elements in the rug as woven) the make-up of the different blocks will become clear.

This arrangement of the colour areas can be put diagrammatically as in Fig. 263 (b) (1), assuming colour A to be white, and colour B to be black. The colour areas can be shifted relative to the threading blocks simply by beginning the colour sequence (of A,A,B,B) on different lifts of the lifting sequence.

Thus if it is begun on 23, instead of 12, the colour areas all shift to the left, see Fig. 263 (b) (2). So in this case the sequence becomes:

12, 23, 34, 41
B A A B

If the sequence is started on 34, the areas shift to the positions shown in (3), and if started on 41, they shift to the positions shown in (4).

Note—That in all these positions, the relation between the solid black, solid white and striped areas is constant, i.e., a striped area always separates two solid areas.

This weave can be produced equally well by lifting as for a 2/2 broken twill and using the two colours pick-and-pick.

(ii) The possibilities of this weave are still further increased by introducing the two lifts, 13 and 24. As will be seen from picks 3 and 4 in Fig. 263 (c), which use these two lifts, the interlacing still consists partly of over two, under one and partly under two, over one, but here the interlacing changes from one variety to the other at *every* junction between blocks.

The four weaves in Fig. 263 (c)–(f) consist of two of the twill lifts (either 12 and 34 or 23 and 41) plus the two lifts 13 and 24. By altering these and the colour sequences, eight more possible arrangements of the colour areas are possible. In all cases the colour sequence is pick-and-pick, either (A,B,A,B) or (B,A,B,A).

Looking at Fig. 263 (c) (where the weft floats have been drawn in as before) it will be seen that Block 1 will be all white, Block 4 all black, and Blocks 2 and 3 will both be striped. This has been shown in the left-hand diagram below the weave plan. The right-hand diagram shows the exact opposite, i.e., what happens if the colour sequence is changed to (B,A,B,A).

Similarly Fig. 263 (d), (e) and (f) show all the other possible arrangements of the colour areas.

Note—That in this weave the solid black and white areas are adjacent and that the striped area spans two adjacent blocks.

—That weave (c) is identical with weave (e) except for the reversed order of picks 3 and 4. The same applies to weaves (d) and (f),

—That the colour diagrams below each weave plan represent on the left the result when (A,B,A,B) is the colour sequence in the weft, and on the right when (B,A,B,A) is the colour sequence.

The above two weaves show the very many possibilities offered by this threading. Any of the colour arrangements, of which there are twelve, can be used separately or in combination. Plate 112 shows a rug with five threading blocks (the fifth being the same as the first) which uses only one of the 2/2 twill sequences throughout. Plate 113 shows a sample in which a design block has been built up of three different colour arrangements. Note how the stripes move slightly to one side when the colour arrangement is changed. Plate 114 shows a rug threaded with three complete repeats of the threading. Each time a design block appears, the relative positions of the solid and striped areas is changed.

Shaft Switching

The shaft switching principle can be applied to this block weave. Looking at Fig. 263, it will be seen that there is only a slight difference between the threadings of any two adjacent blocks. Thus Block 1 is threaded 1,2,3,1,2,3,1,2,3, and Block 2 is threaded 2,3,4,2,3,4,2,3,4. So it is only the ends on shafts 1 and 4 which differentiate the two blocks; the ends on shafts 2 and 3 are exactly the same for both blocks.

So ends have to be switched from shaft 1 to 4 to make an area, threaded as in Block 1, weave as if threaded as in Block 2. Similarly they have to be switched from shaft 4 to 1 to have the reverse effect. The same can be done with any two adjacent blocks.

Between Blocks 2 and 3, the switch is from shaft 1 to 2, or vice versa.

Between Blocks 3 and 4, the switch is from shaft 2 to 3, or vice versa.

Between Blocks 4 and 1, the switch is from shaft 3 to 4, or vice versa.

This enormously enlarges the scope of an already versatile block weave.

Plate 115 shows a rug using this technique, as does the colour frontispiece.

(iii) This draft can be thought of as a skip twill, as well as one based on a straight three-shaft draft. As a skip twill based on a four-shaft straight draft, it excludes every fourth end within a block but it excludes the fifth end at the junction between blocks. The following weaves are based on its identity as a skip twill.

(*a*) With a pick-and-pick weft sequence and lifted as a twill woven on opposites, the weave gives a twill line. It is so flat as to be nearly a horizontal stripe, and is of little use. But if this twill is reversed at frequent intervals, it gives an interesting block weave. The sequence can be:

12, 34, 14, 23, 34, 12, 14, 23,
A B A B A B A B Repeat

From Fig. 264 it will be seen that the weft floats under Blocks 1 and 2 are predominantly colour A and those under Blocks 3 and 4 are predominantly colour B. Hence the appearance of the blocks, neither of which is a solid colour.

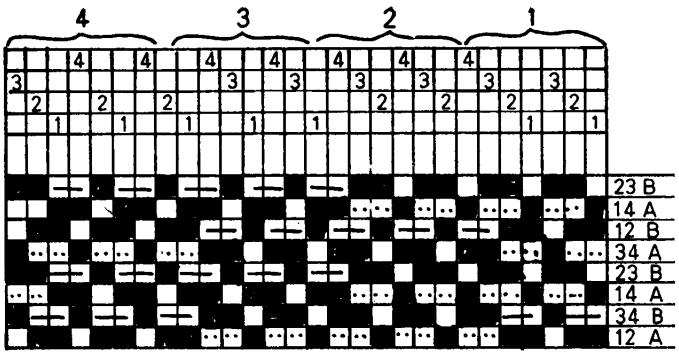


Fig. 264
Block Weave based on straight three-shaft draft. Weave plan when woven as twill 'on opposites'

(*b*) With straight 2/2 twill lifts and a colour sequence of (A,A,B) or (A,B,C) flat twill lines are obtained.

(*c*) Some weaves are achieved also by using the three pairs of opposites repeated several times, i.e. (13, 24) repeated ad lib; (12, 34) repeated ad lib; (23, 14) repeated ad lib, but they are not very sound structurally.

PRACTICAL DETAILS

A warp formula of 6 e.p.i. threaded alternately single and double in the heald, therefor 4 working e.p.i. is suitable, with a weft of 2-ply carpet wool used threefold or some yarn of equivalent thickness. Always use a floating selvage and arrange the selvage ends as for the first block weave described in this chapter.

C. Traditional M's and O's Draft

This interesting draft gives two things. Two blocks of different colours but identical weave and also two blocks of differing weaves which are shown up by the use of two or three colours in the weft

As Fig. 265 shows, the threading of one block is (1,2,3,4) repeat, and of the alternating block (1,3,2,4) repeat. So it is a reduction of the normal M's and O's draft.

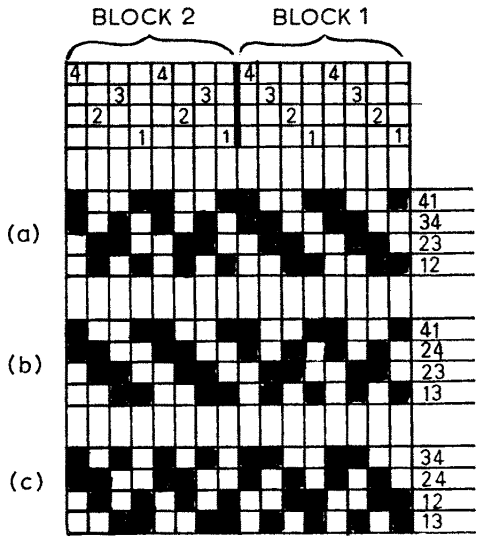


Fig. 265
Block Weave using M's and O's draft. Weave Diagram

(i) The classic way of weaving this threading is by lifting 13, 24 for one design block and 12, 34 for the other design block. This gives a design of plain weave and hopsack in checks. It will be understood that it is not very suitable for a weft-face weave, as a weft suitable for the plain weave areas will be too thin for the hopsack areas. But Plate 116 shows that it is just feasible. The pick-and-pick areas represent the blocks lifted on 13 and 24 and the intervening grey stripe the block lifted on 12 and 34. The characteristic distortion of the weft line is seen on either side of the grey stripe.

(ii) Fig. 265 (a) shows what happens if a 2/2 twill lifting is used. In the block threaded (1,2,3,4) there is naturally a normal twill, but in the other block, the weft is weaving plain weave and hopsack on alternate picks. This will give a slight difference of texture between the two blocks if just one weft is used, but if two wefts are used in an (A,A,B) colour sequence, the difference will be more apparent.

Plate 117 shows a sample woven in this way; the typical oblique lines of two colours are seen in the (1,2,3,4) block and an irregular spotted design in the (1,3,2,4) block. In the latter block, it is mainly the picks that have a hopsack interlacing that form the surface, i.e., virtually only every other pick is seen.

Fig. 265 (b), shows how the weaves in the two blocks can be reversed by lifting (13, 23, 24, 41). This is seen in the upper half of the plate, where the lifting sequence has been reversed to change the direction of the oblique lines.

There are many possibilities here, for in the (1,2,3,4) block, any of the many colour and weave effects described for 2/2 twill can be used and something quite different is bound to appear in the (1,3,2,4) block. This is hinted at in the photograph, where the (A,A,B) colour sequence has been changed to (A,B,B) in the middle of each design block. Luckily the two weaves beat down to the same extent, but any unevenness at the

fell of the rug can be counteracted by reversing the weave areas (i.e., changing from weave (a) to weave (b) in Fig. 265).

(iii) Fig. 265 (c) shows the details of a block weave on this threading using two colours, pick-and-pick. The areas do not appear as solid colours, but as in Plate 118, where it is seen that in the white central block each white float is surrounded by a thin line of black, rather like the appearance of pebbles set on edge in cement. The same applies to the black blocks, the black floats being surrounded by white lines.

An interesting feature of this block weave is that the colours do not reverse on the back of the rug, a white block on the front is also a white block on the back. Examination of the weave plan explains this, see Fig. 265 (c). The surface of Block 2 is formed by the weft floats of pick 1 and 3, therefore it is colour A. But these two wefts float to an equal extent on the back of this block. So the back is also colour A. Colour B only weaves plain in Block 2 so is practically hidden by the floats on front and back; it only shows as the thin outlines mentioned above.

If the two colours were closer than black and white, this outlining effect would be less obvious and the blocks could appear as solid but variegated colours.

The variations described for the three-end block draft also apply to this block weave, thus a block can be converted from solid colour to stripes by changing the colour sequence from (A,B,A,B) to (A,B,B,B). This has been hinted at in Plate 118 where in three places spots appear due to a colour sequence change such as the above. Also three or four colours can be used.

Development. Shaft Switching

Again like the three-end block draft, this weave can be developed to give the possibility of free design, either using the construction in Fig. 265 (a) and (b) or in Fig. 265 (c).

It will be noticed from the threading that the only difference between the two blocks is the placing of the ends on shafts 2 and 3. In Block 1 they are in the normal sequence, in Block 2 in a reversed sequence, so some way has to be found of altering their order at will. The method used is a further development of the shaft-switching principle already described. It is a little more cumbersome, but feasible.

No ends are threaded on shafts 2 and 3, but the two ends which should be so threaded

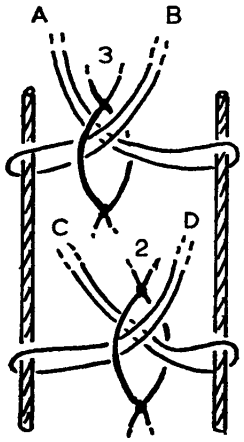


Fig. 266
Block Weave using M's and O's draft. Shaft switching

are drawn in on either side of an empty heald on shaft 2 and an empty heald on shaft 3. See Fig. 266 which in a very diagrammatic way shows only the eyes of these two empty healds. Two string loops go through each eye, one encircling the right-hand end, one the left-hand end. These strings run up to their respective shafts and are knotted above them. The two on shaft 3 have been labelled A and B, the two on shaft 2 C and D.

Now if B is tightened and A is loosened, the left-hand end will move with shaft 3 and if C is tightened and D loosened, the right-hand end will move with shaft 2. Thus the ends will move as if they were threaded (1,2,3,4) as in Block 1.

But if B is loose, and A tight, and if C is loose and D is tight, the ends will become attached to the opposite shafts, and they will move as if the threading were (1,3,2,4) as in Block 2.

To avoid confusion use one colour yarn for the loops of B and C (which are always tightened together), and another colour for loops A and D. So at a changeover the two yarns of one colour are loosened and the two yarns of the other colour are tightened.

This manœuvre means that twice as much shaft switching has to be done, than was necessary with the three-end block draft, to change the threading. So designs will have to be carefully worked out to extract the maximum effect from the minimum of shaft switching.

For this particular weave the threading could be extended a little, thus (1,2,1,4,3,4) for one block and (1,3,1,4,2,4) for the other block. The floats will then be over three ends instead of two and they will beat down more easily, obscuring the plain weave to a greater extent. The first weave involving twill areas will not be possible with this extended threading.

PRACTICAL DETAILS

A warp of 4 working e.p.i. is suitable, with a weft of 2-ply carpet wool used three or fourfold.

2. SIX-SHAFT BLOCK WEAVES

Block weaves on six shafts are of two types, those which are further developments of the two-tie unit drafts and those which are based on three-shaft drafts.

Part 1. Six-Shaft Developments of Two-Tie Unit Drafts

A. Development of Three-End Block Draft

The three-end block draft described earlier can be extended onto any number of shafts. On four shafts and threaded in units of (1,2,3) and (1,2,4), two blocks were obtained or one block and a background. Each additional shaft used, means an additional

block in the design, whose appearance is controllable independently of the other blocks. So with five shafts there are three blocks and with six shafts there are four blocks. Fig. 267 (a) and (b) show two of the many possible ways the threading units can be arranged. Only one repeat of each unit is shown but there could be any number of repeats. In Fig. 267 (a), a unit threaded (1,2,3) alternates with units on (1,2,4), (1,2,5) and (1,2,6). This will give the possibility of three separately controllable blocks on a background, as at Fig. 268 (a). Fig. 267 (b) is a pointed draft variation and can lead to interesting blocks of complex but symmetrical shape, as at Fig. 268 (b).

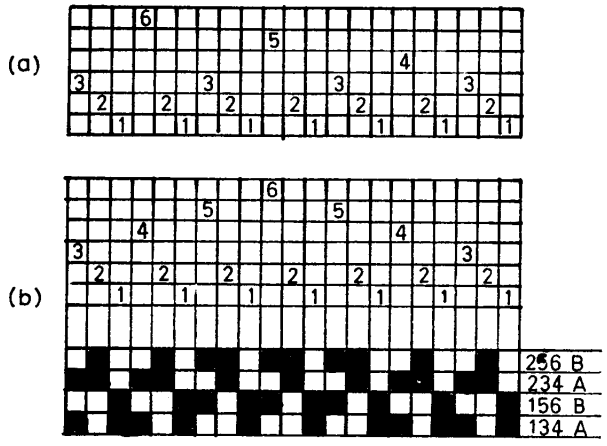


Fig. 267. (a) and (b) Two possible six-shaft developments of Block Weave using Three-End Block Draft

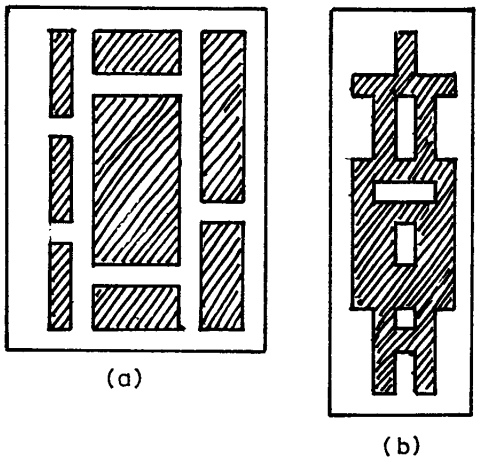


Fig. 268. (a) and (b) Types of design resulting from the drafts in Fig. 267

Two wefts are used pick-and-pick, exactly as in the four shaft version, but as there are four lifts for every possible combination of blocks, the lifts are numerous.

WORKING OUT THE LIFTS

Beneath Fig. 267 (b) is shown the weave plan when (134, 156, 234, 256), are the lifts. This brings colour A to the surface where the warp is threaded on (125) and (126) and colour B to the surface where it is threaded (1,2,3) and (1,2,4). So in the first lift, (134), shafts 5 and 6, which control the blocks where the weft of that pick is wanted on the surface, are not lifted. In the second lift, (156), they are lifted. The third and fourth lift are exactly the same as the first two but substituting 2 for 1, thus (234) and (256).

Similarly if the blocks controlled by shafts 3, 5 and 6 were wanted on the surface then the first lift would be (14) and the second would be (1356). The third and fourth would be (24) and (2356).

So the rule is that the first lift is 1 plus the shafts controlling the blocks *not required* on the surface, and the second lift is 1 plus the shafts controlling the blocks *required* on the

surface (i.e., all the block-controlling shafts not lifted for the first pick). The third and fourth lifts are the same as the first and second, but with 2 instead of 1.

SPECIAL PEDAL TIE-UP

It will be obvious from this that, with a complex design, more lifts are wanted than there are pedals available to control them. So it is best to use a direct pedal tie-up, i.e., let each pedal control the lifting of only one shaft and by pressing a combination of pedals (and using both feet) all the lifts can be made.

A suggested tie-up for the design at Fig. 268 (b) is shown in Fig. 269. The right foot

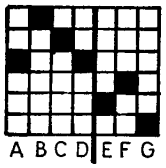


Fig. 269
Pedal tie-up for weaving design in Fig. 268 (b)

controls the lifting of shafts 1, 2 and 3, the left foot of shafts 4, 5 and 6. So the four lifts for the first part of the design, starting at the bottom in Fig. 268 (b), will be obtained thus:

Lift	*Left Foot*	*Right Foot*
1	—	G
13456	B+C+D	F+G
2	—	E
23456	B+C+D	E+F

For the next part, the two blocks at the foot of the motif, they will be obtained thus:

Lift	*Left Foot*	*Right Foot*
1346	A+B	F+G
15	C	G
2346	A+B	E+F
25	C	E

The tie-up at Fig. 269 will give all the lifts needed for the six-shaft version of this block weave, but if more than six shafts are used, a tie-up will have to be designed to suit the various lifts wanted, assuming that every possible lift is not wanted.

USING A DOBBY

A dobby loom can be used in a special way to produce all the possible lifts in this weave. Normally a dobby only gives a repeating design, there being as many lags as picks in the repeat. But in this method a non-repeating design of any size can be woven with a small number of lags.

The loom needs a little adapting. In front of the dobby-controlled shafts, hang two

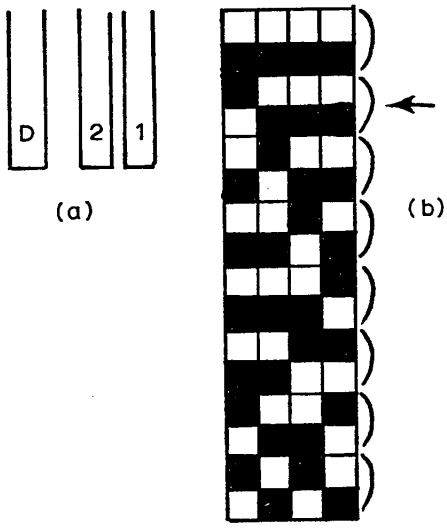


Fig. 270
(a) Arrangement of pedals
(b) Pegging of lags when using a dobby

shafts on pulleys or a roller, so that when one is lowered the other is automatically raised. Attach two pedals to control these, putting them to the right of the dobby pedal, see Fig. 270 (a). Pedal 1 lowers shaft 1 and therefore raises shaft 2. Pedal 2 lowers 2 and therefore raises 1. Pedal 2 is also attached by a cord to the reversing lever of the dobby mechanism. So pressing pedal 2 also reverses the direction in which the chain of lags moves.

The warp is threaded normally. The two specially hung shafts count as shafts 1 and 2 and the dobby shafts behind are numbered from 3 upwards. So only the ends that control the blocks are on the dobby shafts. The other two-thirds of the warp ends are threaded on the two special front shafts.

The lags are pegged as in Fig. 270 (b). Each adjacent pair of lags (bracketed) controls one possible combination of blocks.

The sequence of lifting may seem complex but is quite easy to master as each foot stays down for two picks. Use the left foot for the dobby pedal, and the right foot for pedals 1 and 2. This means that the weaver must work seated.

Press dobby pedal+pedal 1—throw weft A.
Keep dobby pedal down, and press pedal 2—throw weft B.
Keep pedal 2 down, release dobby pedal and press again—throw weft A.
Keep dobby pedal down, and press pedal 1—throw weft B.

Keep pedal 1 down, release dobby pedal and press again—throw weft A.
This is the beginning of the sequence again.

Because of the way pedal 2 is connected to the reversing gear of the dobby mechanism, the chain of lags does not move continuously in one direction in the normal manner. It moves backwards one lag, forwards one lag, repeatedly presenting first one, then the other of an adjacent pair to the needles. Thus, as long as the above sequence

is repeated, one combination of blocks will be woven. When the design dictates another combination, the lags can be moved round (by repeatedly pressing the dobby pedal alone, but of course throwing no weft) until the correct pair of lags is in the correct position in relation to the needles.

The shortest route to the pair of lags wanted may mean moving the lags in the reverse direction (i.e., press pedal 2, while repeatedly pressing the dobby pedal). A plan, showing the relative position of each pair of lags and what combination of blocks they give, should be hung on the loom and then the weaver can easily find his way about.

If the second pair of lags (arrowed in Fig. 270 (b)) are controlling the shafts, then the four lifts will be:

2+456
1+456
1+3
2+3 } Repeated ad lib

(Remember that pedal 1 *raises* shaft 2 and vice versa.)

This gives a slightly different order to the four lifts from the normal, but the weave is practically identical.

The method has only been described briefly as not many weavers possess dobby looms. Those who try it will find that small refinements are necessary, e.g., a counter-weight to make the reversing gear return to its normal position when pedal 2 is released. But once the system is working, it gives complete freedom of design with no repeats; and if four dobby shafts are used, as described here, only sixteen lags are needed to give all possible block combinations.

A really complex design with, say, eight controllable blocks, and therefore eight dobby shafts, will still need only relatively few lags. So using a dobby in this way makes it feasible to weave rugs with intricate designs, which would be quite impossible on a normal loom, due to the multiplicity of the required lifts.

B. Development of Four-End Block Draft

This draft can be extended in exactly the same way as described above. Again, each additional shaft gives another controllable block. Fig. 271 shows a possible threading on six shafts, giving four blocks. Plain weave will be obtained by lifting 12, and 3456.

The lifts for the floating pattern wefts will be of the same type as used above; i.e. 1 or 2 plus a selection of the other four shafts, depending on which blocks the weft is required to show in. Fig. 271 (a) shows two such lifts which will make colour A come to the surface in the areas threaded on (1,2,1,4) and (1,2,1,6). Fig. 271 (b) shows the lifts which will make colour A appear in the opposite areas. From this, the principle controlling the lifts will be understood.

All the four weaves described in the section on four-end block draft can be used.

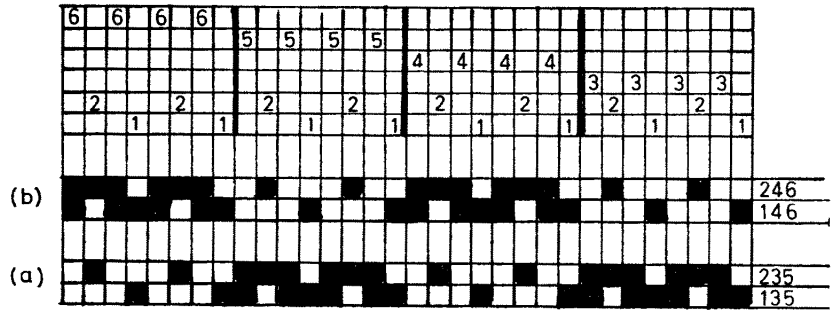


Fig. 271
Six-shaft development of Block Weave using Four-End Block Draft

C. Development of Six-End Block Draft

In exactly the same way six-end block draft can be extended to five or six shafts, see Fig. 272. Each extra shaft used gives another controllable block.

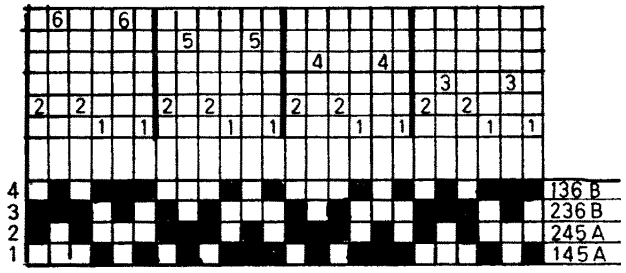


Fig. 272
Six-shaft development of Block Weave using Six-End Block Draft

The lifts to bring various combinations of blocks to the surface are the same as those described in detail for three-end block draft, except that their order is slightly different. In Fig. 272 are shown the lifts which will bring colour A to the surface in Blocks 1 and 4 (controlled by shafts 3 and 6) and colour B to the surface in Blocks 2 and 3 (controlled by shafts 4 and 5).

Note—That in picks 1 and 2, shafts 1 and 2 are lifted in turn, plus those shafts which control the blocks where weft A is *not* required to show, i.e., 4 and 5. In picks 3 and 4, shafts 2 and 1 are lifted in turn, plus those shafts which control the blocks where weft B is *not* required to show, i.e., 3 and 6. So whichever of the block-controlling shafts are lifted for picks 1 and 2, it is the remaining ones which are lifted for picks 3 and 4. So another sequence could be (13, 23, 2456, 1456).

Part 2. Six-Shaft Block Weaves Based on Three-Shaft Weaves

Most of the weaves needing only three shafts can be converted into block weaves by threading some sections of the warp on the front three shafts and the intervening sections on the back three shafts, as shown in Fig. 273.

A. Block Weave Based on Double-Faced 2/1 Twill

The ends threaded on the front three shafts and those threaded on the back three shafts can obviously work independently of each other. Those threaded on (1,2,3) can be made to weave a double-faced twill exactly as in Fig. 208 (in the section on three-shaft weaves). In this, the sequence of:

12, 1, 23, 2, 13, 3
A B A B A B

meant that colour B showed on the face and colour A on the reverse.

The exactly comparable weave on the back three shafts would be:

45, 4, 56, 5, 46, 6
A B A B A B

where colour B again shows on the face. Now if these two weaves are combined, the lifts are:

1245, 14, 2356, 25, 1346, 36
A B A B A B

and colour B will be on the face right across the rug and colour A on the reverse right across the rug. But they could be combined in such a way that the first lift of the front shafts' sequence and the second of the back shafts' sequence were used together, and then the second of the front and third of the back sequence used together, and so on, i.e., $\overset{A}{12+4},\ \overset{B}{1+56},$ etc. In this case colour B will be on the face in the areas threaded (1,2,3) and on the reverse in the areas threaded (4,5,6) and colour A will appear in the opposite areas. In other words a block weave will be produced, with each pick weaving as a 1/2 twill in one block and as a 2/1 twill in the next block.

In fact, in order to make the weaves on the two threadings join properly at the junction between blocks, a slightly different sequence has to be used, thus:

124, 146, 235, 245, 136, 356
A B A B A B

but the principle is exactly as explained above. The weave is shown in Fig. 273 (a). Plate 119 shows a rug woven in this technique. Note the twill lines at the ends of the blocks. These are produced by using a pick-and-pick colour sequence for the weft coming to the surface at that point. Thus (A,B,C,B) will give twill lines of colour A and C in one block and solid colour B in the next block. Other weft sequences will give cross stripes in the blocks.

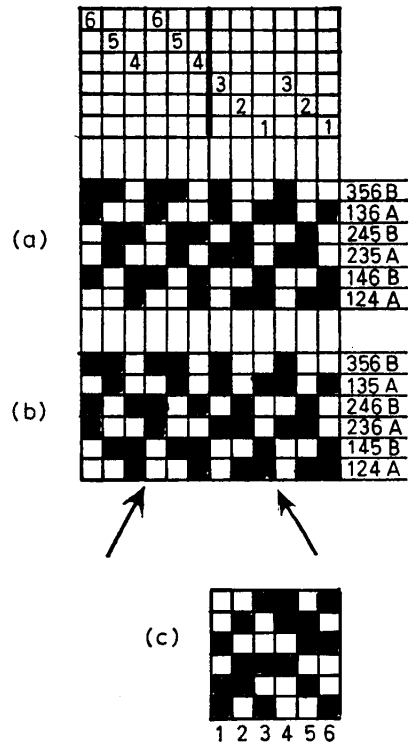


Fig. 273
Block Weave based on Double-Faced 2/1 Twill.
(a) and (b) Weave Diagrams
(c) Pedal tie-up for weave at (a)

The lifting sequence given above makes the twill lines in all the blocks slope up to the left. The lifting sequence at Fig. 273 (b) reverses the twill lines in the areas threaded on (4,5,6), see the arrows. If only one colour were used with this lifting sequence, the blocks would still appear to a slight degree, as the light would be reflected differently from the twill lines in adjacent blocks.

PRACTICAL DETAILS

A warp formula of 6 e.p.i., alternately single and double in the heald, therefore 4 working e.p.i. is suitable, with a weft consisting of 2-ply carpet wool used two or threefold.

If the pedals are tied up as in Fig. 273 (c) then the pedal sequence will be 1,6,2,5,3,4. This is the best way to arrange the tie-up, so that the feet are used alternately in some easily remembered pattern.

B. Block Weave Based on Three-Shaft Krokbragd

In the section on three-shaft Krokbragd it was noticed how different was the effect on the back and front of this weave. By expanding the threading onto six shafts, these two effects can be produced side by side on the front of the rug, as blocks. The thread-

ing is a pointed draft on the front three shafts for one block and a similar draft on the back three shafts for the other block, see Fig. 274.

The lifts shown in Fig. 274 (a) will give the tightly-woven 'right' side in the area threaded on the back three shafts (Block 2) and the loosely woven 'wrong' side in the area threaded on the front three (Block 1). The lifts shown in Fig. 274 (b) will reverse these effects.

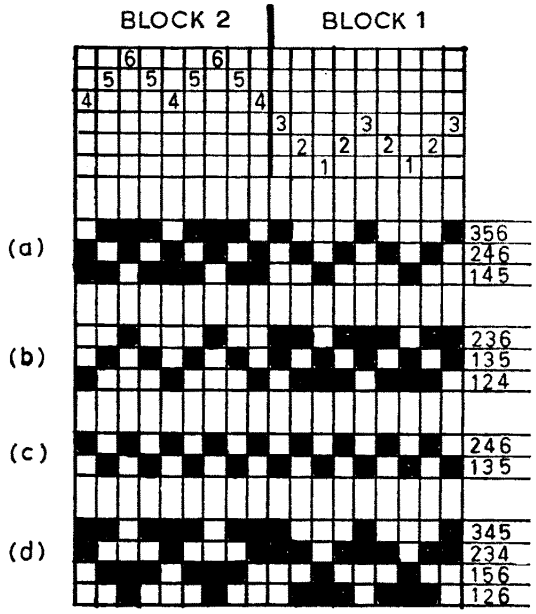


Fig. 274
Block Weave based on Three-Shaft Krokbragd

As in three-shaft Krokbragd, either of these lifting sequences is repeated over and over again, and the design results from the order in which one, two or three wefts are used. Note that in both sequences, the second pick is in plain weave right across. This pick will be hidden as it crosses a block of floats, i.e., Block 1 in Fig. 274 (a) and Block 2 in Fig. 274 (b); but it will contribute importantly to the design in the alternate blocks, i.e., Block 2 in Fig. 274 (a), and Block 1 in Fig. 274 (b). As picks 1 and 3 appear equally in both blocks, it is to this second pick that is due the chief difference in design between the two blocks. In other words, if one special colour is reserved for this pick, this colour will be very apparent in one block, but quite absent in the next.

A colour sequence of (A,B,A), will give warpway stripes of the two colours in Block 2 in Fig. 274 (a), but floats of colour A only in Block 1. See top row of blocks in Plate 120, where white is colour A. A colour sequence of (A,B,B) will give vertical lines of A on a ground of B in Block 2, and warpway stripes of the two colours in Block 1. See second row of blocks in Plate 120, in which the sequence has occasionally been changed to (A,A,B) to give the crossbars to the thin vertical lines. There are many other possibilities which the weaver can discover for himself, as suggested by the lower two rows of blocks in Plate 120.

Note—That in this sample the lifting sequence changes at the beginning of each new row of blocks. So in the top row, the extreme right block is an area of floats. in the second row this block is closely woven.

Plain weave on 135 and 246, see Fig. 264(c), can be used at the beginning and ending of the rug. A few picks of it can also be used as a bridge between the lifting sequences for the blocks.

This threading also gives the first block weave described in the section on four-end block draft. It is shown in Fig. 264 (d). There is no special merit in weaving it on six shafts, but its availability does increase the scope of this threading.

PRACTICAL DETAILS

A warp setting of 5 or 6 working e.p.i. is suitable, together with a weft consisting of 2-ply carpet wool used twofold. Use a floating selvage.

3. EIGHT-SHAFT BLOCK WEAVES

As with six shaft block weaves these can be divided into two classes, those that are further developments of two-tie unit drafts and those based on four shaft weaves.

Part 1. Further Development of Two-Tie Unit Drafts

The three weaves described under this heading in the section on six-shaft block weaves can obviously be extended to eight shafts, giving two more controllable blocks, making a total of six blocks. As there is no difference in principle, only of complexity, there is no need to deal with these in detail.

A. Double Two-Tie Unit Draft

A special case is the double two-tie unit draft, already mentioned in the last chapter, which has many possibilities. Details are shown in Fig. 275. Note that there are two ends on shaft 3 and on shaft 8 where the threading reverses. The threading could obviously be extended to more shafts. It is specially adapted to give a block weave in which the blocks are triangular or diamond-shaped. Any of the weaves described for four-end block draft can be used. Two will be described here.

(i) BLOCK WEAVE NOT REQUIRING PLAIN WEAVE

Fig. 275 (a) shows the lifts and weave plan to give an inverted triangle of colour B on a background of colour A. If on the 10th and last pick the lifts are reversed, a diamond will be woven.

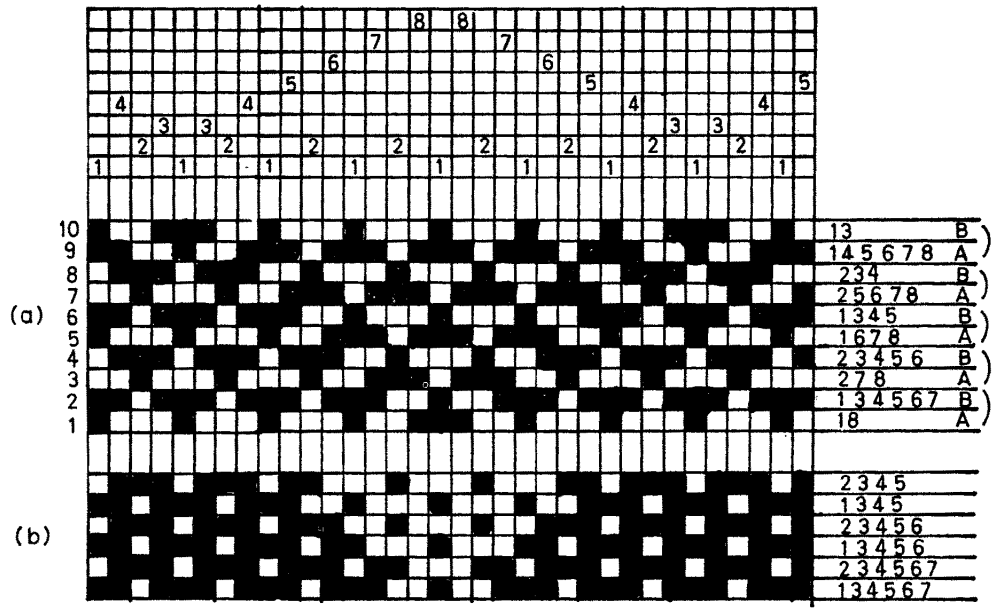


Fig. 275. Eight-shaft development of Double Two-Tie Unit Draft. Weave Diagrams with two weave plans

This will be a diamond with a smooth edge, as the top diamond in Plate 121. The next diamond down has a toothed edge and this is produced by weaving the picks in the order 2,1,4,3,6,5,8,7,10,9, and then reversing the order. The colour sequence is always pick-and-pick.

To make the hollow diamonds, change picks 5 to 10 to the following: 167, 13458, 256, 23478, 145, 13678.

Note—That when this is done with a smooth edged diamond, the contained diamond has a toothed edge (third diamond down from top in Plate 121); and when it is done with a tooth edged diamond, the contained diamond has a smooth edge (fourth diamond down).

As the bottom diamond shows, the angle of the side can be steepened by weaving the picks in this sort of order, 1,2,3,4; 1,2,3,4,5,6; 3,4,5,6,7,8; 5,6,7,8,9,10; etc. Plate 122 shows the reverse of this weave, which is rather unexpected. Colour Plate II shows a full-size rug, in which the draft has been varied to alter the spacing of the motifs.

Practical Details

Warp—5 working e.p.i.
Weft—2-ply carpet wool used threefold.

(ii) BLOCK WEAVE REQUIRING PLAIN WEAVE

The threading is the same as above. One pattern pick is always followed by two plain weave picks on 12, and 345678. Fig. 275 (b) shows a few of the many possible pattern lifts. Shafts 1 and 2 are raised alternately for these lifts, plus a selection of shafts 3 to 8. Plate 123 shows a small piece of this weave. The design is made up of areas of floats of the pattern weft (dark) and areas of plain weave (white) with the pattern weft showing through as spots.

Practical Details

Warp—5 working e.p.i.
Weft—for the plain weave, 2-ply carpet wool used singly.
for the pattern weft, 2-ply carpet wool used three- or fourfold.

B. Three-Colour Block Weave

In a true triple cloth, three plain weave cloths with their own warps and wefts are woven simultaneously, one above the other, and the design results from the various ways these three cloths interpenetrate and come to the surface. There is always a third cloth in the pocket between the upper and lower cloths. But though in this present weave there are three wefts and they give three blocks of solid colour, the structure is far simpler than in a true triple cloth.

There are basically two warps, see Fig. 276. One is threaded on shafts 1 and 2, it is

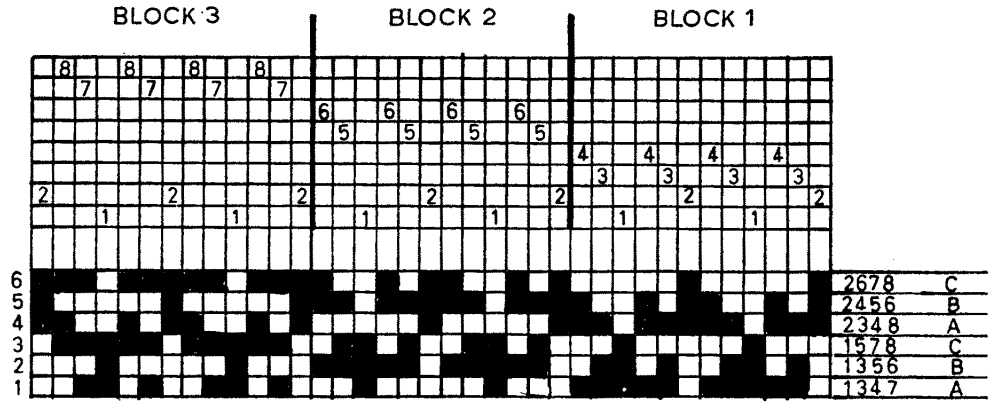


Fig. 276. Three-colour Block Weave. Weave Diagram

evenly spaced across the rug, and is the warp that comes to the surface to tie down the weft floats. Hence the inclusion of this draft amongst the two-tie unit drafts. The other warp is threaded on an extra two shafts for each additional block, i.e., on shafts

3 and 4, 5 and 6, and 7 and 8 in Fig. 276. This warp always lies in the centre of the rug. Of the three wefts being used, one passes over this central warp and appears on the face of the rug, another passes under it and appears on the back of the rug as in normal two-tie unit weaves, but the third weft which at this point does not come to either surface, interlaces in plain weave fashion with the central warp. See cross-sections in Fig. 277.

In Fig. 276, two repeats of each threading block have been shown. The six picks of one of the many possible lifting sequences is shown. Note that for picks 1, 2 and 3, shaft 1 is up and shaft 2 is down the whole time. The three lifts differ from each other only in the movements of shafts 3 to 8, (those controlling the central warp). It is the movement of these shafts which determines whether a pick will show on the front, on the back or be hidden in the centre of the rug. Fig. 277 (a) shows a cross-section of these three picks. For simplicity's sake, only one repeat of each threading block is shown. The circles represent the warp ends, each numbered according to the shaft it is threaded on. From this it will be seen that pick 1 will show on the back in Block 1, on the front in Block 2 but will be invisible in Block 3, as it is weaving with the central warp. The other two picks take a similar course.

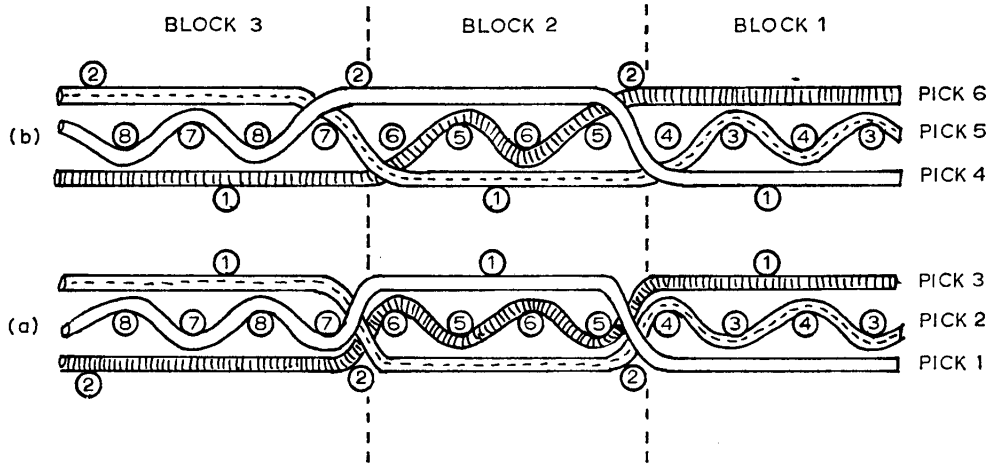


Fig. 277. Three-colour Block Weave. Cross-section of picks 1–6 in Fig. 276

For picks 4, 5 and 6, shaft 2 is up and shaft 1 is down the whole time. Again it is only the shafts controlling the central warp whose movement varies from pick to pick. Fig. 277 (b) shows the cross-section of these three picks. Pick 4 follows a similar course to pick 1, pick 5 to pick 2, and pick 6 to pick 3, but note that where each pick weaves with the central warp, it is now in the opposite plain weave shed.

So in any block of the design, one colour will show on the front and one on the back. These two wefts weave with the same warp, that which is threaded on shafts 1

and 2, and they appear as floats over five ends. Between these two wefts and completely hidden by them, the third weft lies, interlacing in plain weave order with the central warp. This central layer of cloth, besides dealing with the third colour, adds firmness to the weave, which otherwise consists of long floats. It is the manner in which this central warp is raised and lowered that controls the appearance of the colours in the blocks. There are many possible arrangements of the three colours, each of which requires six lifts, and it is better to understand the principle, than blindly to follow a printed list.

Looking at Fig. 276, the central warp for Block 1 is on shafts 3 and 4, that for Block 2 on 5 and 6, and that for Block 3 on 7 and 8. So these are the block controlling shafts.

For picks 1, 2, and 3, shaft 1 is always up.

For picks 4, 5, and 6, shaft 2 is always up.

For picks 1, 2, and 3, the rules for the block-controlling shafts are these:

In the block where the weft is to show on the front, do not raise the shafts.

In the block where the weft is to show on the back, raise both shafts.

In the block where the weft is to be hidden, raise the odd-numbered of the two shafts.

i.e., if weft is to show on front in Block 2, on back in Block 1, and be hidden in Block 3, then lift 1347.

For picks 4, 5, and 6, the same rules apply except that where the weft is to be hidden, the even-numbered of the shafts are lifted. So to make a weft appear as above, lift 2348.

When planning the lifts, ensure that in every block there is only one weft in each of the three positions (front, back or centre). It is easy to weave a block that looks correct on the front, but which will be found to have two wefts appearing on the back and none in the centre. To avoid this it is best to make simple cross-section plans showing the relative positions of the three wefts, see Fig. 278, in which (a) is the plan for the block arrangements shown in Fig. 276.

Note—That (b) and (c), though giving the same colour arrangement on the front, differ from each other on the back.

—that (d) shows one colour only on the front, the other two appearing on the back.

—That (e) shows one colour appearing over two adjacent blocks.

As an example, the six lifts to give the weft arrangement in Fig. 278 (e) are:

A, 134
B, 13578
C, 1567
A, 234
B, 24678
C, 2568

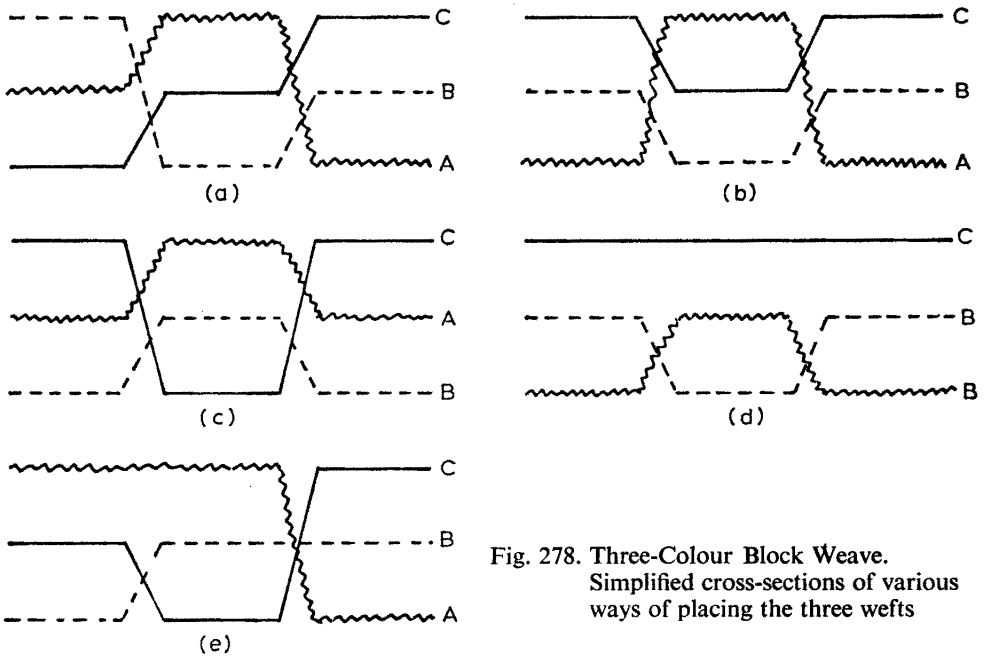


Fig. 278. Three-Colour Block Weave. Simplified cross-sections of various ways of placing the three wefts

Apart from different block arrangements, a great deal can be done by varying the colour sequences in a single block arrangement, i.e., not always using the sequence (A,B,C).

From the above it will be understood that the back and front of a rug in this technique may bear little relationship to each other, also that two rugs with the same design on the front may differ from each other on the back. Plate 124 shows a sample woven with a pointed draft, the threading blocks shown in Fig. 276 being used in the order, 1,2,3,2,1. Fig. 279 (a) shows how this was woven, giving the lifts on the right and the colour sequences on the left.

Note—That at the points marked with an arrow the lift sequence stays the same but the colour sequence changes.

No plain weave is possible with this threading but a one up, two down weave is produced by lifting 12, and 345678, and this can be used for starting and finishing the rug. The pick-up variation of this weave will be found in Chapter 9.

PRACTICAL DETAILS

Warp—9 e.p.i., single through a heald, therefore 9 working e.p.i.
Weft—2-ply carpet wool used three-fold.

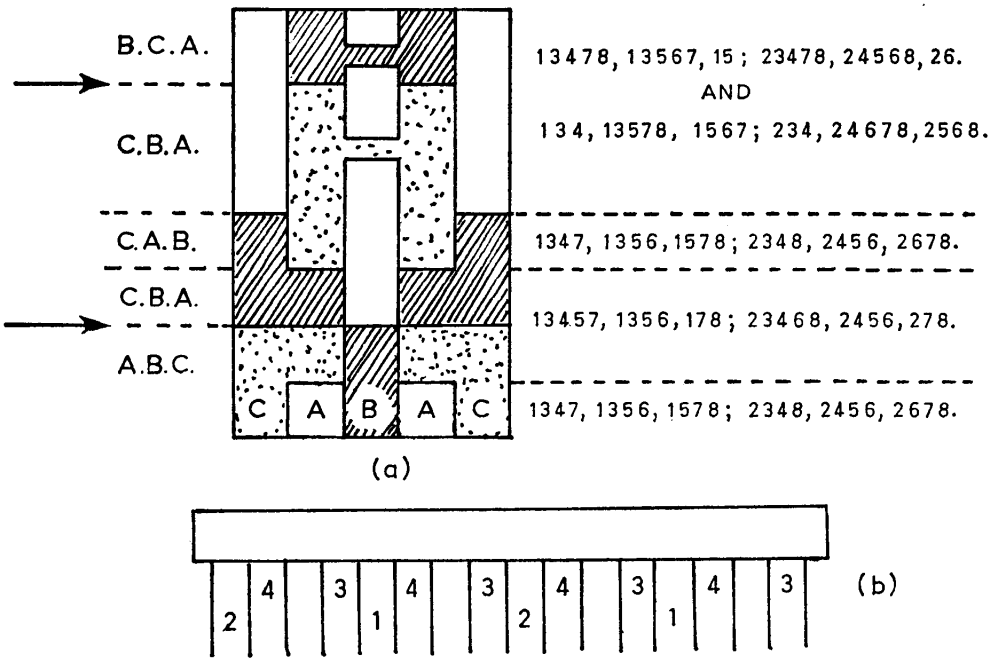


Fig. 279. Three-colour Block Weave. (a) Method of weaving design in Plate 123

The warp is sleyed in a 12 dents per inch reed, as shown in Fig. 279 (b), where each number refers to the shaft on which is threaded the end in that dent.

Note—That the ends on the block-controlling shafts (3 to 8) are threaded in alternate dents, i.e., at 6 e.p.i., and that the ends on shafts 1 and 2 are threaded in every fourth dent, i.e., at 3 e.p.i. So both the central and tie-down warps are spaced evenly and at their own particular set.

If the threading begins and finishes with an end on shaft 1 or 2 (as in Fig. 276), then all three wefts will catch at the selvage. It is best to start these three wefts from the same side, say, the right. Then, in the first three picks, they all move across to the left selvage, in the second three picks, they move back to the right. This gives a firm selvage showing all three colours in succession.

As the sample in Plate 124 shows, the warp is slightly visible. By beating very hard and using a finer weft it can be hidden. But the texture is a good one as described and there is no need to worry about the visible warp unless it interferes with the design.

Six-Shaft Derivative

It will be obvious from the above description that by using only six shafts a two-colour block weave could be produced. There would still be three wefts in use all the

time, but only two of them would show on the front or the back at any point. The cross-section could be as in Fig. 280 (a) in which case the two colours in the design

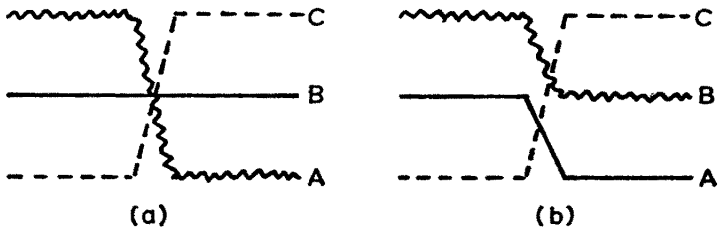


Fig. 280. Six-shaft version of Three-colour Block Weave. (a) and (b) Cross-sections showing ways of placing the three wefts

(A and C) will be reversed on the back and the third colour (B) will lie hidden in the centre throughout the rug. This latter weft will only contribute to the structure, not to the colour, of the rug. Or the cross-section could be as in Fig. 280 (b), in which case colour C appears on both back and front of the rug, but colour A and B only appear on one side.

Four-Shaft Derivative

Similarly if only four shafts are used, a double-faced weave can be produced. It will still use three wefts, one for the front, one for the back and one hidden in the centre. No blocks can be woven.

Part 2. Development of Four-Shaft Weaves

All these weaves are produced on some threading which for one block is on the front four shafts and for the next block on the back four, as in Fig. 281.

A. Block Weave Based on Double-Faced 3/1 Twill

This is the eight shaft version of the weave described in the section on four-shaft twills. There it was seen (Fig. 228) that alternate picks floated over three ends under one, and under three ends over one, the former appearing on the surface all across the rug, the latter on the back.

When the weave is extended to eight shafts as in Fig. 281, the pick that is floating over three ends in one threading block floats under three ends in the next threading block. So it appears alternately on the front and the back of the rug, see pick number 1 in Fig. 281 (a). The next pick will take the opposite type of course, see pick number 2 in Fig. 281 (a). As the colour sequence is (A,B,A,B) this leads to blocks of the two colours, corresponding to the areas threaded on the front four and on the back four shafts.

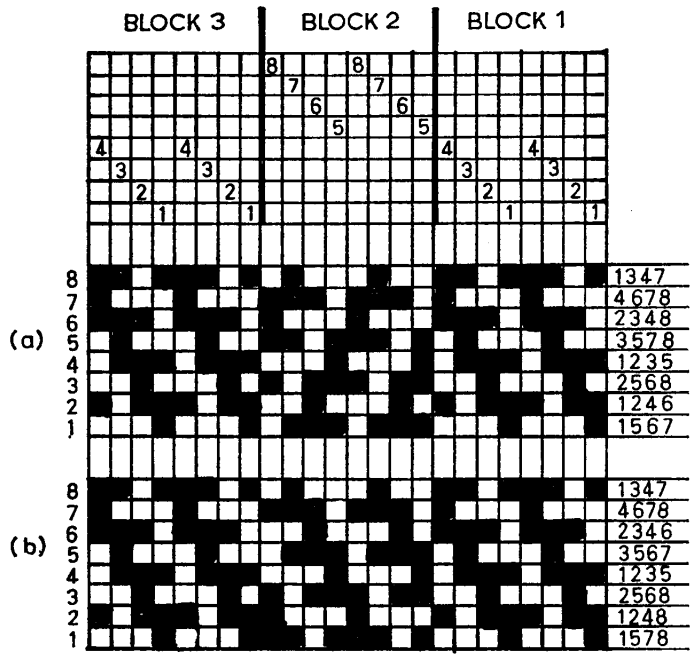


Fig. 281
Block Weave based on Double-faced 3/1 Twill. Weave Diagram with two weave plans

The complete weave plan with lifts is shown at Fig. 281 (a).

As there are eight different lifts it will need eight pedals. As with the four-shaft version, the weave has a strongly twilled surface, and it will be noticed that the twill in Blocks 1 and 3 (threaded on the front four shafts) is the opposite direction to that in Block 2 (threaded on the back four shafts). It will also be noticed that the junction between one block and the next is 'clean cutting', i.e., every weft that passes over the last end in one block, passes under the first end in the next block, and vice versa. This gives a very sharp colour change at the junction between blocks.

Fig. 281 (b) shows the weave plan and lifts for the variation of this technique in which the twill lines in all the blocks are in the same direction. This has a clean-cut junction between Blocks 1 and 2, but not between Blocks 2 and 3.

Note—That only picks 1, 2, 5 and 6 are on different lifts, so it only needs the addition of four pedals to make both types possible in one rug.

Both of these weaves can be converted into broken twill by weaving the picks in the following sequence: 1,2,3,4,7,8,5,6. This gives an extremely tough but flexible rug; the same interlacement will be met in the chapter on pick-up weaves.

Note—That on this threading the block weave based on three-shaft Krokbragd can be woven by lifting. (1568, 2457, 3678) for one block, and (1245, 1368, 2347) for the other block.

PRACTICAL DETAILS

A warp set at 6 working e.p.i. is suitable, together with a weft consisting of 2-ply carpet wool used threefold. Use a floating selvage.

B. Block Weave Based on Four-Shaft Krokbragd

Normal four-shaft Krokbragd was not mentioned among the four-shaft weaves; because the floats on the back of the rug are so long, they make it impractical. But if it is used as a block weave, so that on each side of the rug blocks of close weave alternate with blocks of floats, it becomes feasible.

The threading, see Fig. 282, is a pointed draft on the front four shafts for Block 1, and a similar draft on the back four shafts for Block 2.

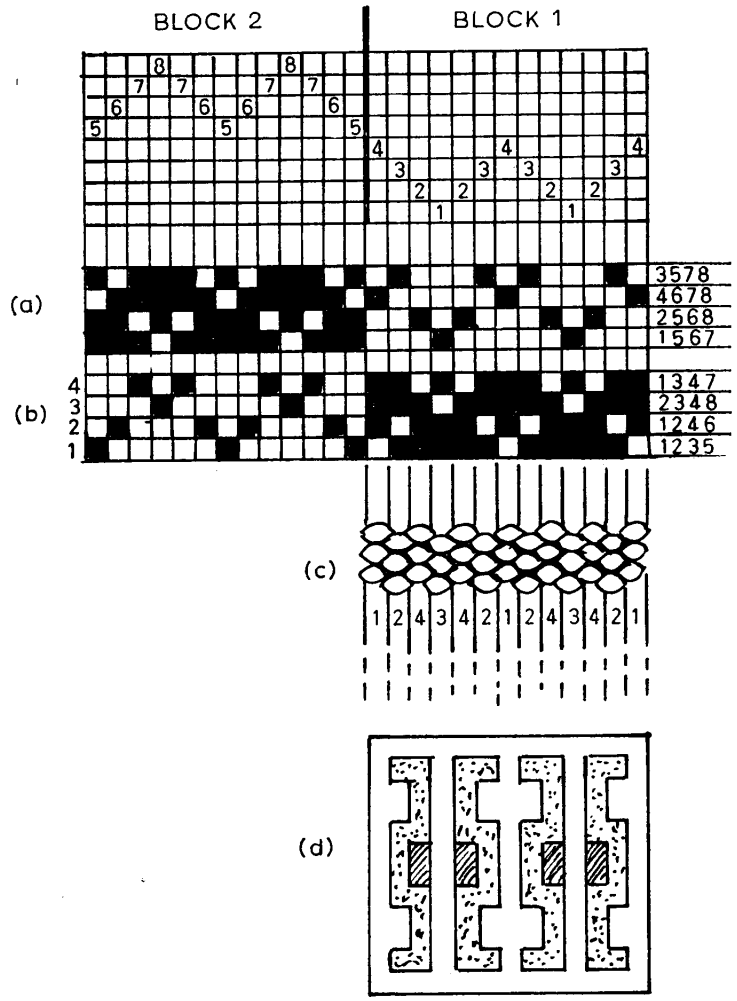


Fig. 282
Block Weave based on Four-Shaft Krokbragd.
(a) and (b) Weave Diagrams
(c) Relationship of picks to surface of Block 1
(d) Possible motif using three colours

As the weave plan at (a) shows, the shafts in the first threading block are lifted one at a time in broken twill order; and those in the second threading block are lifted three at a time in broken twill order. So each pick will float on the face in Block 1, and on the reverse in Block 2. Where it floats on the reverse it appears as a close weave on the surface. So Block 2 will be a closely woven area and Block 1 an area of floats.

The exact opposite is produced if the lifts in (b) are used, so this gives the alternating design block.

In the closely woven area, the four picks of the lifting sequence beat down to make what looks like two picks of plain weave. It is simple from the weave plan to work out which portions of this area are contributed by which picks. This is shown diagrammatically in Fig. 282 (c), which represents the closely-woven area, Block 1, seen directly above in Fig. 282 (b). This area consists of thirteen columns of weft floats, corresponding to the thirteen ends in the threading unit. The numbers indicate which pick is responsible for the appearance of the weft in each column.

Now the interesting thing, is that (in either lifting sequence) picks 2 and 4 are completely hidden in the area of floats. In other words, it is the floats over five ends (picks 1 and 3) that form the surface in these areas. So any weft put in on picks 2 and 4 will only appear in the closely-woven areas.

Looking at Fig. 282 (c) and seeing where the columns formed by picks 2 and 4 lie, it will be understood that many motifs can be woven in this area which will not appear at all in the areas of floats. To produce these, a different coloured weft will be used for pick 2 and/or pick 4 than for picks 1 and 3. So three colour sequences could be used, (A,B,A,B), (A,B,A,A) or (A,A,A,B). Plate 125 shows three such motifs on a full-size rug. Fig. 282 (d) shows another using two colours in one place for picks 2 and 4. There are many possibilities here for experiment.

It is a good idea to weave a few picks of plain weave (on 1357 and 2468) when changing from one lifting sequence to the other, (i.e., from the weave in Fig. 282 (a) to that in Fig. 282 (b)). This means that a total of ten pedals are needed to give all the posible lifts.

PRACTICAL DETAILS

A warp formula of 6 e.p.i., alternately double and single in the heald therefore 4 working e.p.i. is suitable, together with a weft of 2-ply carpet wool used twofold. Use a floating selvage.

The long floats limit the use of this rug, but it is feasible for a bedroom or living room rug. The rug is thick and heavy; the alternating blocks of floats and what looks like plain weave give it an interesting texture.

C. Block Weave Based on Plain Weave Double Cloth

HISTORY

Plain weave double cloth has a considerable history, both as the means of creating a strong double-thickness fabric and as the means of weaving intricate decorative fabrics. Early double cloths are known from Peru, Persia, India and from primitive peoples all over the world. In Europe its use as a floor covering dates from around 1735, when factories in Kidderminster started to produce carpets in this technique on hand looms. These carpets were woven on a 'barrel loom'. A drum above the loom had wooden pins or metal staples set in it, and as it turned it regulated the lifting of the shafts. A new barrel had to be made for each carpet design. Later the jacquard apparatus was used.

The carpets were called Kidderminster or Scotch, or two-ply carpets. The American name was ingrain. The surface was made up predominantly of the weft. Another type which was predominantly warp-face was called British or Damask Venetian. A later development added a 'stuffer' warp which bound the two cloths together but appeared on neither surface. Later still, a three-ply or triple ingrain carpet was woven, which was a true triple cloth, i.e., with three independent warps and wefts. Some of William Morris's carpet designs were produced in the latter technique. Denmark is one of the few European countries still producing double cloth carpets commercially. In the Kidderminster carpets, both warp and weft formed the surface of the rug, but it is a weft-face double cloth which is to be described here.

INTRODUCTION

In plain weave double cloth, two plain weave cloths are woven simultaneously, one above the other. The upper cloth has its own warp and weft, which interlace with each other, but which do not interlace with the elements of the lower cloth, and vice versa. So there is a space or pocket between the two cloths.

The structure can best be understood by looking at an expanded thread diagram, see Fig. 283. Cover the left half of the diagram, i.e., the part to the left of the arrows marked X. And look at the lower half of the diagram now left exposed, i.e., the part below the arrows marked Y. Here four ends are seen interlacing with four picks.

The ends threaded on shafts 1 and 3 (see top of diagram), are shaded, as also are picks 1 and 3. It will be seen that these shaded ends and picks interlace to form a plain weave cloth. This lies on top of a similar plain weave cloth formed by the interlacing of the unshaded ends and picks. For simplicity these will now be called black and white.

Note—There is no connection between these two cloths. The upper one could be lifted off to expose the lower one. In other words there is a pocket between the two cloths. This is indicated by a wavy line in the longitudinal section shown at the right.

So ends on shafts 1 and 3 and picks 1 and 3 form the upper cloth and ends on shafts 2 and 4 and picks 2 and 4 form the lower cloth.

Consulting the shafts above, it will be seen that the upper cloth is woven simply by lifting shafts 1 and 3 alternately. But the lifts for the lower cloth are a little more complex. Consider pick 2. This passes under both black ends (on shafts 1 and 3) and under one of the white ends on shaft 4. So the lift is 134. Similarly the lift for pick 4 is 123. In other words, for the picks of the lower cloth, all the ends of the upper cloth, i.e. the black ones, have to be lifted, plus alternate ends of the lower cloth.

Thus the lifting and colour sequence becomes

1, 134, 3, 123
A B A B

Now if this weave were continued without variation, the result would merely be two pieces of cloth on top of the other, perhaps joined at the selvages if the two wefts had been locked around each other. But if the position of the two cloths were reversed (so that what was the upper cloth now appears on the back, and vice versa), the pocket would be sealed off in a horizontal line at this point.

This is what happens after pick 4 in the right-hand exposed half of the diagram. The upper cloth formed of black warp and weft sinks to the back, and the lower cloth (white) rises to the top. This is seen most dramatically in the longitudinal section at the right. Note how the pocket is completely sealed off at the point where the warp ends change positions. In fact the black and white cloths pass right through each other at this point.

The lifts for picks 5 to 8, can be found by looking at the shafts above. The white cloth, now the upper one, is woven by lifting shafts 4 and 2 alternately. The black cloth, now the lower one, is woven by lifting both white ends plus one of the black ends, so the lift for pick 5 is 124, and for pick 7, is 234. So the sequence becomes

124, 4, 234, 2
A B A B

Thus on four shafts it is possible to weave plain weave double cloth and by varying the lifts to change the relative positions of the two cloths. This latter manœuvre results in a horizontal, weftway, interchange of the two layers. So the visual result will be weftway stripes of black and white cloth, each stripe being a flattened tube with the opposite colour forming its rear wall.

To produce a vertical, warpway interchange of the two layers, i.e., to give the possibility of black and white checks or blocks, the threading must be extended onto eight shafts. This is shown in the left half of Fig. 283, which up to now has been covered to avoid confusion. The ends in this half are threaded on shafts 5 to 8. Look-

II. Weft-face rug in wool on linen warp, using a development of the Double Two-tie Unit Draft, see page 341

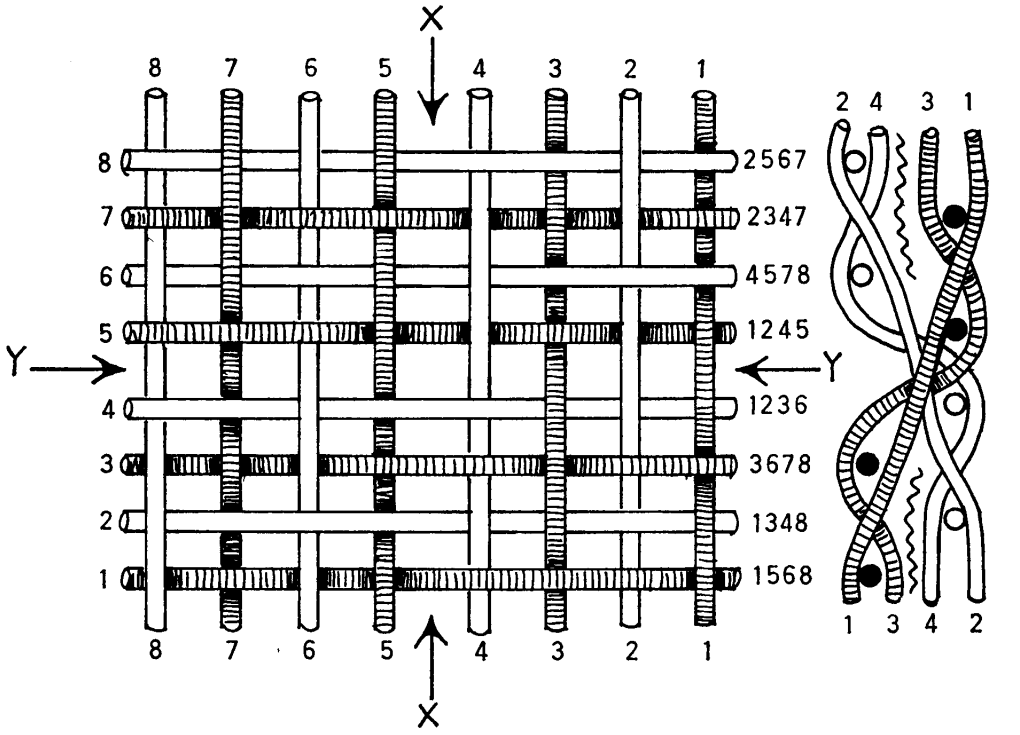


Fig. 283. Expanded view of Plain Weave Double Cloth

ing at the lower half, i.e., picks 1 to 4, it will be seen that the black cloth which was on the front when weaving with ends 1 to 4, is now at the back, and the white cloth which was at the back is now on the front. In other words, the four picks of weft change their relative positions as they pass from interlacing with the ends on the front four shafts to interlacing with the ends on the back four shafts (i.e., as they pass the arrow marked X), in exactly the same way as the four warp ends interchanged between picks 4 and 5. So the longitudinal section, at the right, which shows the warp interchange, could also serve as the diagram of weft interchange if turned through a right angle. Thus between the fourth and fifth end, this weft interchange seals off the pocket between the cloths in a vertical direction.

Consulting the shafts above, it will be seen that the lifts for picks 1 to 4, are

568, 8, 678, 6
A B A B

Looking upward, it will be seen that, as on the right-hand side, after pick 4 the two cloths have changed position. The black is now on the front, the white on the back. The lifts for picks 5 to 8 are

5, 578, 7, 567
A B A B

So combining the lifts worked out for the front four and the back four shafts, the sequence for the lower half of the diagram is

1568, 1348, 3678, 1236
A B A B

If this is repeated, it will give a black cloth on the front in all areas threaded 1 to 4 and a white cloth in front on all areas threaded 5 to 8.

For the upper half of the diagram, where the colours are reversed, the sequence is

1245, 4578, 2347, 2567
A B A B

The weave is shown in diagrammatic form in Fig. 284.

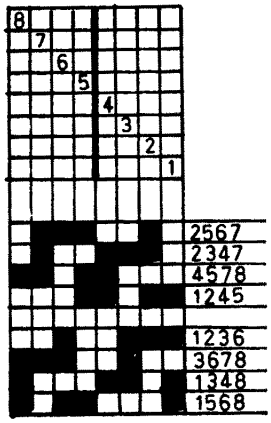


Fig. 284
Weave Diagram for Plain Weave Double Cloth in Fig. 283

WEFT-FACE PLAIN WEAVE DOUBLE CLOTH

In the above description, it was assumed that the two cloths were woven so that the warp and weft of both showed equally, i.e., so that two 50/50 plain weave cloths were produced, one with a black warp and a black weft, and the other with a white warp and white weft. These two colours alternated in both the warping and picking order. This is the type of double cloth used in the earliest Kidderminster carpets and in some modern decorative forms of the weave.

The situation is a little different if both upper and lower cloths are woven as weft-face fabrics, i.e., if the warp setting and weft count are such that the weft completely hides the warp. There is no longer any need for the warp to be of two colours as it contributes nothing to the surface of either cloth. The surface of both cloths is entirely made up of the weft. So the structure at any point is like two weft-face rugs lying one over the other.

(i) WOVEN ON FOUR SHAFTS

If woven on four shafts, i.e., like the right-hand half of Fig. 283, the two cloths can be interchanged as described above, by changing the lifting sequence from:

1, 134, 3, 123 to 124, 4, 234, 2
A B A B A B A B

Colour A will be on the surface in the first sequence and colour B in the second sequence. But the cloths (or, more accurately, the warps) can be interchanged, and yet the same colour can remain on the surface, simply by altering the colour sequence to B,A,B,A, for the second lifting sequence. Conversely the colour can be changed without interchanging the warps, simply by reversing the colour sequence at any point in either of the lifting sequences.

So it is a characteristic of weft-face double cloth, that an interchange of warps does not necessarily mean a change of colour, and vice versa. Thus a rug could be woven, all colour A on the front and colour B on the back, with occasional warp interchanges to give stability to the structure. Or a rug striped on the front and back could be woven, the front and back stripes being completely independent of each other, and also independent of the warp interchanges. These warp interchanges will appear as weftway depressions running across the rug. Between each warp interchange there is a pocket between the upper and lower cloths and this can be padded out with fleece or short ends of wool if so desired, to make a ridge across the rug.

Practical Details

To produce a double cloth rug of satisfactory weight, two thin rugs have to be woven one above the other. So if each rug has a warp setting of 4, 5 or 6 working e.p.i., the combined setting is 8, 10 or 12 working e.p.i. A suitable weft would be 2-ply carpet wool used double or single. The pockets in the structure of the rug are sealed at each point of warp interchange, but they are open at each selvage unless steps are taken to seal them here too. This can be done with a floating selvage round which passes the weft of both upper and lower rugs.

A rug of this type has not very much to commend it.

Many other double-faced weaves have already been described on three to six shafts, which are far quicker to weave. The only distinguishing feature here is the ability to form ridges, by filling the pockets. For these reasons it was not described among the four-shaft weaves.

(ii) WOVEN ON EIGHT SHAFTS

(a) Blocks

But when the weave is extended onto eight shafts giving a block weave there are more interesting results. The warp is threaded in groups of (1,2,3,4) and (5,6,7,8), but a slightly different interlacement is used than that explained in Fig. 283. Now, in Fig. 283, the black and white ends alternate in the warp. This means that the black weft has to weave with odd-numbered ends (black) whether it is forming the upper or lower cloth, see picks 1, 3, 5 and 7. Similarly the white weft has to weave with even-numbered ends (white).

But in a weft-face plain weave double cloth where the warp colour is immaterial, a weft can weave with odd-numbered ends when it is forming the upper cloth and on even-numbered ends when it is forming the lower cloth. This would imply that the weft of the upper cloth in two adjacent blocks would be weaving on even-numbered ends and that of the lower cloth on odd-numbered ends, or vice versa. This leads to one of the advantages of this interlacement, that one pick of appropriate plain weave can effectively seal off the pocket. For example, if the weft of the upper cloth in both blocks is weaving on even-numbered ends as in Fig. 285 (b), then one pick with the lift 1357, will seal the pocket and tie the two cloths together. The other advantage is that the join between adjacent blocks is cleaner. This is shown in Fig. 285 (a) and (b) where at the junction between threading blocks a filled square always comes up against an empty one.

The weave plan in Fig. 285 (a) shows four picks that will give a block weave in which both upper cloths are woven on odd-numbered ends (i.e., those threaded on shafts 1, 3, 5, and 7) so one pick of plain weave on 2468, will seal the pocket in both

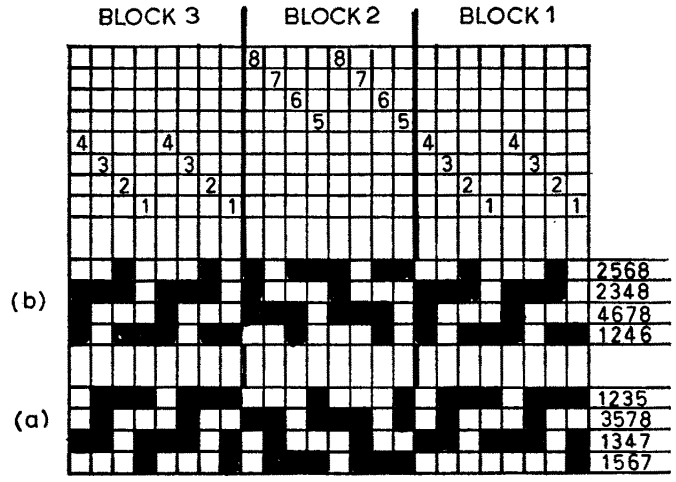


Fig. 285
Block Weave based on Weft-face Plain Weave Double Cloth. Weave Diagram with two weave plans

threading blocks. The colour sequence is (A,B,A,B). Fig. 285 (b) shows the weave plan which reverses the relative position of the warp ends, those weaving lower cloths in 285 (a) weave upper cloths in 285 (b) and vice versa. So changing from weave (a) to (b) also seals the pocket between cloths.

Fig. 286 shows a convenient pedal tie-up with two plain weave pedals, A and B, in the centre and the double cloth pedals arranged so that right and left feet work alternately.

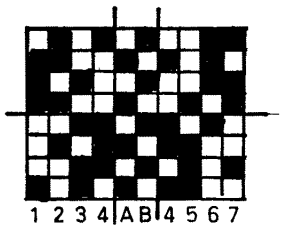


Fig. 286
Block Weave based on Weft-face Plain Weave Double Cloth. Convenient pedal tie-up

For weave (a) the pedals are pressed in the order 1, 4, 2, 5 and for weave (b) the pedals are pressed in the order 3, 6, 4, 7.

Design blocks of any width can be threaded, the smallest of course being of only four ends. In the warp direction it is wise to seal the pocket between cloths every few inches, either by changing the weave from (a) to (b) and back again or by putting in a plain weave pick (with a thinner weft). Otherwise the rug may not lie flat.

The obvious effects the technique gives are warpway stripes and alternating checks. These are not very interesting if both are woven in solid colours, as the texture of the weave is very fine (due to the close warp set of each cloth). So it is better to use blended colours in the weft or more than one weft for each block. Obviously any of the two-shuttle patterns (pick-and-pick stripes, cross stripes and spots) can be woven, either in the areas threaded on (1,2,3,4) or in those threaded on (5,6,7,8) or in both, see Plate 126.

Practical Details

A warp of 8 or 10 working e.p.i. is suitable, which gives 4 or 5 working e.p.i. for both upper and lower cloths. A weft of 2-ply carpet wool, used double or single respectively, is a suitable one to use. It might be assumed that a floating selvage would be best so that the weft from both upper and lower cloth caught round it. But this means that the floating selvage end has twice as many weft picks interlacing with it as do any of the other ends and this can lead to a bulky selvage which will not lie flat on the floor.

A far neater way is to begin and end the threading with two ends from what would be the next threading block; see Fig. 287 (a) where these extra two ends are encircled. If the main part of the threading is single in the heald, these two selvage threads will be double in the heald. Then weave normally with the two wefts. The effect of the

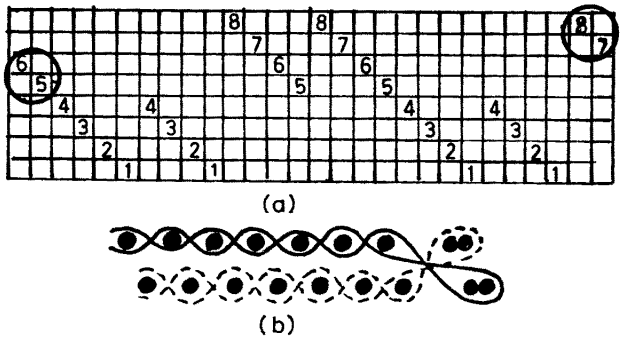


Fig. 287. Block Weave based on Weft-face Plain Weave Double Cloth. (a) Threading for selvage (b) Cross-section of selvage

extra ends is to produce a very narrow 'block' at the edge of the rug, which appears as a line of the colour of the lower cloth. The pocket between its upper and lower cloths is not closed in any way. So a cross-section of the right selvage would be as in Fig. 287 (b). This gives a very firm edge.

(*b*) *Ovals*

It was mentioned above that the texture of such a rug is very fine, But if a much thicker weft is used (i.e., 2-ply carpet wool used five or sixfold) a more interesting surface is obtained. This means that the warp shows slightly in places, so it should approach in colour that of the predominant weft.

In this weave, the pick-and-pick colour sequence is abandoned and several picks of colour A (forming, say, the surface in blocks threaded on 1,2,3,4,) are followed by several picks of colour B (forming the surface in the intervening blocks). The result is that the colours can be made to appear as ovals, see Plate 127.

The basic sequence of pedals, using the tie-up in Fig. 286, is thus:

1,2,B,2,1,—Weft A
4,5,4,5, —Weft B
2,1,B,1,2,—Weft A
5,4,5,4, —Weft B
} Repeat

The pick on pedal B, which is plain weave, ties the two cloths together. This pick appears as a line of spots on both sides of the rug, so its use in a different colour offers design possibilities. This pick also serves to separate the ovals of colour B.

A similar pick could be introduced in the middle of the oval woven on pedals 4 and 5.

Note—That the pedal before a plain weave pedal is repeated after it.

Plate 127 shows a few of the possibilities. It can be assumed the background colour is weft A, so the various ovals in black and white are produced by weft B.

The top oval is solid black. The next oval has an extra pick, so that it has five instead of four. It is woven in white, with the central pick (appearing as spots) in black. The next oval is all black, but it has a central plain weave pick which shows as a line of black spots in the intervening areas. The next oval has picks 1 and 4 woven with the background weft and only picks 3 and 4 with a different colour, white. These two picks appear as a wavy line. In between each of these above ovals there is of course an oval of background colour; these all fuse together visually to give the areas of solid colour between the columns of black and white ovals. The warp can be seen as light spots in the Plate. Plate 128 shows a full-size rug.

There is of course another pedal sequence which changes the relative positions of the warp ends. This, still referring to the tie-up plan in Fig. 286, is

6,7,A,7,6—Weft A
3,4,3,4 —Weft B
7,6,A,6,7—Weft A
4,3,4,3 —Weft B
} Repeat

Changing from one sequence to the other will seal the pocket between cloths and do away with the necessity of the plain weave pick. It is best to carry out this change, half way through an oval, as indicated by the arrows, below:

4, 5, 3, 4
↑
or 1, 2, 6, 7
↑

(*c*) *Block Weaves Based on the Analysis of Rameses' Girdle*

Interesting variations of plain weave double cloth are derived from the girdle woven for King Rameses III, about 1170 B.C. This remarkable textile, now in Liverpool Museum, is in two warp-face weaves which some think were done on tablets, others on a multishaft loom. The two weaves were analysed by Thorold Lee in 1913. One of these needed four shafts and eight different sheds, the other five shafts and eight sheds. The weaves to be described are obtained by turning the above weaves through a right angle so that they become weft-face weaves on eight shafts, and needing four sheds and five sheds, respectively. The details of the first weave are shown in Fig. 288 (a). The threading which is the same for both weaves is on (1,2,3,4) repeated ad lib, followed by two 'linking' ends on 1,2, then (5,6,7,8) repeated ad lib, followed by two 'linking' ends on 5,6. The four lifts are shown and in the weave plan these have been repeated twice to give a better idea of the structure.

Note—That these are the same four lifts as those in Fig. 285 (a).

To weave the sort of complex but small scale motifs present on Rameses' girdle, two or three wefts are used in special sequences, but the lifting sequence never changes. The distinguishing feature of these small motifs is that, though centred on one threading block, they spread across into the two adjacent threading blocks. See Fig. 288 (c) where the motif is centred on Block 2 (threaded on back four shafts) but spreads over into the blocks (threaded on front four shafts) on either side.

The weaving of these motifs can best be understood if a plan is made of how the four picks in the lifting sequence appear on the surface. This has been done diagrammatically in Fig. 288 (b).

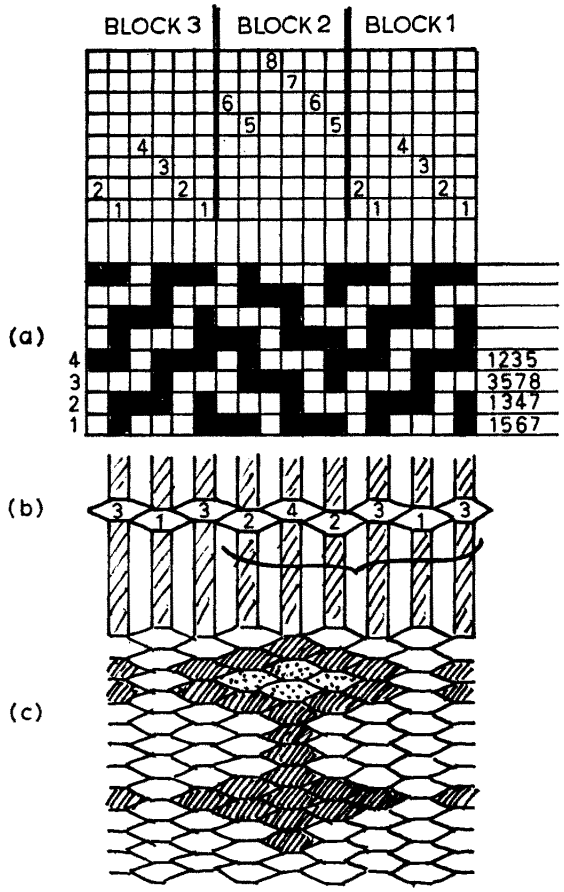


Fig. 288
Block Weave based on analysis of Rameses' Girdle.
(a) Weave Diagram
(b) Relationship of picks to surface of Blocks 1 and 2
(c) Motif woven in this technique

Note—That if Blocks 1 and 2 are taken together (bracketed in Fig. 288 (b)), the four picks come to the surface in six places and thus cover the six ends involved in the upper cloth. These six ends are represented by shaded lines. There are obviously another six ends woven in a similar way to form the back layer of cloth.

—That picks 1 and 4 only appear once and picks 2 and 3 both appear twice.

When beaten down these four picks make a solid line of weft, looking just like two picks of plain weave. To weave a motif, such as in Fig. 288 (c), the colour sequence will have to change frequently. Beginning at the bottom it is,

(A,A,A,B)×2
A,B,B,B
A,B,A,B
(A,A,A,B)×3
A,B,B,C
A,C,B,C
A,B,A,B
A,A,A,B

where A=the background colour
where B=the colour of motif
where C=the colour of the small diamond within the motif.

If the warp were threaded exactly as at the top of Fig. 288, motifs of the same size would appear all across the rug. But if some threading blocks had been extended, e.g., to (1,2,3,4)×3 followed by 1,2, then (5,6,7,8)×3 followed by 5,6, the motif would be correspondingly wider in these areas, see Plate 129.

The back of the rug shows a completely different design. The relationship between the appearance of the four picks on the back and front is shown in Fig. 289 (a). This

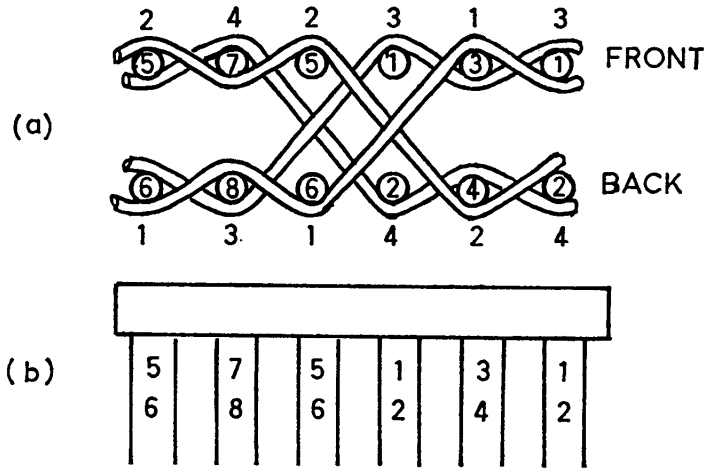


Fig. 289
Block Weave based on analysis of Rameses' Girdle.
(a) Cross-section through Blocks 1 and 2 showing how picks appear on back and front
(b) Method of sleying in a reed with eight dents/inch

represents a cross-section through the area of the rug bracketed in Fig. 288 (b), i.e., through an area threaded on a complete repeat of the pattern. The circles are the cross-sections of the twelve warp ends involved, and they are numbered according to the shaft they are threaded on. The four picks are also numbered where they come to the surface.

Note—That the picks 1 and 4 which only appear once on the front appear twice on the back, and picks 2 and 3 which appear twice on the front appear only once each on the back.

This causes the dissimilarity between the design on the two sides. Some colour sequence could be devised which showed similarly on both sides. Thus if picks 1 and 2 were colour A and picks 3 and 4 colour B, reference to Fig. 289 (a) will show that the two colours will appear as pick-and-pick stripes on both sides of the rug.

There is obviously great scope here for design, but only on a small scale. Plate 130 shows a rug woven in this technique.

The four lifts used give a plain weave double cloth so there is a pocket, running warpway between the two cloths in each threading block. To ensure that the rug lies flat, this should be sealed at intervals, either by a pick of plain weave (using a thin weft) or by interchanging the warp ends. In the latter case, the four lifts become (1246, 4678, 2348, 2568).

Hopsack can be woven by lifting 1278 and 3456; this is useful for the beginning and ending of a rug.

Practical Details

A warp with the following formula is suitable. 8 or 10 e.p.i., threaded single in the heald, therefore 8 or 10 working e.p.i. This gives 4 or 5 working e.p.i. for both upper and lower cloth, so a suitable weft would be of 2-ply carpet wool used two or three-fold for the first setting, and one or twofold for the second.

As Fig. 289 (a) shows, the warp ends tend to lie in pairs vertically above each other, and it is well to sley them in the same pairs. So if an 8-dent-to-the-inch reed is used, put two ends in every other dent, as shown in Fig. 289 (b).

A selvage threading similar to that described above is not a great help, because the weft sequence is constantly changing. So a floating selvage has to be used. Selvage ends are generally sleyed closer than the ends in the rest of the rug, but in this case sley them exactly as the rest of the rug, and this will in some way counteract the effects caused by the selvage ends interlacing with twice as many picks as do the other ends.

Variations

(1) *Four-Pick Weave*

By slightly changing the lifts, a weave can be produced that will show the same design on both sides of the rug.

Fig. 290 (a) shows a cross-section.

Note—The difference between it and that in Fig. 289 (a).

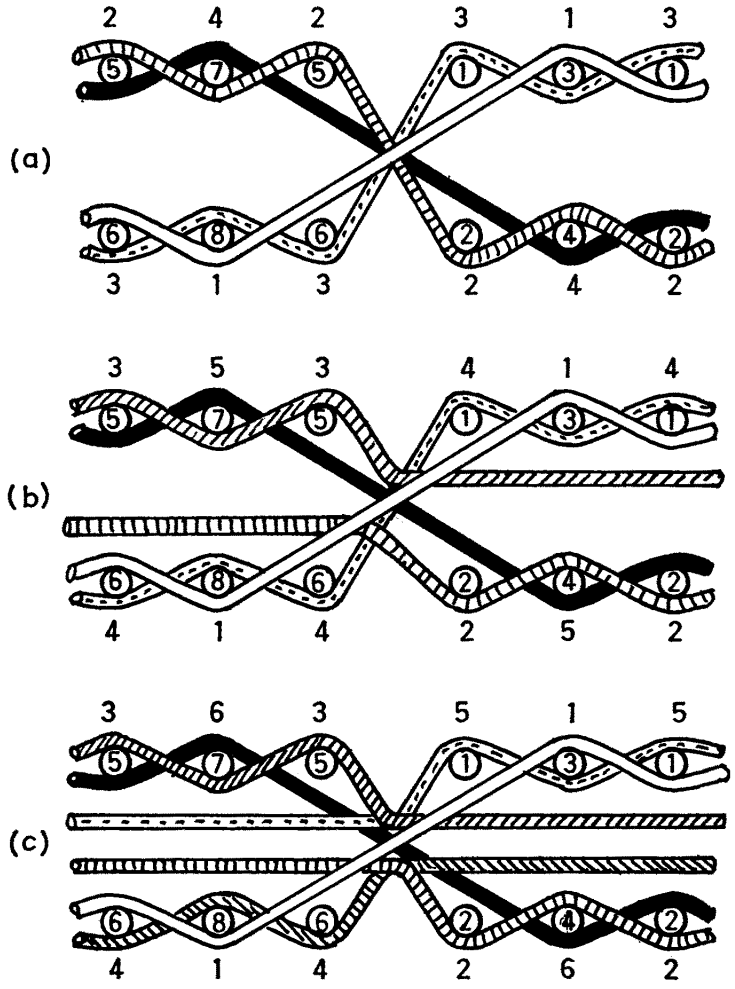


Fig. 290
Block Weave based on analysis of Rameses' Girdle. Variations of the weave
(a) With four picks in a repeat
(b) With five picks in a repeat
(c) With six picks in a repeat

Here all the wefts change from front to back of the rug, and vice versa, exactly at the same point. For this reason it is more difficult to beat down properly, so a 2-ply carpet wool used twofold as the weft is more suitable with an 8 working e.p.i. warp setting. The labelling of the picks in the cross-section shows the design will be the same on both sides.

The lifts are shown in Fig. 291 (a). The bottom four repeated or the top four repeated will give the same effect. Changing from one to the other interchanges the relative positions of the warps of upper and lower cloths.

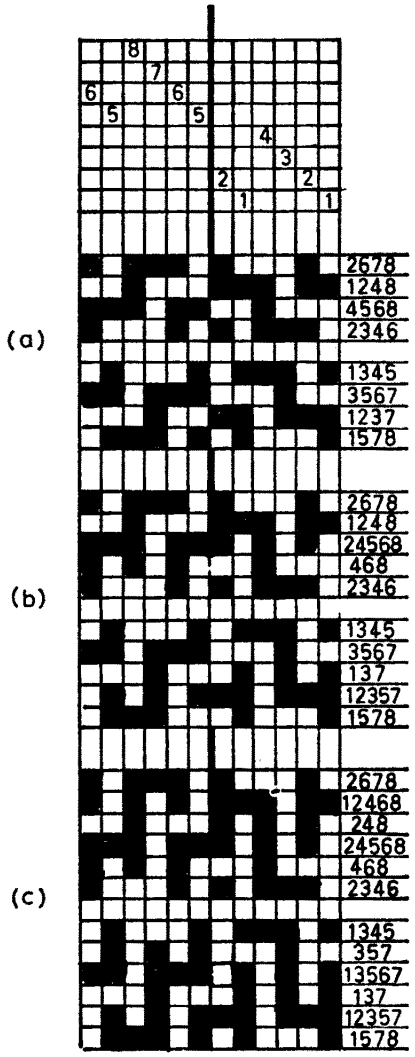


Fig. 291
Block Weave based on analysis of Rameses' Girdle. (a–c) Weave Diagrams corresponding to cross-sections in Fig. 290

(2)' *Five-Pick Weave*

This is derived from the second weave found in the Rameses' girdle. Fig. 290 (b) shows a cross-section. If it is compared with Fig. 290 (a), it will be seen to be the same except that the second pick in Fig. 290 (a) has been replaced by two picks (numbers 2 and 3 in Fig. 290 (b)) one of which, pick 2, only appears on the back and the other, pick 3, only appears on the front. Where these picks are not visible on either surface they are floating between the upper and lower cloths. So though they contribute nothing to the surface at these points, they contribute to the thickness of the rug, padding out the pocket between the two cloths.

Note—If picks 2 and 3 are of the same colour, then the design on both sides will be identical.

—By making these two picks of different colours, the two sides of the rug can show a similar design but differently coloured in parts.

The two sets of lifts are shown in Fig. 291 (b). The weft should be 2-ply carpet wool used twofold if the warp is 8 working e.p.i.

(3) *Six-Pick Weave*

This is an extension of the above weave, see Fig. 290 (c). Pick 4 in Fig. 290 (b) has been split into two and appears as picks 4 and 5 in Fig. 290 (c). Pick 4 appears on the back only and pick 5 appears on the front only, elsewhere they both float in the pocket between upper and lower cloths.

Note—That only picks 1 and 6 appear on both sides of the rug, so here there is more opportunity of varying the colours between the back and front of the rug, though not of course of varying the motifs.

—The pocket has twice as many 'padding' picks as in the above weave, so the rug is correspondingly thicker.

The two sets of lifts are shown in Fig. 291 (c). 2-ply carpet wool used twofold is suitable as a weft if the warp is set at 8 working e.p.i. This will give a very firm rug.

D. Block Weaves Based on the Three-Weft Double-Faced Weaves

These are the eight-shaft developments of the three-weft double-faced weaves described in Chapter 7. They each had a weft for the front and a weft for the back of the rug and a third weft which wove in such a way that it was hidden in between the other two. There were two types which differed in that, in one weave, the third weft interlaced in plain weave order and, in the other weave, in hopsack order. The same distinction carries through to the block weaves here described.

(i) WITH A HIDDEN WEFT IN PLAIN WEAVE

Fig. 292 gives the details of this weave. The threading is in groups on the back four and front four shafts. These groups can contain any number of repeats of either (1,2,3,4) or (5,6,7,8). The lifts and weave plan shown at Fig. 292 (a) give a block weave. Note there is a three-colour weft sequence (A,B,C). This weave is best understood by the cross-section shown in Fig. 293. At (b) is a cross-section of picks 1 to 3, at (a) of picks 4 to 6. The circles represent warp ends, numbered according to the shafts they are controlled by.

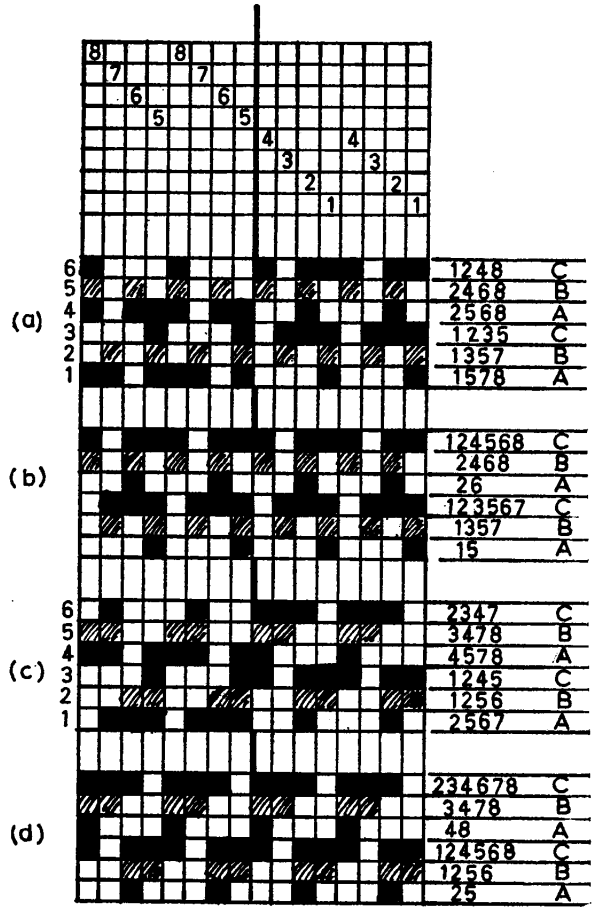


Fig. 292
Block Weaves based on three-Weft Double-Faced Weaves.
(a) and (b) Weave Diagrams with hidden weft in plain weave
(c) and (d) Weave Diagrams with hidden weft in hopsack

It will be seen that, as in the four-shaft weaves, picks 2 and 5 (dotted lines) are in normal plain weave. They are unaffected by the junction between blocks (indicated by arrows), and carry on from selvage to selvage. They contribute nothing to the surface of the rug as they are hidden by the floating wefts above and below them. The latter (colours A and C, indicated by white and black lines) are seen to change positions at the junction between blocks. What was the upper weft becomes the lower weft and vice versa, hence it is a block weave, with alternating blocks of colour A and C.

It is difficult with this structure to get a perfect join between adjacent blocks, and maybe there is a better solution than the one described above. The aim, of course, is to make the floating wefts change from an over-3-under-1 weave, to an under-3-over-1 weave (or vice versa), in as simple a way as possible at the block junctions.

Fig. 292 (b) shows the lifts that will give the same colour all across on the front and another colour all across on the back.

(ii) WITH A HIDDEN WEFT IN HOPSACK

Fig. 292 (c) gives the details of this variation. As the cross-sections in Fig. 293 (c) and (d) show, picks 2 and 5 weave in hopsack right across. The other picks take a different but comparable, course to those in the above weave.

Fig. 292 (d) shows the lifts that will give one colour all across on the front and another at the back. The pick-up varieties of these weaves will be found in the following chapter.

Practical Details

Warp—6 working e.p.i.

The weft for colours A and C should be 2-ply carpet wool used threefold. The weft for colour B should be 2-ply carpet wool used singly if it is to be quite invisible, or used twofold or threefold if it is required to show slightly on the surface. Use a floating selvage and start all wefts from the same side.

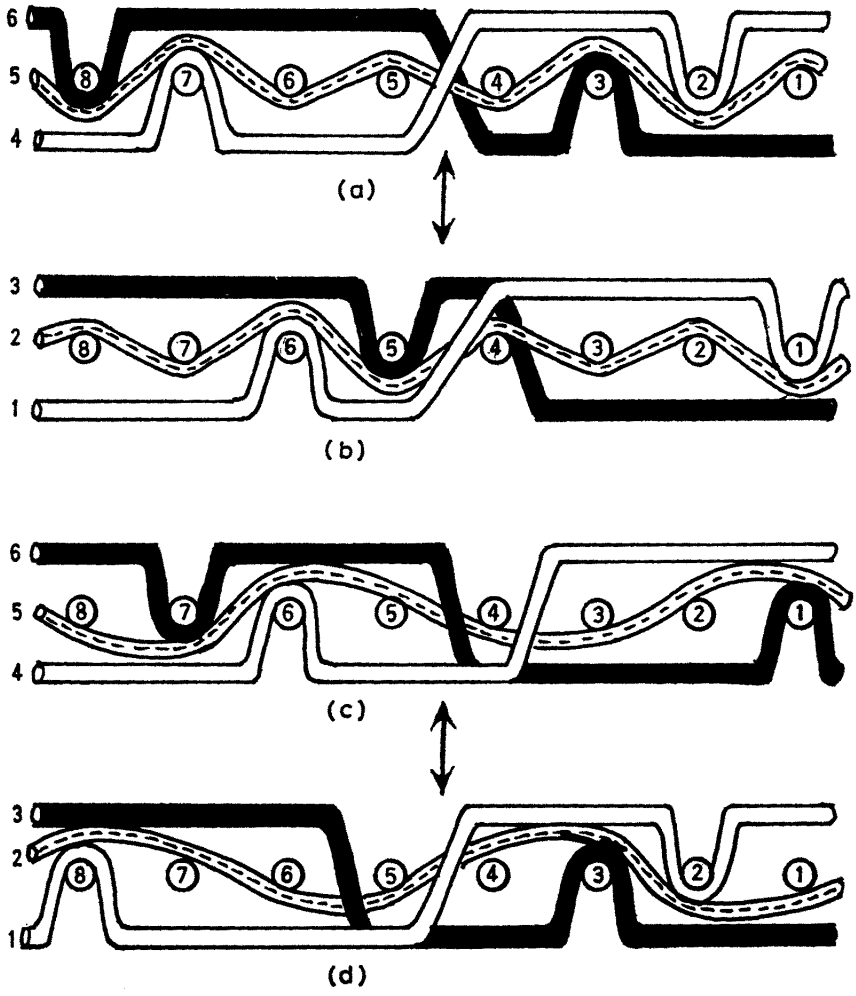


Fig. 293
Block Weaves based on Three-Weft Double-Faced Weaves.
(a) and (b) Cross-sections o picks in Fig. 292(a)
(c) and (d) Cross-sections o picks in Fig. 292(c)

9 · Weft-face Rugs in Multishaft Weaves

PART THREE: TECHNIQUES GIVING BLOCK DESIGNS CONTROLLED BY PICK-UP METHODS

INTRODUCTION

Each pick-up weave is structurally identical to one of the block weaves, which are themselves related to the double-faced weaves. In the block weaves, the positioning of the colour areas depends on variations in the threading of the warp, e.g., whether it is threaded (1,2,3) or (1,2,4) in Three-End Block Draft. So it is shaft-controlled and it cannot be altered once the warp is threaded, except by the technique of shaft switching. In the pick-up weaves, the threading is generally the same all across the width of the warp, and the positioning of the colour areas depends entirely on various manipulations of the warp, using one or more pick-up sticks. These manipulations raise some ends, lower others, and in fact control the warp exactly as do the shafts in the block weaves. But as the stick can be inserted differently for every set of picks, it is as if the threading of a block weave is being altered at will, pick by pick.

TWO METHODS OF PICK-UP

There are basically two ways of performing the pick-up; one is the more normal one and can be woven on almost any type of loom, the other is more suited to rugs, due to their widely spaced warp, but it needs a loom which gives a rising and falling shed. These two ways will be described in detail for the first weave. Once this has been understood, the shorter description of the subsequent weaves will be found to be sufficient.

It is difficult to classify the pick-up weaves by the number of shafts they require, as the identical weave can sometimes be produced on two, three, or four shafts. So they will be listed according to the block weave they are related to and in each case the various ways of producing them will be given.

1. PICK-UP VERSION OF BLOCK WEAVE USING THE THREE-END BLOCK DRAFT

It will be remembered that in this weave (the first one described in Chapter 8) it is the ends on shaft 3 or 4 which control the appearance of the weft either on the face or the reverse of the rug. So it is these ends that have to be manipulated in the pick-up. As mentioned above this can be done in two ways.

A. Centre Shed Pick-Up

(i) USING TWO SHAFTS

This method can most easily be understood by considering the two-shaft version of the weave.

Set up a two-shaft loom in such a way that *every third end is not threaded on either shaft.* Fig. 294 (a) shows the threading diagrammatically, where O signifies the position of an unthreaded end. The unthreaded ends are treated normally in the reed.

There are now only two possible sheds, shaft 1 up with shaft 2 down, and shaft 2 up with shaft 1 down. As the side views in Fig. 294 (b) and (c) show, these are both split, or double, sheds because the unthreaded ends naturally lie in the middle of the sheds, unaffected by the shafts' movements. In Fig. 294 (b) there is a half shed, A, above this central layer and a half shed, B, below it. The corresponding half sheds in Fig. 294 (c) are labelled C and D.

Two shuttles bearing black and white weft are used. The black goes through A, the white through B. Both are beaten and the shed is changed. The black returns through

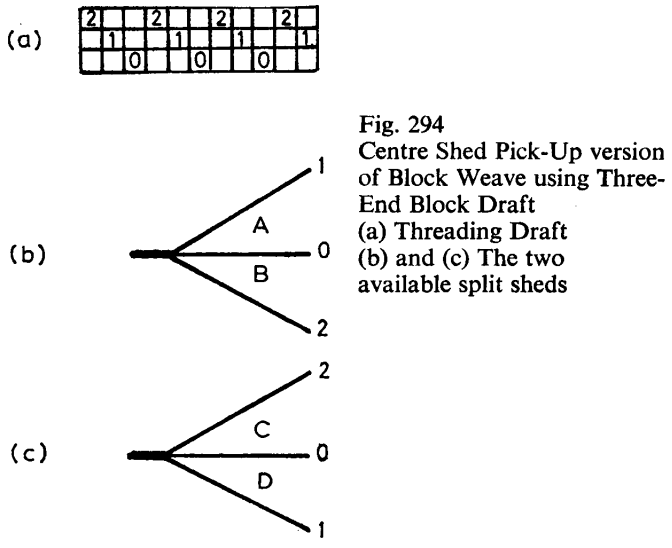


Fig. 294
Centre Shed Pick-Up version of Block Weave using Three-End Block Draft
(a) Threading Draft
(b) and (c) The two available split sheds

C, the white through D, and both are again beaten. If this is repeated, a rug black on the face and white on the reverse will be woven.

Note—That there are two picks for every one change of shed.
—That the weave produced is identical to that shown in Fig. 211 in Chapter 8.

To pick up a design, attention has to be focused on the central layer of unthreaded ends. The shed as in Fig. 294 (b) is opened. Fig. 295 (a) shows a diagrammatic view of the central layer seen from above; for convenience, the uppermost layer of ends (those on the first shaft) have been omitted.

Enter a pick-up stick in the A shed (i.e., above the central layer), then pass it down through this layer into the B shed and then bring it back again up into the A shed. Turn it on edge and throw the black weft across in the shed so formed. In Fig. 295 (a) the stick is shown passing over the first three unthreaded ends, under the next three, and over the last three. Take out the pick-up stick and then using the black weft as a guide, re-insert the stick making it take the exact opposite course through the central layer. For convenience, this stage has been called pick-down as it is the opposite of pick-up. So the stick begins in the B shed, comes up into the A shed passing over the middle three ends and then drops back again into the B shed. It is turned on its side and the white weft thrown across in the shed so formed.

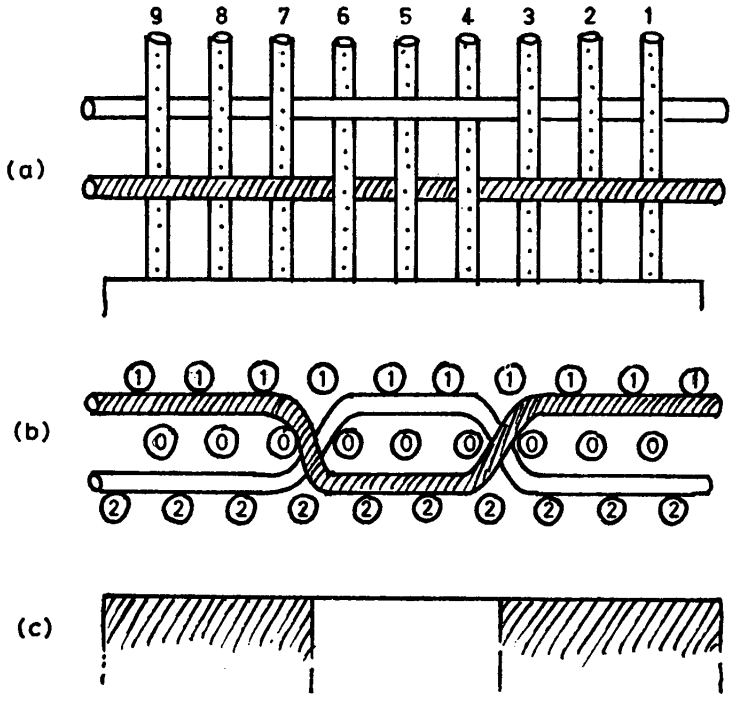


Fig. 295
Centre Shed Pick-Up version of Block Weave using Three-End Block Draft
(a) Central layer of unthreaded ends with two picks of weft
(b) Cross-section through warp showing two picks
(c) Resulting design

Take the pick-up stick out and beat the two wefts. The cross-section at Fig. 295 (b) (which indicates all three layers of the shed) shows the relationship of the two wefts to the central layer at this moment. They slip over each other so that the white only shows in the centre and the black at either side.

Change the shed and repeat the above procedure exactly. This is the complete cycle.

If the pick-up is continued exactly as in Fig. 295 (a), then the design would be as in Fig. 295 (c).

Note—That where the stick passes over the central layer, the following weft comes to the surface; where it passes under, the weft goes to the back.

—That when the pick-up stick is turned on edge for the first passage of the black weft, it is in effect raising unthreaded ends 4, 5, and 6, and lowering unthreaded ends 1,2,3, and 7,8,9. Shaft 1 is up and shaft 2 is down, so it is giving exactly the same shed as that obtained from a warp threaded (1,2,3)×3, (1,2,4)×3, (1,2,3)×3, when shafts 1 and 4 are raised. Similarly the shed that the stick gives for the first passage of the white weft raises unthreaded ends 1,2,3 and 7,8,9 and lowers unthreaded ends 4,5, and 6. This is the same shed as lifting 13 would give on a warp threaded as above.

In the same way, the picked-up shed for the second black pick, corresponds to a lift of 24. And the shed for the second white pick corresponds to a lift of 23.

If this is understood it will be seen that the pick-up stick has taken over the function of shafts 3 and 4 in Three-End Block Draft. The weave structure obtained is identical in the pick-up and the block weave version.

—That the stick is always inserted twice in each shed; once for the black weft (pick-up) and once, taking the opposite course, for the white weft (pick-down). One weft, here the black, always acts as the leader, initiating any change in the design, the other merely follows. So the two wefts always work as a complementary pair. At any point in the cloth, one is forming an element of the design on the face and the other is forming a similar element but in a different colour on the reverse.

The great advantage of the pick-up method is that the course taken by the pick-up stick can be changed every time the shed is changed. Thus designs of any complexity can be woven, which would require a very large number of shafts if woven as a block weave.

It will be obvious from the above description that a loom which gives a rising and falling shed is necessary. So a two-shaft vertical rug loom, a counterbalanced and a countermarch loom will all be suitable, but a table loom will not. However, a table loom can be simply adapted for this technique. Fix an extra, raised, back bar. The

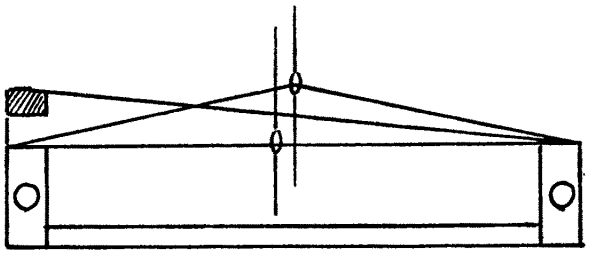


Fig. 296. Centre Shed Pick-up version of Block Weave using Three-end Block Draft. Adapting table loom to give split shed

unthreaded ends pass over this, while the threaded ends pass over the normal back bar. As Fig. 296 shows, this gives the required split shed, as long as the extra back bar is at the correct height. A jack loom is suitable as long as, in the shafts' position of rest, the heald eyes are well below the line from breast beam to back beam.

(ii) USING FOUR-SHAFT COUNTERBALANCED LOOM

Thread the warp (1,2,3, 1,2,4) repeat, or in groups of (1,2,3) and (1,2,4) as for a block weave. Immobilize the top roller or pulleys to prevent any movement of shafts 3 and 4 when shafts 1 and 2 are raised and lowered. Tie two pedals so that one lowers shaft 2 and therefore raises shaft 1, and the other lowers shaft 1, and therefore raises shaft 2. When either pedal is used, the ends on shafts 3 and 4 do not move and so they form the central layer of the shed. Perform the pick-up as described above.

It is obvious that with this set-up, a shaft-controlled block weave can be combined with the pick-up version, the latter being used occasionally to give variety to the fixed colour areas of the block weave.

(iii) USING THREE OR FOUR-SHAFT COUNTERMARCH LOOM

Thread as above and tie up pedals as in Fig. 297 (a).

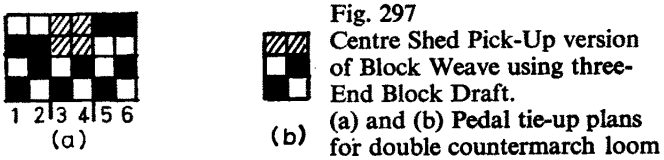


Fig. 297
Centre Shed Pick-Up version of Block Weave using three-End Block Draft.
(a) and (b) Pedal tie-up plans for double countermarch loom

The convention for the tie-up diagram is thus:
black square=tie pedal to lower lam, i.e. the shaft is raised.
white square=tie pedal to upper lam, i.e., the shaft is lowered.
shaded square=do not tie pedal to either lam.

Thus pedal 3 is tied to the lower lam of shaft 1, to the upper lam of shaft 2 and is not connected at all to the lams of shafts 3 and 4. Pedals 3 and 4 will give the two

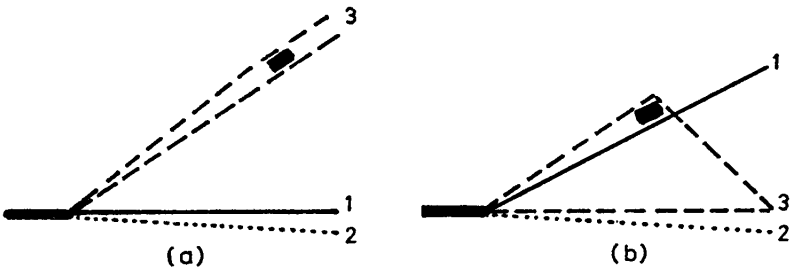


Fig. 298. Raised End Pick-up Method

split sheds for the pick-up. Pedals 1,5,2, and 6 will give the shaft-controlled block weave.

If the countermarch loom is threaded, (1,2,3) repeat, and the pedals tied as in Fig. 297 (b), then only the pick-up weave is possible (plus of course any purely three-shaft weave).

PRACTICAL DETAILS

The warp and weft settings are obviously the same as used for Three-End Block Draft, i.e., 4 working e.p.i. and 2-ply carpet wool used threefold. If the threading begins and finishes with two ends on shafts 1 and 2 (as shown in Fig. 294 (a)) the two wefts will catch at the selvage, providing that they begin from opposite selvages.

The pick-up stick should be of smooth wood, flattened so that when turned on its edge it gives a shed about 2 inches deep, and it should be pointed at both ends. When weaving samples or a narrow rug, the stick can be dispensed with; the shuttles themselves (preferably of the type used in netting) are threaded in and out of the central layer.

If a large piece of work in this technique is to be woven, it is an advantage to have the warp of two colours, the ends on shafts 1 and 2 in a dark colour, the ends of the central layer in a light colour. The latter are then more easily distinguished when picking up. A further refinement is to have threads of contrasting colour, spaced perhaps 2 inches apart, in the central layer. This makes the following of a design more easy and if ends have to be counted they do not have to be counted all the way in from one or other selvage.

B. Raised End Pick-Up

In this method the pick-up stick does the same manipulations with the same set of threads as above, but, instead of lying in the centre of a shed, these threads are raised to form the upper layer of a shed. Thread the warp (1,2,3) repeat, then the procedure is in the four following stages.

(i) Raise shaft 3. Pick-up with the stick in this raised layer of threads exactly as described above. So some of the threads on shaft 3 now pass over and some pass under the stick. This stage is shown in diagrammatic side view in Fig. 298 (a). The stick passes over the ends where the weft is to show on the front and under the ends where the weft is to show on the back.

Lower shaft 3, leaving the stick in position.

Raise shaft 1. The stick is naturally lifted by this new layer of threads. With it, are lifted all those ends from shaft 3 that, as a result of the pick-up, pass over the stick. Those that pass under the stick are not raised; they join the ends from shaft 2 to form the lower layer of the shed. Fig. 298 (b) shows a diagrammatic side view of this stage.

Throw colour A across in the shed directly under the stick. Lower shaft 1, remove the stick and beat.

(ii) Raise shaft 3 again. Pick-down with stick, i.e., make it take the exact opposite course through this raised layer of threads, going over where it previously went under and vice versa.

Lower shaft 3, leaving stick in position.

Raise shaft 1, and throw colour B across in the shed under the stick.

Lower shaft 1, remove stick and beat.

(iii and iv) Repeat the above two stages, but lifting shaft 2 instead of 1. So the whole process can be put in shortened form thus:

Raise 3, pick-up, lower 3, raise 1, weave weft A.
Raise 3, pick-down, lower 3, raise 1, weave weft B.
Raise 3, pick-up, lower 3, raise 2, weave weft A.
Raise 3, pick-down, lower 3, raise 2, weave weft B.

Note—The stick for this type of pick-up can be of small cross-section as long as it is fairly stiff. So a metal rod of $\frac{1}{4}$ inch diameter, tapered at both ends, is very suitable; or a flat metal strip, such as is used in rigid frame shafts for suspending the healds.

—In this type of pick-up the shed obtained is always shallow. When weaving a sample this is no inconvenience as a stick shuttle can easily be inserted into it and passed from selvage to selvage. But with a full-width rug, it may be necessary to insert the type of stick used for Centre Shed Pick-Up, turn it on its edge and thus enlarge the shed sufficiently for the shuttle's passage.

—The wefts work in pairs exactly as in Centre Shed Pick-Up. The pick-down is always the exact opposite of the pick-up. The design can be changed after every two picks if so desired, but never after only one pick.

—As in Centre Shed Pick-Up the stick is taking over the function of shafts 3 and 4 in Three-End Block Draft.

—This method is very suitable for table looms and jack looms.

VARIATIONS

(1) *In Picking Order*

Raise shaft 3, pick-up, lower 3, raise 1, weave weft A.
Leaving pick-up stick in position, raise 2, weave weft A.
Raise shaft 3, pick-down, lower 3, raise 1, weave weft B.
Leaving pick-up stick in position, raise 2, weave weft B.
Raise shaft 3, pick-up, lower 3, raise 2, weave weft A.
Leaving pick-up stick in position, raise 1, weave weft A.
Raise shaft 3, pick-down, lower 3, raise 2, weave weft B.
Leaving pick-up stick in position, raise 1, weave weft B.

This gives a slightly different weave (in which spots of colour A show through an area of colour B and vice versa) but it has the advantage of only needing half the normal number of pick-ups.

(2) *In Colour and Lifts*

A sequence can be developed in which some picks are in normal shaft controlled sheds while others are in picked-up sheds, thus:

Raise 1—weave weft A.
Raise 13—weave weft B.
Raise 3, pick-up, lower 3, raise 2, weave weft C.
Raise 3, pick-down, lower 3, raise 2, weave weft D.

This will give Colour A all across on front, colour B all across on the back, and colours C and D only appearing where picked up. So the front of the rug will show areas of A striped with C and of A striped with D, and the back will show similar areas of B striped with D and B striped with C. Of course all four wefts need not be different colours. Two or three colours could be used in this way.

Practical Details

Exactly as for Centre Shed Pick-Up.

Two Pick-Up Methods Compared

(1) Picking up on raised ends is easier on the eyes than picking up in the middle of the shed, especially with a close set warp.

(2) Centre Shed Pick-Up always gives a good shed, as the stick used is turned on its edge for the passage of the shuttle. In Raised End Pick-Up, the shed is poor, so a second stick may be necessary to enlarge it.

(3) Using Raised Shed Pick-Up it is possible with some weaves to insert two picks of one colour after each pick-up. This is never possible with Centre-Shed Pick-Up, where every throw of the shuttle is preceded by its own individual pick-up.

2. PICK-UP VERSION OF BLOCK WEAVE BASED ON DOUBLE-FACED 2/1 TWILL

A. Centre Shed Pick-Up

This is only possible on a countermarch loom. Thread (1,2,3) repeat, all across the rug. Tie up pedals as in Fig. 299 (a), remembering a shaded square means that there is no pedal-to-lam tie at this point.

Fig. 300 shows the three different split sheds given by the three pedals with the above tie-up. Thus with pedal 1, ends on shaft 1 are raised, ends on shaft 3 are lowered, and ends on shaft 2 do not move at all, and thus form the central layer. The other two pedals give similar sheds, the ends from a different shaft forming the central layer in each case. The weaving sequence is thus:

Press Pedal 1—pick-up in the central layer, weave weft A.
pick-down in the central layer, weave weft B.
Press Pedal 2—pick-up in the central layer, weave weft A.
pick-down in the central layer, weave weft B.
Press Pedal 3—pick-up in the central layer, weave weft A.
pick-down in the central layer, weave weft B.
Repeat.

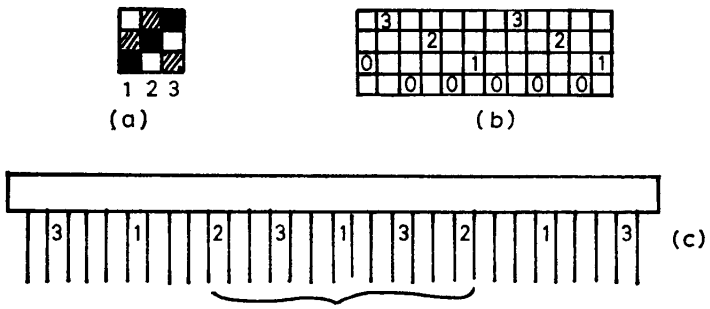


Fig. 299. Pick-up version of Block Weave based on Double-faced 2/1 Twill.
(a) Pedal tie-up for double countermarch loom
(b) Alternative threading
(c) Sleying when using a pointed draft

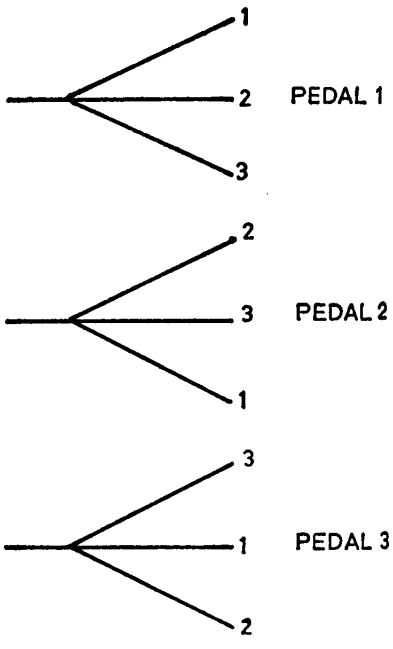


Fig. 300
Pick-up version of Block Weave based on Double-faced 2/1 Twill. Three split sheds for the Centre Shed method

Plate 131 shows a rug woven in this technique. The outlines of the rhomboid-shaped motifs follow the twill lines of the weave. If a motif with vertical, i.e. warpway, outline is woven, it will be found that this outline is in reality a succession of small angled teeth. The fact that the weave is a twill makes it impossible to obtain straight vertical colour junctions. This weave can be varied by threading as in Fig. 299 (b), but tying up pedals and weaving exactly as described. The centre layer of ends will now consist of the unthreaded ends (O) plus the ends threaded on one of the shafts. The wefts will now float over five instead of three ends, so the warp must be set closer, e.g., 6 working e.p.i. The extra warp ends add body to the rug, but do not affect the weave in any other way.

B. Raised End Pick-Up

Thread warp (1,2,3) repeat.
Lift 1, pick-up, lower 1, raise 3, weave weft A.
Lift 1, pick-down, lower 1, raise 3, weave weft B.
Lift 2, pick-up, lower 2, raise 1, weave weft A.
Lift 2, pick-down, lower 2, raise 1, weave weft B.
Lift 3, pick-up, lower 3, raise 2, weave weft A.
Lift 3, pick-down, lower 3, raise 2, weave weft B.

This is suitable for table and jack looms.

Practical Details

Warp—6 e.p.i., alternately single and double in the heald, therefore 4 working e.p.i.
Weft—2-ply carpet wool used two or threefold.

VARIATION USING A POINTED DRAFT

The weave can be varied by using a pointed draft on three shafts, i.e., 3,2,1; 3,2,1; 3; 1,2,3; 1,2,3; 1; 3,2,1; 3,2,1; etc. This enables diamond shapes to be picked up, the diamonds being centred on the reversing points of the threading.

There are two sequences to be used:

(1) When a diamond is increasing in size.

Raise 1, pick-up, lower 1, raise 2, weave weft A.
Raise 1, pick-down, lower 1, raise 2, weave weft B.
Raise 3, pick-up, lower 3, raise 1, weave weft A.
Raise 3, pick-down, lower 3, raise 1, weave weft B.
Raise 2, pick-up, lower 2, raise 3, weave weft A.
Raise 2, pick-down, lower 2, raise 3, weave weft B.

(2) When a diamond is decreasing in size.

Raise 1, pick-up, lower 1, raise 3, weave weft A.
Raise 1, pick-down, lower 1, raise 3, weave weft B.
Raise 2, pick-up, lower 2, raise 1, weave weft A.
Raise 2, pick-down, lower 2, raise 1, weave weft B.
Raise 3, pick-up, lower 3, raise 2, weave weft A.
Raise 3, pick-down, lower 3, raise 2, weave weft B.

Naturally at the widest point of the diamond, a switch from one sequence to the other has to be made. Do this in such a way that the shafts lifted for weaving reverse their sequence at this point. Thus:

Pick-up and pick-down on shaft 1, weave on 2 } First sequence
Pick-up and pick-down on shaft 3, weave on 1 } First sequence
Pick-up and pick-down on shaft 2, weave on 3 } First sequence
Pick-up and pick-down on shaft 2, weave on 1 } Second sequence
Pick-up and pick-down on shaft 3, weave on 2 } Second sequence

Note—This means picking up twice with the same shaft raised (here shaft 2).

Practical Details

The warp setting is 4 working e.p.i. If a reed with 12 dents per inch is used, 3 empty dents follow every filled dent. But at the reversing points in the threading draft, leave only 2 empty dents between 5 consecutive ends, bracketed in Fig. 299 (c). This is to reduce the length of the otherwise overlong weft floats at these points.

3. PICK-UP VERSION OF ONE OF THE BLOCK WEAVES USING THE FOUR-END BLOCK DRAFT

A. Centre Shed Pick-Up

This can be woven in two ways.

(1) On two shaft loom, or using only two shafts of a multishaft loom.

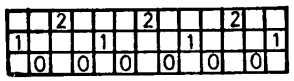


Fig. 301
Pick-up version of Block Weave using Four-End Block Draft.
(a) Draft for Centre Shed method
(b) Pedal tie-up

Thread loom as in Fig. 301 (a), i.e., every other end is left unthreaded (O). Apart from the threading, this method is exactly similar to the first pick-up described in this chapter. So the sequence is:

Raise 1, lower 2, pick-up, weave weft A.
Raise 1, lower 2, pick-down, weave weft B.
Raise 2, lower 1, pick-up, weave weft A.
Raise 2, lower 1, pick-down, weave weft B.
Repeat. See Plate 132.

(2) Using four shafts on a counterbalanced loom.

Thread (1,3,2,4) repeat. Immobilize the top roller, to prevent any movement of shafts 3 and 4 when shafts 1 and 2 are moved. Tie pedals as in Fig. 301 (b). The sequence is:

Press Pedal 1, pick-up, weave weft A.
Press Pedal 1, pick-down, weave weft B.
Press Pedal 2, pick-up, weave weft A.
Press Pedal 2, pick-down, weave weft B.

The ends on shafts 3 and 4 form the central layer.

B. Raised End Pick-Up

Thread (1,2,3,4) repeat.

Raise 24, pick-up, lower 24, raise 1, weave weft A.
Raise 24, pick-down, lower 24, raise 1, weave weft B.
Raise 24, pick-up, lower 24, raise 3, weave weft A.
Raise 24, pick-down, lower 24, raise 3, weave weft B.

A variation of this is the following:

Lift 24, pick-up, lower 24, raise 1, weave weft A.
Lift 24, pick-down, lower 24, raise 3, weave weft B.
Repeat three or four times, then
Lift 24, pick-up, lower 24, raise 3, weave weft A.
Lift 24, pick-down, lower 24, raise 1, weave weft B.
Repeat three or four times as before.

The resulting weave has a ridgy surface.

4. PICK-UP VERSION OF BLOCK WEAVE USING THE SIX-END BLOCK DRAFT

A. Centre Shed Pick-Up

Thread as in Fig. 302 (a), i.e., every third end is unthreaded. The sequence is as follows:

Raise 1, lower 2, pick-up, weave weft A.
Raise 1, lower 2, pick-down, weave weft B.
Raise 2, lower 1, pick-up, weave weft A.
Raise 2, lower 1, pick-down, weave weft B.

See the section on this block weave in Chapter 8 for other possible colour sequences.

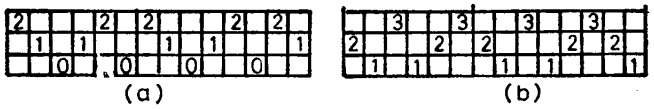


Fig. 302
Pick-Up version of Block Weave using Six-End Block Draft. Two threading drafts

B. Raised End Pick-Up

Thread on three shafts as in Fig. 302 (b).

Raise 3, pick-up, lower 3, raise 1, weave weft A.
Raise 3, pick-down, lower 3, raise 1, weave weft B.
Raise 3, pick-up, lower 3, raise 2, weave weft A.
Raise 3, pick-down, lower 3, raise 2, weave weft B.

Alternatively the warp can be threaded on four shafts as for Six-End Block Draft in which case the pick-up is performed with shafts 3 and 4 raised.

Practical Details

The warp should have 5 working e.p.i., with a weft of 2-ply carpet wool used two or threefold.

5. PICK-UP VERSION OF ONE OF THE BLOCK WEAVES USING M'S AND O'S DRAFT

The pick-up method used for this weave is different from all the others described in this chapter.

A. Centre Shed Pick-up

Thread as in Fig. 303 (a), noting that two unthreaded ends always follow two threaded ends. As is normal with this type of threading, start and finish it with threaded ends. When shaft 1 is raised and shaft 2 lowered, the central layer of unthreaded ends will appear in pairs, with a definite space between each pair, see Fig. 303 (b).

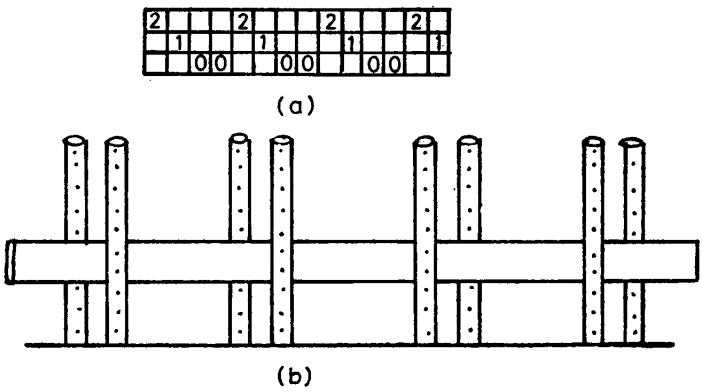


Fig. 303. Pick-up version of Block Weave using M's and O's draft. (a) Draft for Centre Shed method (b) View of central layer of threads

Now in picking up, the stick passes under either the right-hand or the left-hand end of *every* pair. In Fig. 303 (b), it passes under the left-hand ends of the first two pairs and under the right-hand ends of the next two pairs. How the pick-up is related to the appearance of the weft on the front or the back of the rug depends on which shaft is raised. The sequence is as follows:

(a) Raise shaft 1, lower 2.

Pick-up the left-hand end of each pair, where the weft is required on the surface, and the right-hand end of each pair where the weft is not so required.

Turn stick on its edge, and weave weft A in the shed so formed.

Withdraw stick and beat.

(b) Raise 1, lower 2, i.e., use the same shed.

Pick-up the exact opposite. Thus, pick-up right-hand ends where left-hand ends were picked up above and vice versa.

Turn stick on its edge and weave weft B.

Withdraw stick and beat.

(c) Raise 2, lower 1.

Pick-up exactly as done in stage (b) above, and weave weft A. This will not appear in the same position as weft B above, as might be supposed. But, because the main shed has been changed, it appears in a similar position to weft A in stage (a).

(d) Raise 2, lower 1, i.e., use the same shed.

Pick-up exactly as done in stage (a) above, and weave weft B. Again because the main shed is changed, this will appear in a similar position to weft B in stage (b).

The sequence is slightly complicated as the pick-up for weft A in stage (a) is the opposite of the pick-up for weft A in stage (c), and the same applies for weft B in stages (b) and (d). The pick-up could be made easier if all the right-hand ends of the pairs were one colour and the left-hand ends another colour.

B. Raised End Pick-Up

Thread (1,2,3,4) repeat.

The sequence is as follows:

(a) Raise 23, thus giving pairs of ends spaced out across the warp, as in the above method.

Pick-up left-hand end of each pair where the weft is required on the surface and the right-hand ends where it is not so required.

Lower 23, raise 4, weave weft A.

(b) Raise 23, pick-up the exact opposite, i.e., select right-hand instead of left-hand ends, and vice versa, lower 23, raise 4, weave weft B.

(c) Raise 23, pick-up as in stage (b), lower 23, raise 1, weave weft A.

(d) Raise 23, pick-up as in stage (a), lower 23, raise 1, weave weft B.

After each stage, remove stick and beat.

The two wefts work as a pair, so the design can only be changed after (b) or (d).

If at any point in the design, the same areas of colour are required for some distance it will save time to change to the following sequence.

(a) Raise 23, pick-up as required, lower 23, raise 4, weave weft A.
(b) With pick-up stick still in the above position, raise 1, weave weft B.
Remove stick and beat the two above picks together.
(c) Raise 23, pick up the exact opposite, lower 23, raise 1, weave weft A.
(d) With pick-up stick still in the above position, raise 4, weave weft B.
Remove stick and beat both picks together.

There are only two pick-ups in this sequence instead of four. Care must be taken in changing from one sequence to the other.

Plate 133 shows a sample woven in this technique. Like the block weave it is derived from, the technique gives a textile identical on the two sides; i.e., there is the same black shape on a white ground on both sides of this sample.

PRACTICAL DETAILS

Warp—6 e.p.i., alternately single and double in the head, therefore 4 working e.p.i.
Weft—2-ply carpet wool used threefold.

6. PICK-UP VERSION OF BLOCK WEAVE BASED ON DOUBLE-FACED 3/1 TWILL

A. Centre Shed Pick-Up

(i) USING A COUNTERMARCH LOOM

Thread (1,2,3,4) repeat. Tie pedals as in Fig. 304 (a). This tie-up makes each pedal lower one shaft, raise another, and leave the other two shafts unaffected. The ends on the latter form the central layer. The sequence is as follows:

Press Pedal 1, pick-up in central layer, weave weft A.
Press Pedal 1, pick-down in central layer, weave weft B.
Press Pedal 2, pick-up in central layer, weave weft A.
Press Pedal 2, pick-down in central layer, weave weft B.
Press Pedal 3, pick-up in central layer, weave weft A.
Press Pedal 3, pick-down in central layer, weave weft B.
Press Pedal 4, pick-up in central layer, weave weft A.
Press Pedal 4, pick-down in central layer, weave weft B.

(ii) USING A COUNTERBALANCED LOOM

Thread (1,3,2,4) repeat, tie pedals as in Fig. 304 (b). Tie top roller of harness to prevent

any reciprocal movement between front two and back two shafts. Because of this, when pedal 1 is used, shaft 1 is lowered and shaft 2 raised, but shafts 3 and 4 are unaffected and the ends threaded on them form the central layer. The sequence is exactly as above.

B. Raised End Pick-Up

Thread (1,2,3,4) repeat. The sequence is as follows:

Lift 13, pick-up, lower 13, lift 4, weave weft A.
Lift 13, pick-down, lower 13, lift 4, weave weft B.
Lift 24, pick-up, lower 24, lift 3, weave weft A.
Lift 24, pick-down, lower 24, lift 3, weave weft B.
Lift 13, pick-up, lower 13, lift 2, weave weft A.
Lift 13, pick-down, lower 13, lift 2, weave weft B.
Lift 24, pick-up, lower 24, lift 1, weave weft A.
Lift 24, pick-down, lower 24, lift 1, weave weft B.

The weave has a twilled surface; the motifs can run with the twill lines or against them. Like its parent block weave, this is an extremely good rug weave, tough yet flexible.

PRACTICAL DETAILS

Warp—6 working e.p.i.
Weft—2-ply carpet wool used threefold. Use a floating selvage.

7. PICK-UP VERSION OF PLAIN WEAVE DOUBLE CLOTH

This is the pick-up weave that has been most used in the past. Here the weft-face variety is described.

A. Centre Shed Pick-Up

(i) USING A COUNTERMARCH LOOM

Thread (1,2,3,4) repeat. Tie up the pedals as in Fig. 304 (a). The sequence is as follows:

Press Pedal 1, pick-up, weave weft A.
Press Pedal 2, pick-down, weave weft B.
Press Pedal 3, pick-up, weave weft A.
Press Pedal 4, pick-down, weave weft B.

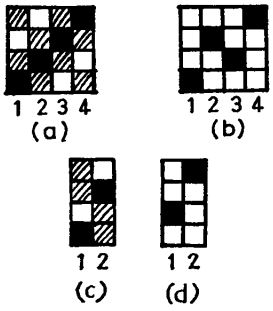


Fig. 304
Pick-Up version of Block Weave based on Double-Faced 3/1 Twill. Two pedal tie-ups

(ii) USING A COUNTERBALANCED LOOM

Thread (1,3,2,4) repeat. Tie up the pedals as in Fig. 304 (b). Tie top roller of harness to prevent reciprocal movement between front two and back two shafts. The sequence is exactly as above.

B. Raised End Pick-Up

Thread (1,2,3,4) repeat. The sequence is as follows:
Lift 24, pick-up, lower 24, lift 1, weave weft A.
Lift 13, pick-down, lower 13, lift 2, weave weft B.
Lift 24, pick-up, lower 24, lift 3, weave weft A.
Lift 13, pick-down, lower 13, lift 4, weave weft B.

The weaving can be speeded up considerably by weaving two picks of A, then two picks of B, thus:

Lift 24, pick-up, lower 24, lift 1, weave weft A.
With the stick still in position, lift 3, weave weft A.
Lift 13, pick-down, lower 13, lift 2, weave weft B.
With stick still in position, lift 4, weave weft B.

The weave gives two completely separate weft-face plain weave cloths, one above the other. They are only joined at the perimeter of each colour area. So for the stability of the rug it is best to weave small units of design; or if large units are essential, break them up with stripes or spots of the other colour, thus tying the upper and lower cloths together.

PRACTICAL DETAILS

Warp—10 or 8 working e.p.i.
Weft—2-ply carpet wool used singly or twofold respectively.

For variations in pick-up methods for this weave, see *The Double Weave* by Harriet Tidball.

A Variation

A much simpler method of weaving is based on the fact that the warps of the two cloths, being invisible, do not need to interchange at horizontal colour junctions. So an upper warp can be used for *both* colour areas on the face of the rug and a lower warp for *both* colour areas on the reverse. In the following description, the upper warp consists of ends on shafts 1 and 3, the lower of ends on shafts 2 and 4.

A. Centre Shed Pick-Up

(i) USING A COUNTERMARCH LOOM

Thread (1,2,3,4) repeat. Only two pedals are needed, tied as in Fig. 304 (c). The two resulting split sheds are used in the normal way, thus the sequence is as follows:

Press Pedal 1, pick-up, weave weft A.
Press Pedal 1, pick-down, weave weft B.
Press Pedal 2, pick-up, weave weft A.
Press Pedal 2, pick-down, weave weft B.

(ii) USING A COUNTERBALANCED LOOM

Thread (1,2,3,4) repeat. Tie pedals as in Fig. 304 (d). If the top roller of the harness is tied to prevent reciprocal movement between the front and back two shafts, the two pedals will produce the same two split sheds as above. So the weaving sequence is exactly the same.

B. Raised End Pick-Up

Thread (1,2,3,4) repeat. The sequence is as follows:

Lift 34, pick-up, lower 34, lift 1, weave weft A.
Lift 34, pick-down, lower 34, lift 1, weave weft B.
Lift 12, pick-up, lower 12, lift 3, weave weft A.
Lift 12, pick-down, lower 12, lift 3, weave weft B.

PRACTICAL DETAILS

Warp—10 or 8 working e.p.i.
Weft—2-ply carpet wool used singly or twofold respectively.

This weave is the weft-face version of the warp-face weave known as One-Weft Double Cloth, described in Chapter 11.