

A Workshop Program

Step by Step through Double Weave with 4 and 8 Shaft Looms

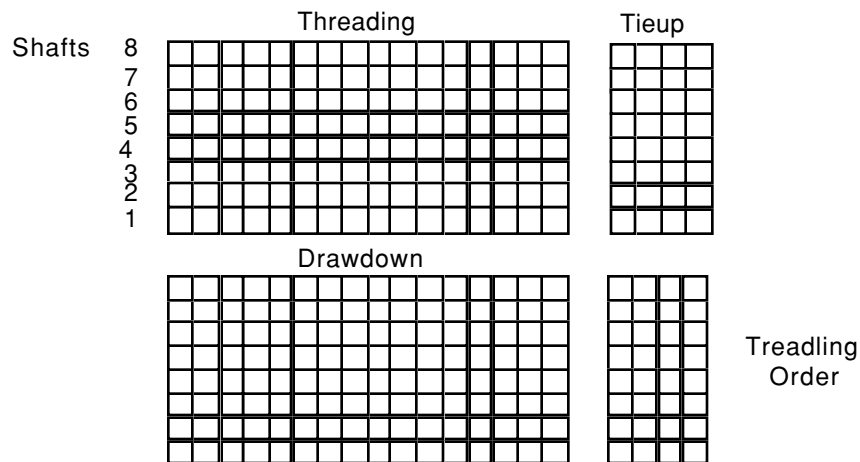
This presentation is made so that individuals or groups can carry out the program that I have been presenting as three day workshops in double weave at various guilds and conferences during the last 10-15 years. I would be happy to communicate via e-mail to set up an approximate time schedule that could be followed together with a regular question and answer program again by e-mail. My address is

paul@oconnor.net

Participants would use their own looms, choose their own yarns and move at a pace convenient to them. I on the other hand would escape some of the challenges that arise in travel today.

Introduction. Threading - Tieup - Treading Order leads to Drawdown

The procedure of writing out a threading, choosing an appropriate tieup, and selecting a treading order in order to develop a drawdown is learned early by weavers. I want to use a diagram such as this one to serve as the framework for an understanding of double weave.

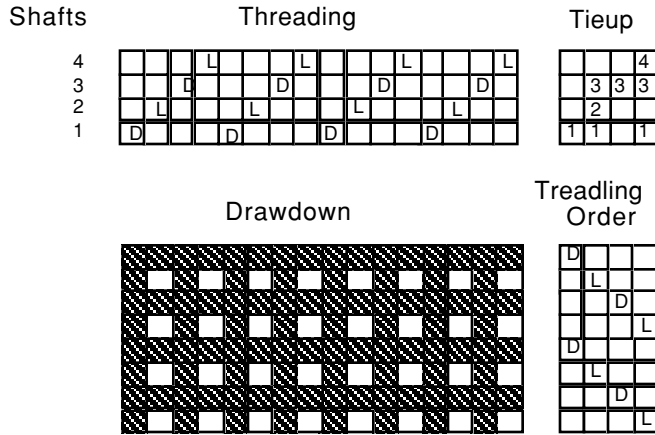


The starting point is a 4 shaft threading, double weave tieup, treading order and drawdown given in the next diagram. The directions for double weave are often presented in the following manner.

1. The threading is straight draw twill on four shafts. Dark warp threads on odd number shafts; light warp threads on even number shafts.
2. The tieup, basic double weave tieup # 1 in this example, weaves dark warp and dark weft in the top (T) cloth layer and light warp and light weft in the bottom (B) cloth layer.
3. The treading order, in this example, leads to two separate cloth layers.
4. One dark warp and one light warp are to be sleyed together in the same dent of the reed. The sett should be twice the sett for a single layer weave with the yarns you have chosen.
5. Two shuttles are needed. Shuttle # 1 has a dark weft and shuttle # 2 has a light weft of the same yarns as used in the warp. The shuttles alternate, dark weft-light weft, during the weaving.

4 Harness Double Weave

Two Cloth Layers
Two Shuttle Weave
To Weave Dark Cloth Layer Over Light Cloth Layer



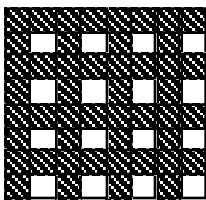
There are some points to be discussed about the meaning and mystery of this set of diagrams. After that I want to make changes in each of the elements to see what happens and why it does. The order of this discussion starts with those things that are relatively easy to change and moves on to things that are harder to do. The threading and the treading order are straightforward and look the same as other threadings and treading orders that you have seen. But where does that tieup come from? And what does it mean? The drawdown is also very mysterious looking. But weren't we supposed to be weaving two separate cloth layers? The drawdown doesn't seem to show that, or does it? Here is a good place to begin our discussion.

A. The mystery of the drawdown

The traditional method for creating the drawdown shows all the warp and all the weft threads in one layer. What is needed is a way to make two drawdowns, one for the top cloth layer and the other for the bottom cloth layer. Most of the commercially available computer weave programs display the drawdown in this same fashion, as a single layer.

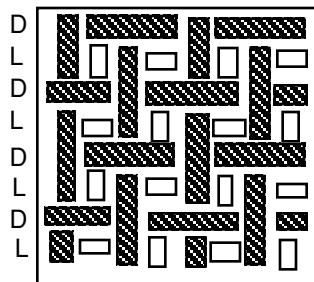
A weave structure diagram helps to see what is going on in double weave. If you somewhat unfocus your eyes, you will begin to see that the dark warp and weft threads lie in the top cloth layer while the light warp and weft threads lie below in the bottom cloth layers. There are no intersections between the dark and light threads so they can move past one another to create two separate cloth layers. When you see a

Traditional Drawdown

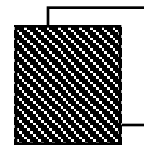


Weft Picks

Warp Threads
D L D L D L D L



Appearance of
the Two Layers



drawdown of light spots on a dark background, the weave structure helps you to

understand that two cloth layers have been woven with dark on top and light underneath.

B. The mystery of the tieup

Weave structure is again the key to understanding how the tieup has been developed and more important what it means. The weft pick by weft pick appearance as the weaving progresses is shown next. Follow the dark and light weft threads as they weave in accordance with the instructions on the right side. This serves as the guide for developing the tieup diagram at the bottom with T meaning the warp thread will be in the top layer, B meaning the warp thread will be in the bottom layer and the two black dots show that the warp threads in the top layer must be raised out of the way in order to weave the bottom layer. And therein lies the secret to double weave.

To weave the warp threads in a layer of double weave all warp threads in layers above that particular layer must be raised up out of the way

As

you weave, remind yourself of what is happening by saying to yourself:

I want to raise the warp threads on shaft 1 and throw shuttle # 1 with dark weft to weave in the top layer of dark warp threads.

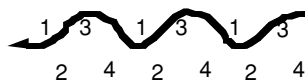
I want to raise the warp threads on shafts 1 and 3 up out of the way. Then when I raise the warp threads on shaft 2, I can throw shuttle # 2 with the light weft to weave in the bottom layer of light warp threads.

I want to raise the warp threads on shaft 3 and throw t shuttle # 1 with the dark weft to complete the weaving of the top layer of dark warp threads.

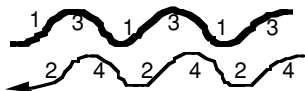
I want to raise the warp threads on shafts 1 and 3 up out of the way. Then when I raise the warp threads on shaft 4, I can throw shuttle # 2 with the light weft to complete the weaving of the bottom layer of light warp threads.

Threading

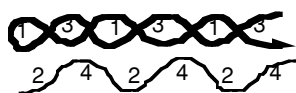
Shafts	4			L				L
	3		D				D	
	2	L				L		
	1	D			D			



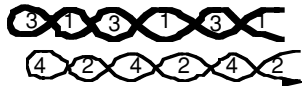
First Weft Shot Raise Shaft 1
Use Shuttle 1 Dark Weft



Second Weft Shot Raise Shafts 1 and 3
Raise Shaft 2
Use Shuttle 2 Light Weft



Third Weft Shot Raise Shaft 3
Use Shuttle 1 Dark Weft



Fourth Weft Shot Raise Shafts 1 and 3
Raise Shaft 4
Use Shuttle 2 Light Weft

Shafts	4							B
	3			.	T	.		
	2			B				
	1	T	.					
Weft Pick		1	2	3	4			

Now do you see how the tieup develops directly out of the weave structure?

The shorthand notation
13/24
is saying that
this tieup

4				4
3		3	3	3
2		2		
1	1	1		1
	1	2	3	4

weaves
dark top layer
and
light bottom layer



C. The Two Basic Tieups for Double Weave

The tieup 13/24 is one of the two basic tieups for double weave. The second basic tieup has the form 24/13 and puts the dark warp and weft threads in the bottom layer and the light warp and weft threads in the top layer, just the reverse of what happens with tieup 13/24.

4 Harness Double Weave

Two Cloth Layers
Two Shuttle Weave

To Weave Light Cloth Layer Over Dark Cloth Layer

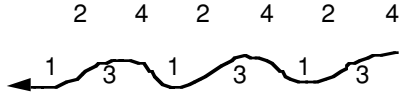
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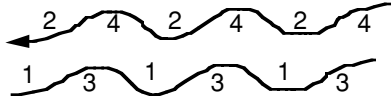
Go through the process of weaving the first four weft picks again and see how this tieup can be developed. The threading and the shuttle order has not changed.

Threading

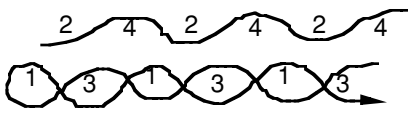
Shafts	4				L				L
	3			D				D	
	2	L					L		
	1	D				D			



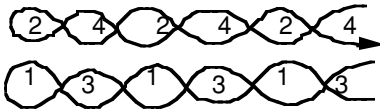
First Weft Pick: Raise shafts 2 & 4
 Raise Shaft 1
 Use Shuttle 1, Dark Weft



Second Weft Pick: Raise Shaft 2
 Use Shuttle 2, Light Weft



Third Weft Pick: Raise Shafts 2 & 4
 Raise Shaft 3
 Use Shuttle 1, Dark Weft



Fourth Weft Pick: Raise Shaft 4
 Use Shuttle 2, Light Weft

4	.			
3	.			
2	.			
1	B			
	1	2	3	4

4	.			
3	.			
2	.	T		
1	B			
	1	2	3	4

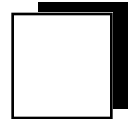
4	.	.		
3	.		B	
2	.	T	.	
1	B			
	1	2	3	4

4	.	.	T	
3	.		B	
2	.	T	.	
1	B			
	1	2	3	4

The shorthand notation
 24/13
 is saying that
 this tieup

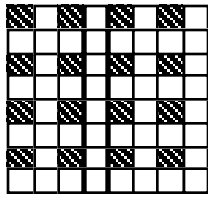
4	4		4	4
3			3	
2	2	2	2	
1	1			
	1	2	3	4

weaves
 light top layer
 and
 dark bottom layer



The traditional drawdown, the expanded weave structure, and the appearance of the two layers, when tieup # 2 is used, are shown next. Compare with similar drawings for tieup # 1 on page 3.

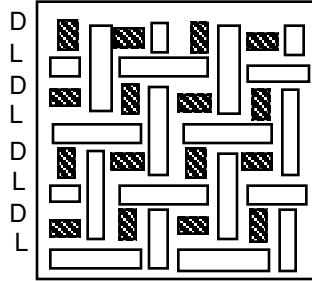
Traditional Drawdown



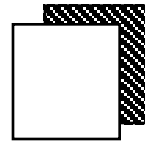
Weft Picks

Warp Threads

D L D L D L D L



Appearance of the Two Layers



Exercises #1 and 2 fit here.

With this introduction I want to begin changing one component at a time. Changing the shuttle order # 1 and # 2 is the easiest thing of all to do but for reasons that will be explained later, the shuttle order is not to be changed at this time. Changes in the treading order is very easy to do and will be first on our list. Tieup changes may require crawling under the loom so let's put that off for now. And changes in the threading probably call for rethreading or winding a new warp. That is last on our list!

D. Let's Change the Treading Order

Four different treading orders are given as four grids below the tieup grid. On the right of each treading order grid there is an indication of the number of shuttles required and the nature of the weaving that results. Notice in one shuttle weavings only one color is used for the weft; arbitrarily L is the choice.

4 Harness Double Weave
Changes in the Treading

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Changing the treading order and the number of shuttles brings some rather startling changes. You can weave a tube rather than two cloth layers or you can weave a double width cloth, one of the most important tricks that double weave can do for you in that the "width" of your loom is suddenly doubled. The fourth treading order allows you to weave the bottom layer of the cloth while the warp threads of the top layer float. Some interesting

things can be carried out by needle weaving in those floats.

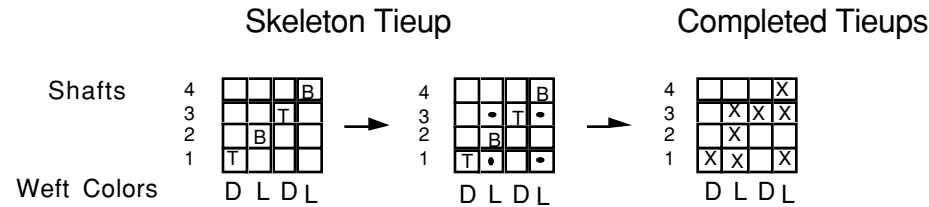
This is a good place to weave more samples.
Complete exercises 3-6

Congratulations! You have completed part 1 of this workshop. Ready to make more changes in one of the components? Tieups come next and they often are the most challenging for someone new to double weave.

E. Tieup Changes (Also read pages A-G after the section on 4 shaft double weave)

In single layer weaving, all of the warp threads weave in that layer. One of the unique aspects of double weave is that you can choose to have warp threads weave in the top layer or in the bottom layer. The colors and the design of the top and bottom layers may be quite different in appearance. For example the top layer might be a single color while the bottom layer might be a different color with warp stripes. How can this be done? All in the tieup so let's explore that at some length starting with a (relatively) simple way to figure out tieups. I have already introduced the shorthand notation 13/24 to mean that warp threads on shafts 1 and 3 weave in the top layer and warp threads 2 and 4 weave in the bottom layer.

The first step is writing down a skeleton tieup. Remember that two shuttles alternate and the weft color order will be kept DLDL throughout this discussion. Warp threads 1 and 3 weave in the top layer with dark weft and warp threads 2 and 4 weave in the bottom layer with light wefts. Here is the development starting with the skeleton tieup that specifies which warp threads are to be in the top and bottom layers, adding dots to show the top layer raised out of the way, and converting to the final tieup form with X's rather than the T's and B's.



It may help you as you develop the tiedown to say to yourself:

- I want warp threads 1 and 3 to be in the top layer, weaving with a dark weft.
- I want warp threads 2 and 4 to be in the bottom layer weaving with a light weft.
- I must raise the top layer, warps 1 and 3, to weave in the bottom layer.

Now we are ready to go. Only the tieup is to be changed. The weft color stays constant, always DD in the top layer and LL in the bottom layer. (Of course we change that in the next section!)

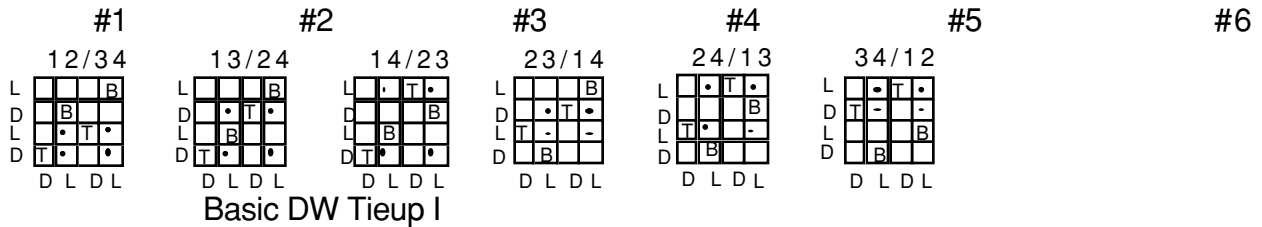
There are six possible ways to combine 4 things 2 at a time so four warp threads can be arranged to give six different tieups:

- 12/34 13/24 14/23 23/14 24/13 34/12

The tieups are shown in the T, B, black dot form. The colors of the warp threads are indicated vertically to the left and the colors of the weft threads are indicated horizontally across the bottom of each grid. To help you see what happens, two additional lines are presented below the six grids. The first line gives you the warp colors in the top and bottom layers (in the form DL/DL). The second line then adds the weft colors (in the form DL-DD/DL-LL) where the first two letters in each group of four identify the warp colors and

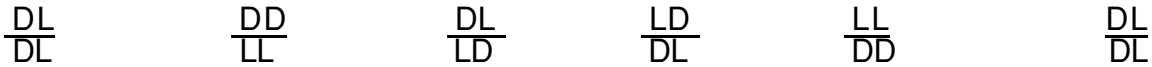
the second two letters add the weft colors in that layer. Notice in these examples that the weft colors stay the same, always DD in the top layer and LL in the bottom layer. As you look at each of these tieup diagrams, say to yourself "I want warp threads on shafts 1 and 2 to be in the top layer and warp threads 3 and 4 to be in the bottom layer and the black dots show that I am raising shafts 1 and 2 out of the way when I weave in the bottom layer" and so on across the group.

Group I. The Six Tieups Where the Dark Weft is in the Top Layer



Instead of a single warp color combination which is true in single layer weaving, you the weaver have more choices for the warp color combinations in the top layer. The first line gives those choices and the weft color is added in the next line

Warp Color Combinations in the Top/Bottom layers



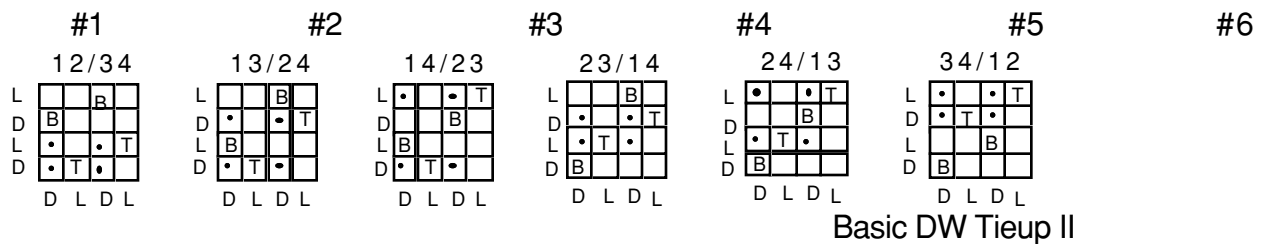
Warp and Weft Color Combinations in the Top/Bottom Layers



Only the second tieup, 13/24, gives you all dark threads in the top layer and all light threads in the bottom layer. The first, third, fourth and sixth give 75 D - 25 L blends in the top layer and 25 D - 75 L blends in the bottom layer. The fifth tieup gives a 50D - 50L blend in both layers.

How can we make the weft threads appear in the top layer? There are two ways to accomplish this. The most obvious is to switch the order of throwing the two shuttles from DLDL to LDLD but I don't want you to do that just yet. I want to keep the weft color order the same, DLDL. Be sure to do exercise 7 where the order of weft colors is looked at. The second method changes the tieup so that the dark warp threads weave in the bottom layer and the light warp threads weave in the top layer. At the same time the light weft weaves in the top layer and the dark weft weaves in the bottom layer. Are you confused? Six new tieups must be developed. Look at each one carefully to see that the T's and B's have shifted positions in the columns. The warp threads that wove with a dark weft are now weaving with a light weft.

Group II. The Six Tieups Where the Light Weft is in the Top Layer



Warp Color Combinations in the Top/Bottom layers



Warp and Weft Color Combinations in the Top/Bottom Layers



The fifth tieup weaves LL-LL/DD-DD, a light cloth top layer and a dark cloth bottom layer. The second tieup weaves 50-50 in the two layers, DD-LL/LL-DD and the other four give the 75-25 or 25-75 color effects. All that has been done is to exchange the position of the T's and B's in the columns in the first set of grids. The two basic double weave tieups I and II are identified in the preceding diagrams.

Exercises 9 - 11 are perhaps the most important of all the exercises for double weave. Color possibilities are explored so settle back and weave for a while

F. Weaving Errors when Tieup Changes are Made

This section is an interlude to highlight weaving errors that may happen when tieups are changed. Suppose you want to make the tieup change.

$$\frac{13}{24} \longrightarrow \frac{14}{23}$$

No weaving error occurs. The last two weft picks for the section that is controlled by the tieup 13/24 call for weaving the warp threads on shaft 3 and then weaving the warp threads on shafts 4. When the tieup is changed to 14/23, the new section starts by weaving the warp threads on shaft 1 and then weaving the warp threads on shafts 2. Threads on the same shaft are not raised and woven twice in succession. No weaving error occurs. How about these two tieup changes?

$$\frac{13}{24} \longrightarrow \frac{34}{12} \qquad \frac{34}{12} \longrightarrow \frac{13}{24}$$

In the first example, the warp threads on shaft 3 are raised at the end of the first tieup section and then raised again at the start of the next tieup section, twice in succession. The warp threads float for two picks, a weaving error. For the second example the error takes place in the bottom layer because the warp threads on shaft 2 are raised for two successive picks. Another weaving error. Here is an easy way to avoid those errors. Simply reverse the order of the warp threads in the second tieup for the layer where the weaving error occurs.

$$\frac{13}{24} \longrightarrow \frac{43}{12} \qquad \frac{34}{12} \longrightarrow \frac{13}{42}$$

G. Changes in the threading

We have changed the treadling order and the tieup so now let's see what can happen when the threading is changed. The first part of the discussion deals with some ideas on color and on design.

In 4 shaft double weave the weft threads travel from selvage to selvage in the top and the bottom layers. We can however introduce a number of variations in the threading that will give rise to some interesting possibilities. I want you to rethread your loom so that sections of DLDL threading alternate with sections of LDLD threading. You can choose to have five sections of equal size or you can make the LDLD sections different in size from the DLDL sections.

Shafts	Threading #2																
4				L			D				L			D			L
3			D			L			D			L			D		
2		L			D			L			D			L			
1	D			L			D			L			D				

Now when you use the 13/24 tieup, the warp for the top layer will have sections of dark warp alternating with sections of light warp. The warp for the bottom layer will have a similar appearance with the dark and light sections reversed. Exercise 12 outlines some samples that you can weave with this warp. If you have only a 4 shaft loom or if you would like to explore more variations in double weave, a new warp is needed. Here are several suggestions in which a third or fourth color is introduced. Let's call these colors A,B, C and D rather than D and L.

Shafts	Threading #3																
4				B			C				B			C			B
3			A			A			A			A			A		
2		B			C			B			C			B			
1	A			A			A			A			A				

One layer could have a warp of the single color A across the width of the warp while the other layer would have a warp stripe where sections of the warp color B alternate with sections of the warp color C. These sections can be the same or of varied width.

Shafts	Threading #4																
4				D			D				D			D			D
3			C			C			C			C			C		
2		B			B			B			B			B			
1	A			A			A			A			A				

Warp 4 introduces a fourth color and the threading is a straight draw with the four colors ABCD. You can now use the six different tieups to control the warp color combinations in the top and bottom layers. A word of caution however until you have done some experimentation. The four colors should be about the same value and from neighboring color families or the four should be a single color of different values.

Shafts	Threading #5															
4				D			A			B			C			D
3			C			D			A			B			C	
2		B			C			D			A			B		
1	A			B			C			D			A			

Warp 5 introduces the idea of rotating the color order from one section of the warp to the next. I like to have the outside two sections the same to give a sense of balance in the weaving. Now when different tieups are used, the warp color combinations shift across the warp. For example if you use the tieup 12/34, the warp pairs in the top layer change from AB to BC to CD to DA and back to AB. Other tieups produce a different order for the warp color pairs.

Another variation in the warp is discussed in the next section. The possibilities are endless.

G. Different Size Threads in the Warp and Weft

You might like to try something a bit different in the warp. It is not too difficult to weave one layer of double weave with a fine yarn and the other layer in a thicker yarn. One of the layers will have fewer warp threads per inch than the other layer. The same will be true for the weft shots, more per inch in the fine layer than in the thick layer. This technique is more common in commercial weaving than in handweaving. Finer more expensive yarns are used in the top layer and larger and cheaper yarns for the bottom layer. This is also a way to introduce extra insulation to a cloth.

When one of the warps is say 1 unit in size and the other is 2 units (that is twice as large), you need twice as many warp threads per inch and twice as many weft picks per inch for the finer yarn. So the sett would be 2 1 2 1 2 1, that is, a thick and thin in the first dent followed by a thin in the second dent in the appropriate size reed. The weft picks would be 2 of the fine yarn and 1 of the thick.

If the ratio of yarn sizes is 1:4, then everything changes by another factor 2. The sett would be 2 1 1 1 2 1 1 1 2 1 1 1. There would be 4 weft picks of fine for each pick of thick yarn.

H. Some Practical Things

1. If you use a table loom for this workshop, you can easily get any of the lift combinations that have been discussed in the preceding sections. However here is a suggestion if you have a floor loom. Most 4 shaft floor looms have six treadles. A skeleton tieup allows you to treadle any of the combinations required for 4 shaft double weave without crawling under the loom to change the tieups. You will have to use both feet while treadling. Some weavers like having the tabby tieups on the outside while others prefer the tabby treadles in the middle. Here is the skeleton tieup with the tabby tieups on the outside. Now you can easily treadle all combinations of raising one shaft at a time, raising three shafts at a time, or raising the two tabby treadles.

Skeleton Tieup

Shafts	4	X				X	
	3				X		X
	2	X		X			
	1		X				X

2. Watch your beat. Remember that you are beating each layer twice, once for the first weft shot and again for the second weft shot.

3. The draw-in is likely to be greater in double weave for the same reason. It may help to reduce the warp tension a bit. Another solution is to pull out a thread from the selvage edges after the weaving comes off the loom. Some weavers use a floating selvage to minimize the draw-in..

4. Which brings us to the problem of draw-in when weaving a double width cloth. When the cloth layers are spread apart, you may have a decided ridge at the closed selvage. There are several methods to minimize that effect. First, ease up on warp tension. Second decrease the sett for about an inch at the selvages. So if you have a sett of 2 threads per dent, change to 1 1/2 or 1 threads per dent at the selvages. Some use a monofilament nylon warp as a floating selvage at the closed selvage side. When the weaving comes off the loom, it is easy to pull the monofilament out. Washing the fabric will also help threads to move a bit and adjust. I have found that removing two threads at the closed selvage.(to keep the weave structure for tabby or twill correct) works well for me. I often reinforce the neckline in the ruanas I have woven with those extra threads.

5. It is a wise idea to advance the warp frequently. Remember that two threads in the two layers are being beat in at the same position so most of the weaving should be done with the beater close to the vertical position as threads are pressed into the fell line of the cloth. If not you may suddenly discover that the top cloth may not lie directly above the bottom cloth. This effect can go in either direction. Look at the angle your beater is making and try to stay reasonably close to the vertical. Although you can always weave several extra threads in the layer that is lagging behind, the real problem is that your beat has not been even. Try to avoid the problem by watching where the two cloth layers are situated as you weave. One above the other is what you want.

6. I often start my weavings as two separate cloth layers because i want to hide the warp ends in the finished weaving. I do this by folding the two layers back inside themselves and hand sewing the two layers together. This means I am careful not to cross the weft threads at the selvages. For the main body of the weaving I always cross the weft threads at the selvages so the layers are locked together. Control of the selvage edge is much easier when I do this.

7. Pickup techniques can be used in 4 shaft double weave to create "pictures". There are a number of articles in the weaving literature describing various methods to do this. I like Nancy Searle's method that is described in her book called "The Technique of Freeform Design" as a way to do this which is very easy to understand. The shuttle is passed for a certain distance across the warp and brought up out of the weaving. Then the two layers are interchanged and the shuttle reinserted into the weaving for the next distance desired

and brought out of the weaving again. The layers are changed back and the weaving continues. This is slow initially but soon the design helps you see where to pass the shuttle either into or out of the weaving.

8. A final suggestion. When you come to a point in your weaving where you have to start a new weft thread, begin that new weft by overlapping one warp end. Continue weaving for an inch or so and then go back to weave the two weft threads between the two layers of double weave. You have what appears to be a perfect join of the new and old weft threads. Later when the weaving is removed from the loom and the fabric is washed, you can trim the ends. Of course an even better way to join new and old weft threads is to unply the yarn for a short distance and overlap one ply of the old weft with one ply of the new weft. Then you really do have an invisible joining of the two wefts.

I. Exercises

Prepare a 3-4 yard warp in two colors 5-6" wide with the total number of threads divisible by 4. Choose either two colors of approximately equal value from adjacent color families or two colors from the same color family with different values. Avoid yellow because it is so dominant a color and also avoid very light or very dark values. Thread the loom in straight draw twill order and alternate the two colors on shafts 1-4. Sley two threads per dent. Prepare two shuttles for weaving, using the same yarns and colors you chose for the warp yarn. This warp will be used through exercise 11 so keep that in mind as you weave samples.

3/2 Perle cotton is a convenient material to use in samples because it is a smooth yarn, available in a range of colors, and large enough so that it does not take long to warp or weave. A sett of 20 epi is about right if your beat is light or 24 epi if your beat is hard.

Exercise 1. Weave a tabby heading. Weave about an inch, alternating the two shuttles, using basic double weave tieup 1 (page 4) and the first treadling order (page to give two separate cloth layers. Adjust your beat so that you weave a balanced plain weave. Do not cross the two weft threads at the selvages. When you finish weaving, raise shafts 1 and 3 and slide your fingers between the two layers to convince yourself that you have indeed woven two separate cloth layers.

Weave another inch but this time cross the two wefts at each selvage. Now raise shafts 1 and 3 and slide your finger between the layers. Notice the two layers are locked together at the selvages. Weave another section of tabby to separate sample 1 from sample 2.

Exercise 2. Repeat exercise 1 but this time use basic double weave tieup 2 (page 6). Weave an inch and then change the tieup to basic double weave tieup 1, weave another inch and switch back to basic double weave tieup 2.

Exercise 3. Weave an inch using the second treadling order. This is a one shuttle weave, the weft going round and round weaving first in the top layer, then the bottom layer, back to the top layer and finally the bottom layer again. You have just woven a tube. Notice the treadling order is the same as in exercise 1 but you have only used one shuttle. After you have finished weaving, raise shafts 1 and 3 and slide your finger in to convince yourself that you wove a tube. Close off with another section of tabby weave.

There will be two warp threads woven in the same shed at one of the selvages. Release the tension and look at each selvage to identify this error. Normally in tubular weave the warp should have an odd number of total threads which automatically eliminates the error. However you are going to use this warp for a number of different projects so it has an even number of warp ends, hence the error.

Exercise 4. Weave an inch using the third treadling order. The weft travels in the top layer, then the bottom layer, back across the bottom layer and finishes by weaving in the top layer to complete the weaving sequence. You can start weaving from either the right or the

left selvage. The end result: the two cloth layers are woven together at one selvage and not woven together at the other selvage. When the weaving is taken off the loom, the two cloth layers open out into a single layer of cloth twice as wide as the warp. The ability to weave a double width cloth is an important and useful application of double weave.

Exercise 5. Weave an inch using the fourth treadling order. Another one shuttle weave and only two treadles are required. The top layer is raised out of the way and

the bottom warp layer is woven. Weave a short section using the first treadling order to hold the warp floats in place. Use some needle weaving techniques to see what can be done with the floats. Try wrapping a small group of the floating warps with short lengths of different color yarns. The ends of the wrapping yarn can be woven into the body of the weaving. Or anchor a length of the weft thread in the lower woven layer and use it to introduce a variety of leno twists in the floats and then anchor it again in the bottom layer.

Exercise 6. This exercise is a repeat exercises 1 and 2. Start with basic double weave tieup 1 with the first treadling order. Do not cross the weft threads at the selvages. After weaving an inch, change the tieup to the basic double weave tieup 2 and weave another inch. Be sure not to change the shuttle order. The two cloth layers have changed position. The top layer has become the bottom layer and vice versa and the weaving is locked together across the warp, not just at the selvages. Change back to tieup 1 and weave another inch. Release the tension on the loom slightly and convince yourself that you can slide a needle or a pencil through the horizontal tube formed in section 2 of the three sections you have woven.

Square or round wood dowels, polyfill, or yarn thrums can be laid into these tubes just before changing the tieup. The filler is locked in place. With thrums or polyfill you probably want to cross the wefts at the selvages as you weave so that the padding material is sealed off and not visible after you change the tieup again.. With dowels you may want them to extend beyond the selvages.

(A horizontal tube like this can be produced in double weave with a 4 shaft loom. To weave vertical tubes in double weave an 8 shaft loom is needed. This will be discussed later.)

Exercise 7. For exercises 1-6, the order for the weft colors has been the same throughout, DLDL. Now repeat exercise 1 with basic double weave tieup 1 and weave six short sections where the order for the weft color changes by using a different order for the way the two shuttles are thrown. Start as before with DLDL and change to DDLL, DLLD, LLDL, LLDD, and LDDL.

Exercise 8. D and L are all well and good. Your loom is warped with two colors so as an exercise redraw the 12 tieups above and substitute letters for your colors (for example R and O for red and orange or B and G for blue and green).

Exercise 9. It is time to begin playing with color in double weave and this exercise is really a group of exercises. Refer back to the tieup groups called I and II.

Weave an inch using the first tieup of Group I. Change to the second tieup of Group I and weave another inch. Change to the fifth tieup of Group I and weave another inch. (Don't bother with tieups # 3, #4, and # 6 of Group I because they give essentially the same result as using tieup #1.

Continue to weave using tieups #1, #2, and #5 from Group II. The weft colors change layers.

Exercise 10. Choose one of the tieups from Group I. Experiment with changing the weft color for the top layer but don't bother to change the weft color for the bottom layer.

You might try several schemes such as staying with the same hue and changing the value

in successive sections of the weaving. Or change the hue as you weave several sections, perhaps purple to several blues to several greens. Or purple to magenta to red to red orange to orange. Try to keep the value about the same as you change weft colors. Or use colors opposite on the color wheel from the warp color you are weaving.

Balanced weave is similar to the pointillist painting of such artists as Seurat. The eye combines the individual dots of color (either paint or fiber) in an additive manner. Closely related colors tend to enhance each other while opposite colors tend to mute one another. These effects are more noticeable if fine yarns are used.

Exercise 11. Here is a real challenge for you. Change the tieups and the weft colors as you move from one section of the weaving to the next. Plan to make the top and the bottom layers different from each other, perhaps by changing the colors or by changing the width of the stripes that you will be weaving. Choose tieups from groups I and II. If you really do not like the effect you are getting in a section, unweave it and move on!

I have found in my own weaving that doing “everything” in one weaving, too many color changes, too many tieup changes, too many changes in the width of sections may lead to a disappointing overall appearance. Think of that as you weave these samples. I also find choosing some mathematical relationship such as rotating colors in an organized way helpful.

Exercise 12. You have rethreaded your warp so start off with a section of tabby to spread the warp threads. Then use the basic double weave tieup # 1 to weave an inch section. Change the tieup to basic double weave tieup # 2 and weave another inch section. Reverse the layers several times to see the type of design that develops. Try some more weft color changes and finish weaving with warp # 1.

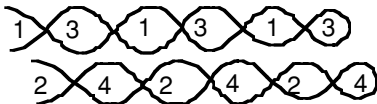
Exercise 13. You may have decided to put on a warp with 3 or 4 colors. Explore in your weaving the variety of designs and color effects that are possible. Weave some short samples with stripes in one layer and a single color in the other layer. What happens if you change the weft color without interchanging the layers? It won't take long before you begin to introduce other variations into your double weave. I find part of the challenge in my own weaving is not to do everything in one weaving. Not all the color changes, not all the tieup changes. Designing takes time and attention particularly if you want both sides of double weave to be satisfying.

The next page summarizes the weave structures for 4 shaft double weave.

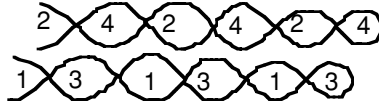
Let's now move on to double weave with an 8 shaft loom. But let me point out that if you want my two books called “Loom Controlled Double Weave” and “More Loom Controlled Double Weave” see if your favorite yarn and book company has them. If not, they are available from Norwood Enterprises, P.O.Box 349, Amherst MA, 01004-349. Phone and Fax: 413-549-6341.

Weave Structures in 4 Shaft Double Weave

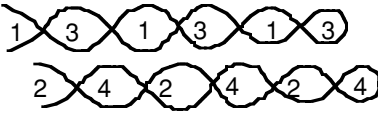
Two Separate Cloth Layers



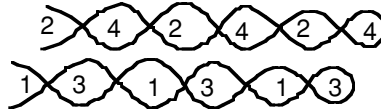
Two Separate Cloth Layers Interchanged



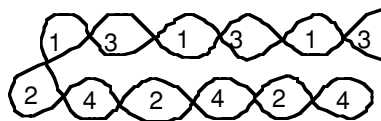
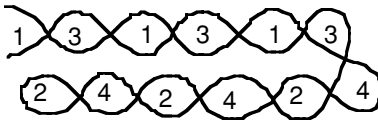
Opposite Weft Colors



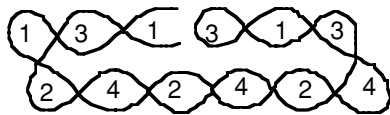
Opposite Weft Colors



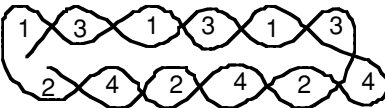
Double Width Weaving, with Opening at either Selvage



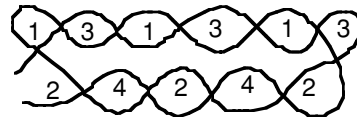
Double Width Weaving with Opening at Middle of Top Layer



Tubular Weave, with Weaving Error



Tubular Weave, Error Corrected



One Layer Not Woven

