

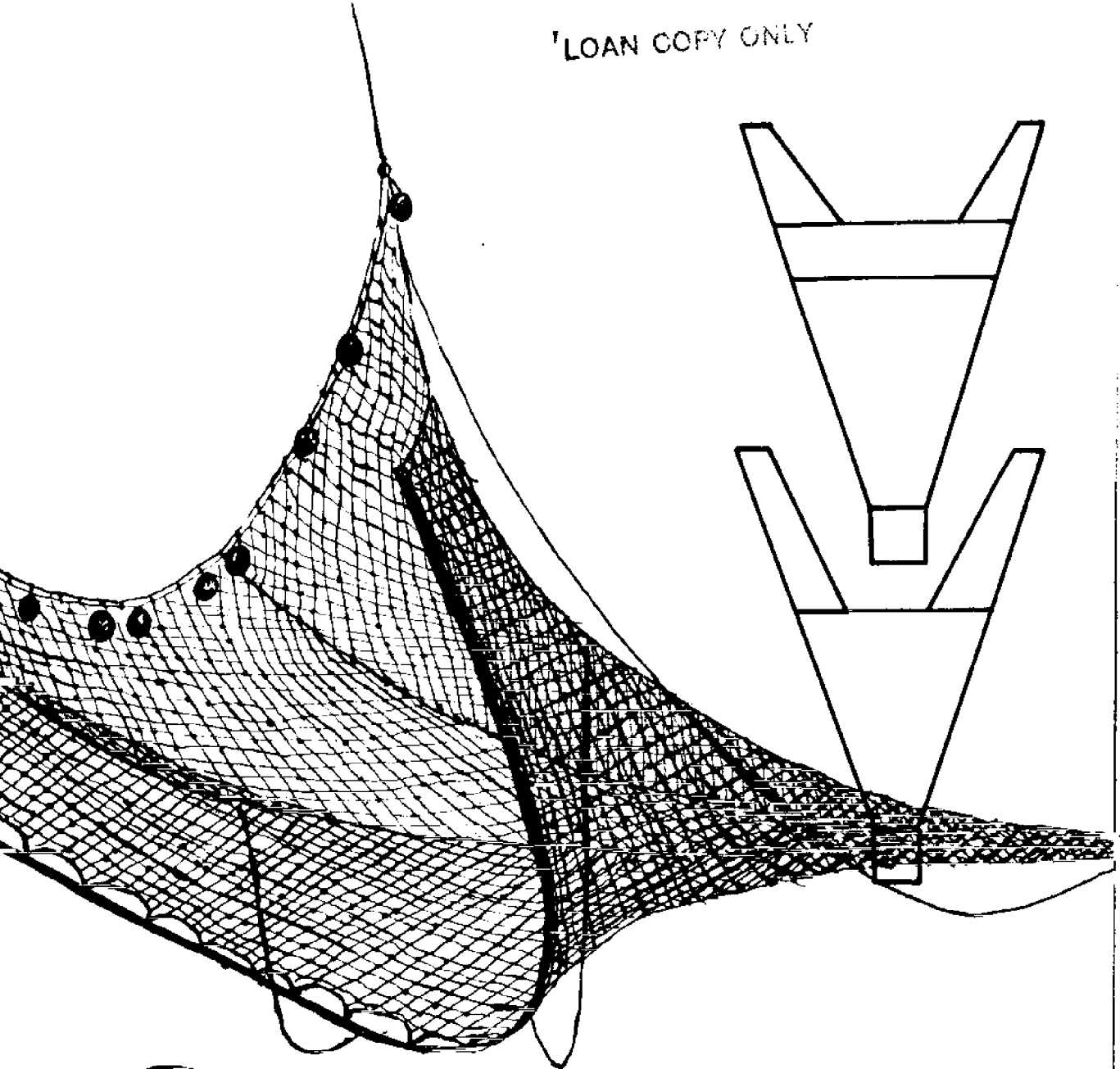
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HOW TO PLAN AND CUT NETS *loan copy*

by Albert J. Hillier

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All midwater and bottom nets used in the world's fisheries are composed of sections called bellies, squares, wings, or jibs. These sections usually vary in mesh size and dimensions.

It seems that most net builders—often after trial and error—have developed their own methods of tapering these sections, which are easy to copy by counting them out. Many books have been published on planning and constructing nets and trawls, but nowhere can you find the netmaker explaining how he arrived at the figures for his tapers. Thus, in teaching the plan or scale to someone else, the explanation can be quite a problem.

The Department of Fisheries and Marine Technology at the University of Rhode Island made a start at improving this situation when Professor Geoffrey A. Motte developed a formula that can be used to determine any taper that might ever be needed in a net or trawl. James Kluver, a former student and now a commercial fisherman, modified the formula for lower wing tapers and explained how to apply it when the results are in fractions.

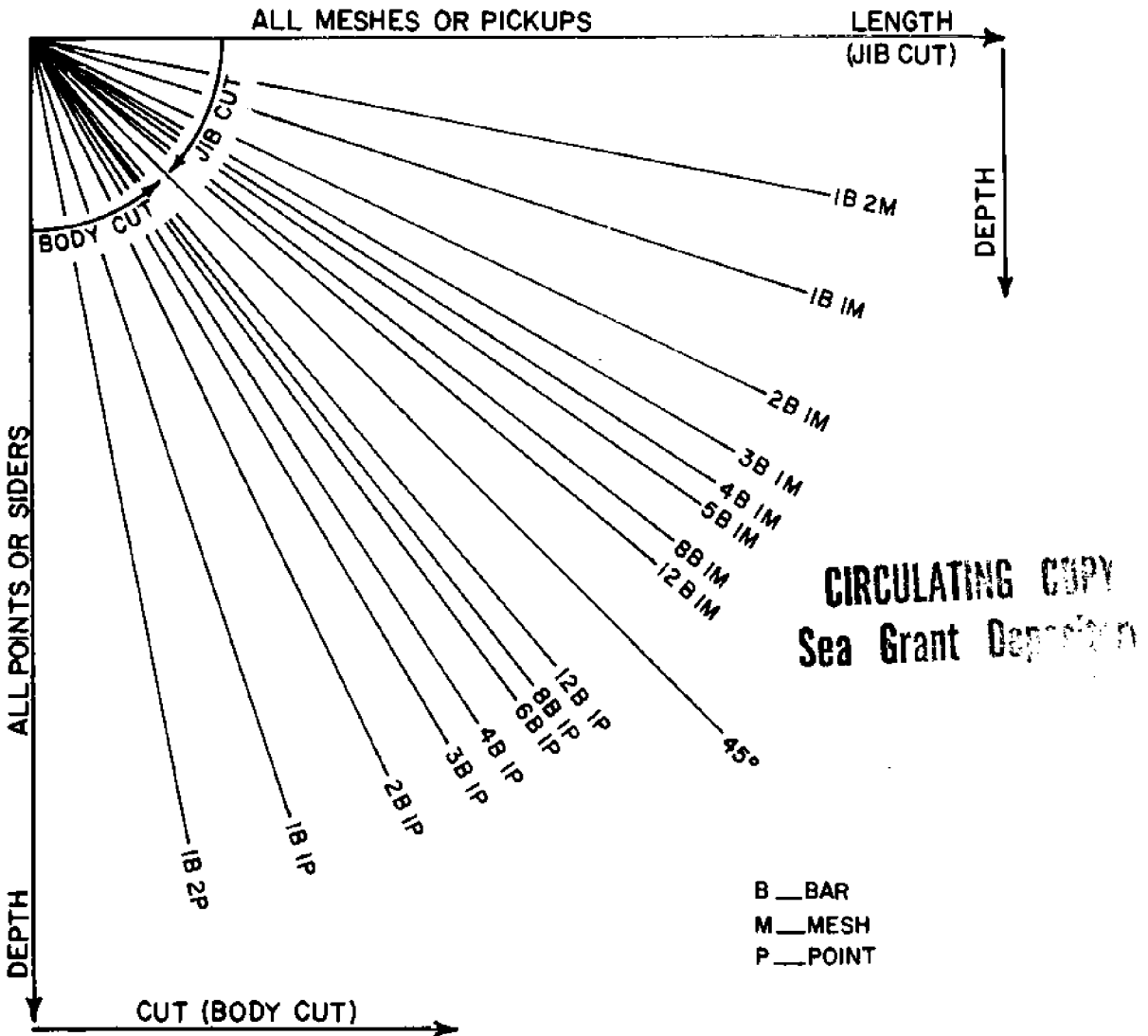


FIGURE 1. Angles resulting from cutting net tapers, assuming meshes are square.

The formula itself is easy to work, but, like the carpenter's steel square, if it is not used properly, many wrong angles will be cut and a lot of twine possibly ruined. My advice to the beginner is to use an old piece of webbing and cut a few tapers to make sure that he understands the formula completely before attempting to cut up a lot of expensive twine. The formula can be scaled down to any size, making it easy to test. For example, to demonstrate it for a square with the dimensions of 180 x 140 x 32, scale down these figures by any number that will divide equally into the three, such as the number 4, giving 45 x 35 x 8. The taper always will be the same, and, for this reason, a small piece of twine can be used to demonstrate the formula.

The basic formula, known as the *body cutting formula*, is used when a taper goes anywhere from a sider to a straight bar, or from a right angle to a 45-degree angle. A variation, the *jib formula*, must be used when the angle to be cut is greater than 45 degrees.

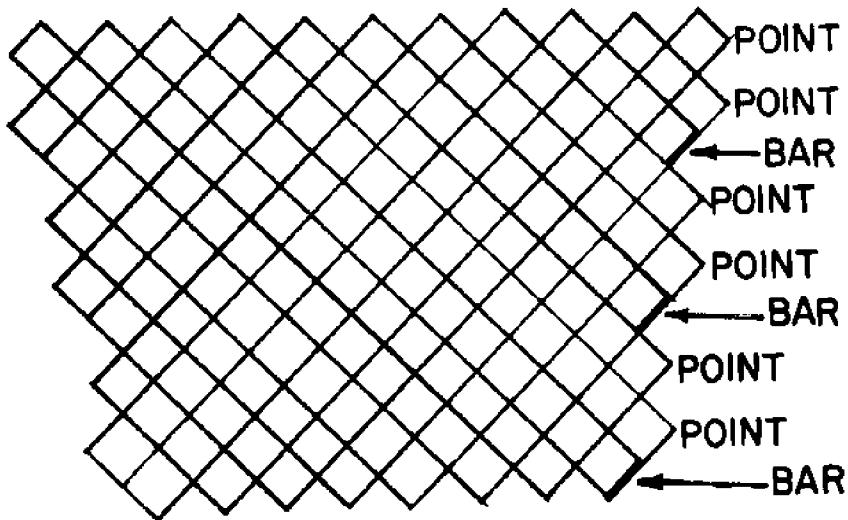


FIGURE 2. Body cut showing 2 points to 1 bar.

BODY CUTTING FORMULA

Formula: $2c/d-c = \text{taper}$

There are six points to keep in mind when using this formula:

1. c = cut (in meshes lost).
2. d = depth (cut in meshes).
3. Cut must be divided by 2 if both sides are to be tapered to form bellies, squares, or jibs.
4. If the depth is equal to the cut, the body taper is used and a straight bar will be the result.

5. If the cut is greater than the depth, the jib formula *must* be used.
6. If the difference between the cut and the depth is greater than twice the cut, the taper will be the body cut, but the taper will have more points than bars as shown in Figure 2.

This may all seem very complicated, but after a little practice, the formula and its variations will seem very simple.

Working Example*

Formula: $2c/d-c = \text{taper}$

1. To find cut, first subtract narrow end from wide end: $140 - 50 = 90$.
2. Divide by 2 if both sides are to be tapered. In this case, the cut = $90/2 = 45$.
3. Subtract cut from depth: $80 - 45 = 35$
4. Divide the difference (35) into twice the cut: $\frac{90}{35} = 2\frac{20}{35}$ or $2\frac{4}{7}$.
5. Since fractions cannot be cut, you must break the fraction down to find a workable taper. This is done by finding the lowest common denominator, which in this case gives $\frac{18}{7}$. Now you can cut 18 bars to 7 points, but to even the taper more, break down the $\frac{18}{7}$ into $\frac{3}{1}\frac{2}{1}\frac{3}{1}\frac{2}{1}\frac{3}{1}\frac{2}{1}\frac{3}{1} = \frac{18}{7}$.

To make this point, alternate 3 bars to 1 point with 2 bars to 1 point.

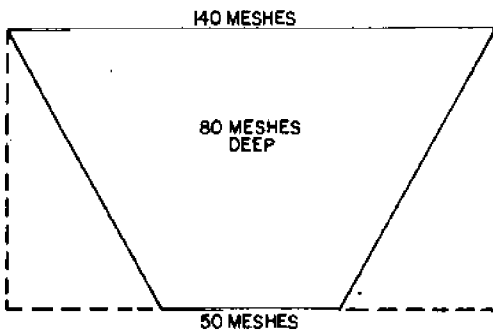


FIGURE 3. Working example of a belly.

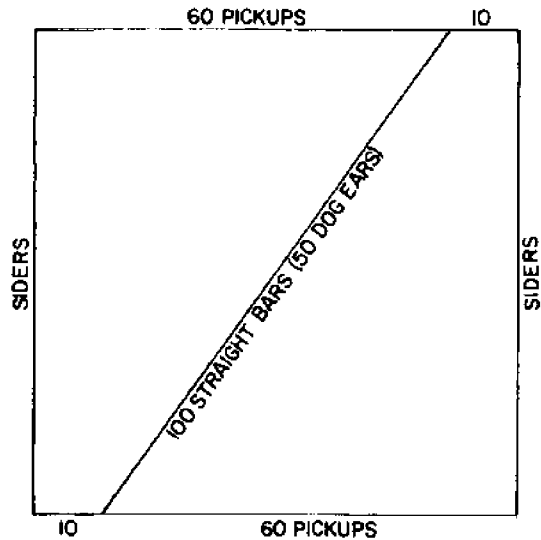


FIGURE 4. Working example of a top wing.

*Both squares and bellies are figured by exactly the same method.

Top Wing

Formula: $2c/d-c = \text{taper}$

Dimensions: 60 x 10 x 50 dog ears

1. To find cut, first subtract narrow end from wide end: $60 - 10 = 50$.
2. Since only one cut is to be made, the cut is 50, which is equal to the depth. Therefore, the taper is a straight bar.
3. Please note that if dog ears are required, 2 meshes are added to the $60 + 10$; if straight bars are required, only 1 mesh is added.

Explanation

In the case of this top wing, the taper will be on one side only. Therefore, the cut is not divided by 2, as it is for belly or square sections. Since the cut is $60 - 10 = 50$, the cut and depth are the same, which means that the cut is a straight bar, or 45-degree angle.

The top wing will sometimes have *dog ears*, or *fly meshes*. On the other hand, it may have straight bars. It should be noted that if the above wing, which has a depth of 50 meshes, were converted to bars, there would be 100 bars. *Therefore, if a wing dimension calls for bars instead of meshes, the bars must be converted to meshes or the formula will not work.*

Dog ears are usually knit on after the wing is cut, but they may be cut out when tapering, by cutting every second bar. Cut ears would be weaker than knitted dog ears, however.

The diagram on page 9 shows clearly how this is done for a lower wing.

Lower Wing

Tapering for the lower wing is a little different than that for the rest of the net since there are two different tapers. The dog ears must be on a straight bar, leaving only one side to be tapered.

Formula: $2c/d-c = \text{taper}$

Dimensions: 45 x 30 x 80 dog ears, or 160 bars

1. To find cut, first add narrow end to depth: $30 + 80 = 110$.
2. Subtract wide end from total: $110 - 45 = 65 = \text{cut}$.
3. Subtract the cut from the depth: $80 - 65 = 15$.
4. Divide the difference (15) into twice the cut: $\frac{130}{15} = 8\frac{2}{3}$; $8\frac{2}{3} = \frac{26}{3}$.
5. Figure taper to lowest form: $\frac{9}{1} \frac{9}{1} \frac{8}{1} = \frac{26}{3}$. The taper is 9 bars to 1 point, 9 bars to 1 point, and 8 bars to 1 point.

6. Add 3 meshes to wide end and narrow end for each pair of lower wings:
 $45 + 30 + 3 = 78$ meshes required.

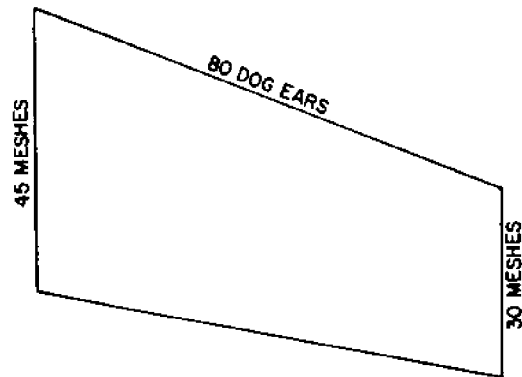
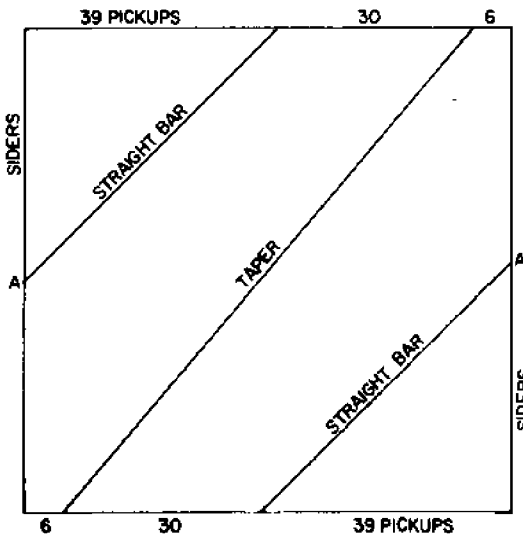


FIGURE 5. Working example of a lower wing with straight bars. Join straight bars and siders at Point A.

FIGURE 6. Working example of a lower wing with dog ears.

"V" Cuts in Wing End

Some fishermen who wished to cut the wings back on a "V" found that the straight bar did not take the V back far enough. Because no formula was available it was done by guess, but I have found the body cutting formula will indeed give the right cut for the desired V. Consider a top wing with dimensions of 60 x 10 x 50 dog ears (Figure 7). In this case, the selvedge is all siders, and we want to leave five meshes on the door end and cut the V back to the depth of 15 dog ears. At that point in the wing we have 25 meshes—the difference between the wide end and the depth of 60 meshes that we want to make the taper. We lost 35 meshes when we cut the dog ears, so the piece of twine we want to taper is 25 x 5 x 15 dog ears, which, using the formula, works out to 1 bar to 1 point.

Formula: $2c/d-c = \text{taper}$

Decide how far back into the wing you want the cut. Count the wing across from A to B and count the dog ears from B to C. Decide how many meshes are to be left on the door end from C to D in order to get the proper taper.

1. To find cut, first subtract number of dog ears from number of meshes across from A to B: $25 - 15 = 10$.
2. Subtract number of meshes on door end from difference: $10 - 5 = 5$, the cut.
3. Subtract the cut from the depth: $15 - 5 = 10$.
4. Divide the difference into twice the cut: $10/10 = 1$. Therefore, the taper is 1 bar to 1 point.

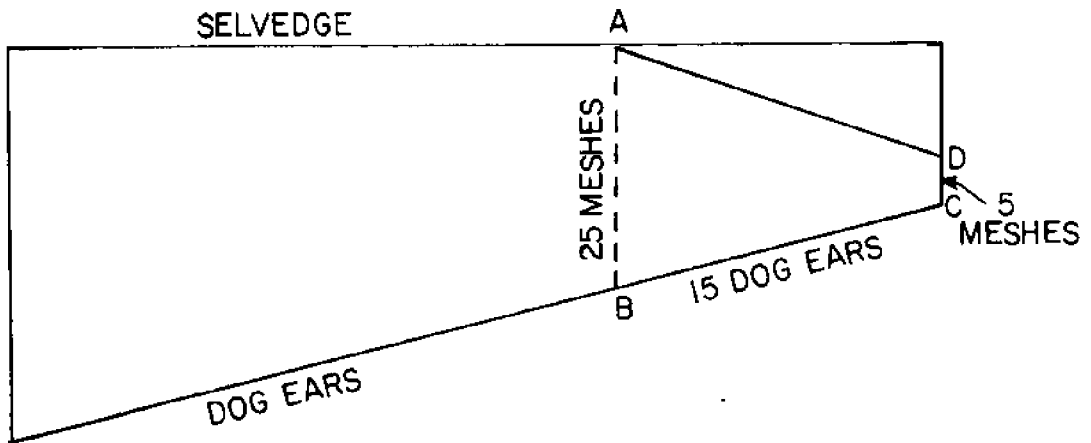


FIGURE 7. Working example of "V" cuts in wing end.

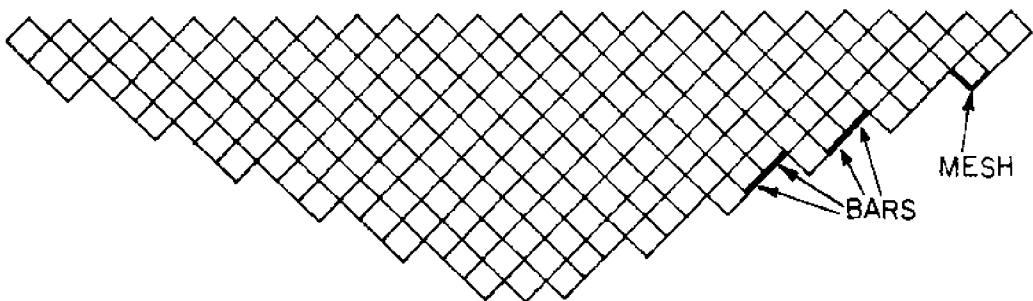


FIGURE 8. Jib with dimensions of 25 x 3 x 7 deep and a taper of 2 bars to 1 mesh. Note that the taper in the jib cut is in meshes instead of points. Take caution in cutting jibs due to the difference between a point and a mesh.

THE JIB CUTTING FORMULA

The jib in a net is usually found in the quarters between the square and top wings, and between the lower wings and belly. Although they are seldom found in New England nets, they are very common in the southern shrimp fleet. In all the nets I have examined as well as in the government pamphlets on shrimp trawls, I have found the taper always to be 2 bars to 1 mesh. Because the body cutting formula will not work for any angle greater than 45 degrees, we devised a workable variation for any jib cut.

The illustrated example shows how to use the jib formula. Note that the taper reads bars and meshes instead of bars and points. A point means the side of the mesh, or sider; and mesh means the end of a mesh, or pickup. By comparing Figure 8 with Figure 13, these terms can be easily understood.

Formula: $2d-3/d-c+1 = \text{taper}$

1. To find cut, first subtract narrow end from wide end: $25 - 1 = 24$.
2. Divide by 2 if two sides are to be cut: $24/2 = 12$, so cut is 12.
3. Multiply depth by 2, subtract 3: $8 \times 2 - 3 = 13$.
4. Subtract d-c and add 1: $12 - 8 + 1 = 5$.
5. Divide the difference between cut and depth into twice the depth minus 3: $\frac{13}{5} = 2\frac{3}{5}$.
6. Figure taper to lowest form: $\frac{3}{1} \frac{2}{1} \frac{3}{1} \frac{2}{1} \frac{3}{1} = \frac{13}{5}$. The taper, then, alternates 3 bars to 1 mesh and 2 bars to 1 mesh.

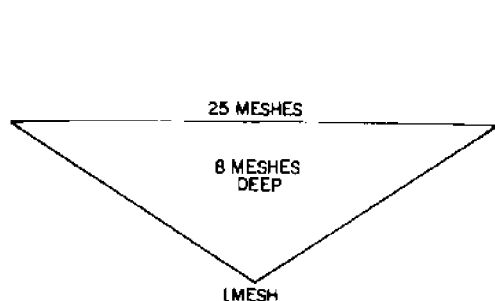


FIGURE 9. Working example of a jib.

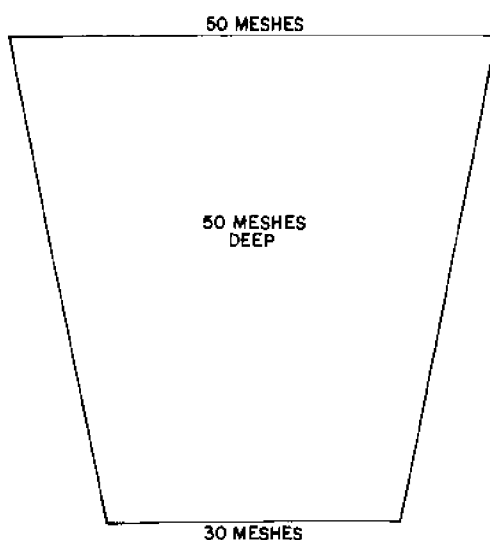


FIGURE 10. Working example of extension cut.

EXTENSION PIECE FORMULA – WATCH OUT!

We have seen how the formula works in every section of the net but one, the extension piece, where most skippers prefer a very slight taper.

Suppose the required dimensions of the extension are 50 x 30 x 50 deep. This is where the formula will play a trick on you if you don't use it correctly—but like the carpenter with the steel square, you can do anything with it, if you do use it properly. In this case, twist the formula a little.

Follow the usual steps until you find that when the cut is subtracted from the depth it is found to be less than double the cut and, thus, cannot be divided. However, overcome this problem by dividing *twice the cut* into the difference between the cut and the depth.

Extension Cut Example

Formula: $2c/d-c = \text{taper}$

1. To find cut, $50 - 30 = 20/2 = 10$, the cut.
2. $d-c = 50-10 = 40$.
3. When the difference between the cut and the depth is greater than twice the cut as it is here, double the cut and divide this figure into the difference between the cut and the depth: $40/20 = 2$. *When this is done, the result is always in points and bars rather than in bars and points. Therefore, the taper is 2 points to 1 bar.*

OTHER PROBLEMS AND SOLUTIONS

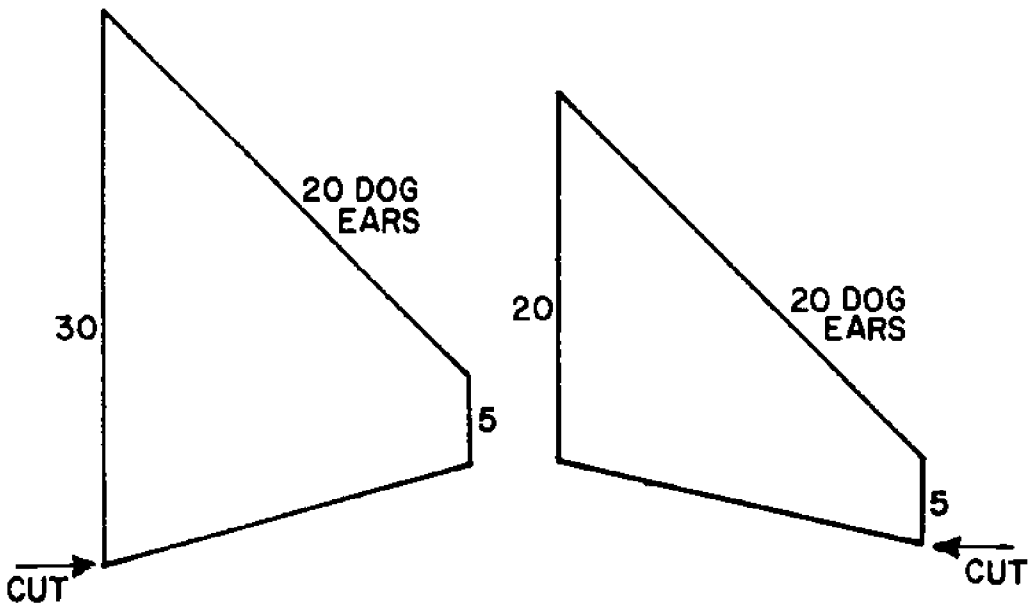


FIGURE 11. Two pieces of twine with different dimensions but the same taper proves the importance of knowing where to start the taper. As stated in the text, the beginner should always cut from the wide end, which is determined by adding the number of dog ears to the intended narrow end. If this is greater than the intended wide end, then the cut should start as indicated in the left drawing. If the opposite is true, then the taper should start as indicated in the right drawing.

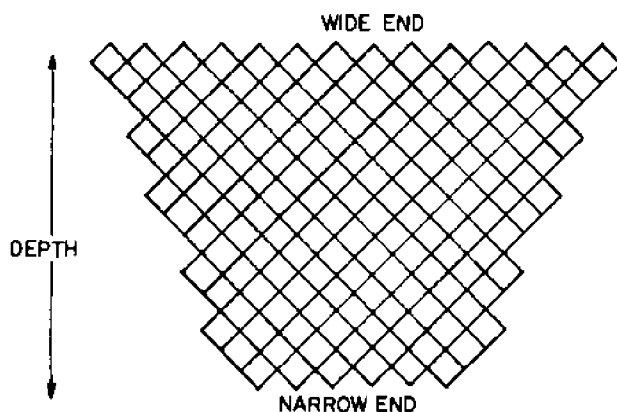


FIGURE 12. Belly or square with dimensions of 14 x 6 x 9 deep. This body cut shows 2 bars, 1 point, then 1 bar, 1 point.

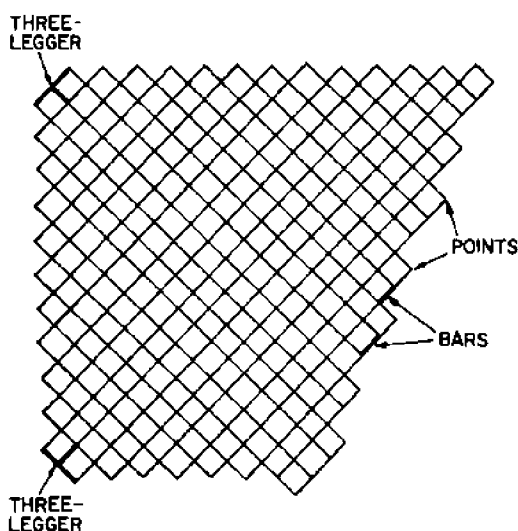


FIGURE 13. Half belly. When a single belly or square is to be cut, caution must be taken. Note that the three-leggers are on the half belly as shown; therefore, the other half must not have any three-leggers. Should this mistake be made, it can be corrected by cutting off a half mesh starting on one three-legger and ending on the selvage. In order to sider two pieces of twine together, there must be a three-legger on one piece to start and on the other piece to end.

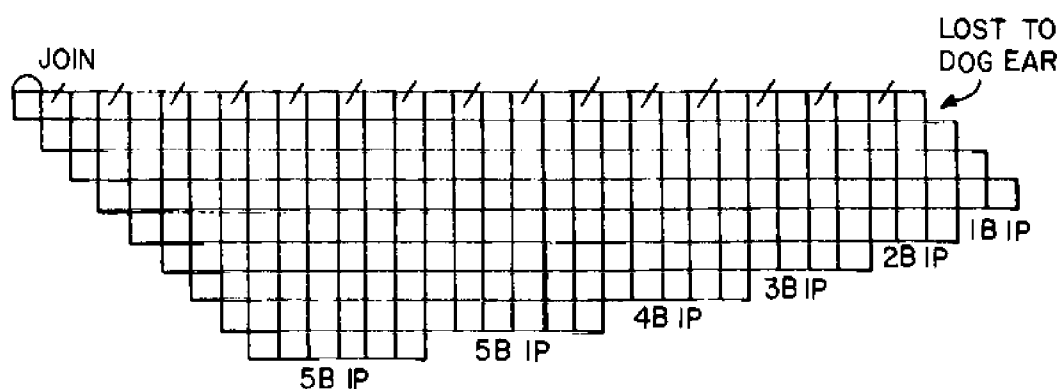


FIGURE 14. Wing before the dog ears are knit on. Cut bars starting between bar 1 and 3 as shown. Join the needle at the first point. This will leave the required three-legger in the proper position. A taper cut by guess may look like that shown above, or be even worse. The proper taper should be 3 bars to 1 point, 3 bars to 1 point, and 4 bars to 1 point repeated until the taper is completed.

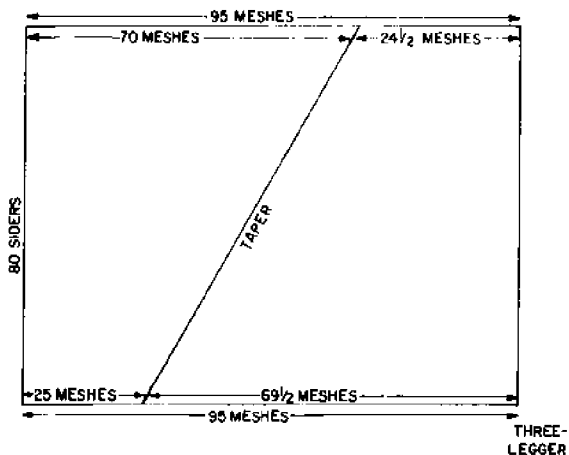


FIGURE 15. One belly or one square example. Using the formula $2c/d-c$, a total of $95\frac{1}{2}$ meshes will make a belly with dimensions of $140 \times 50 \times 80$. Note that the 95 meshes are half of the wide end plus half of the narrow end. The half mesh is gained when the two halves are sidered together. One square is cut the same way. Remember to *always use total dimensions whenever you figure a taper*. Refer to caption, Figure 13, for position of three-leggers.

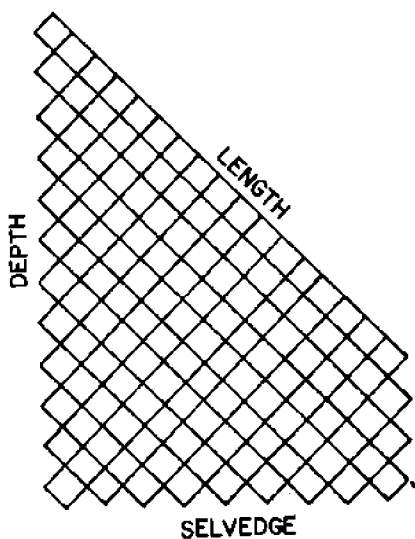


FIGURE 16. Straight bar top wing with dimensions of $12 \times 4 \times 16$ bars. A standard top wing has no taper on the selvedge. However, if a wing needs to be longer than the depth, the lower wing taper formula should be used -

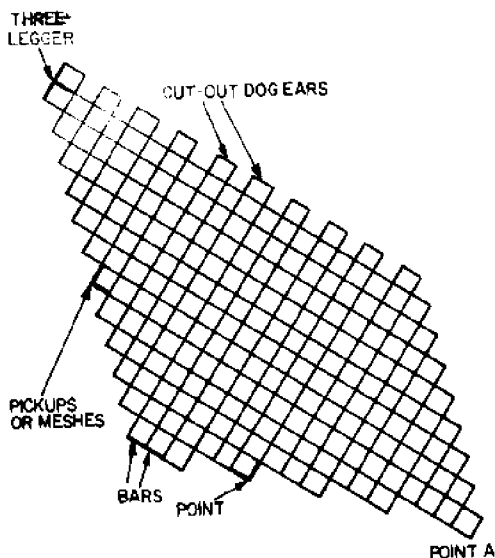


FIGURE 17. Tapered wing with dog ears with dimensions of $12 \times 8 \times 10$ dog ears and a taper of 2 bars to 1 point. Note that only a single three-legger is left on all dog ear wings. The other one is on the taper at Point A and will be taken up when the net is laced. The narrow end of all wings should have double meshes. This can be done by cutting off a half mesh and knitting it back with a double needle or going over the mesh with a single needle.

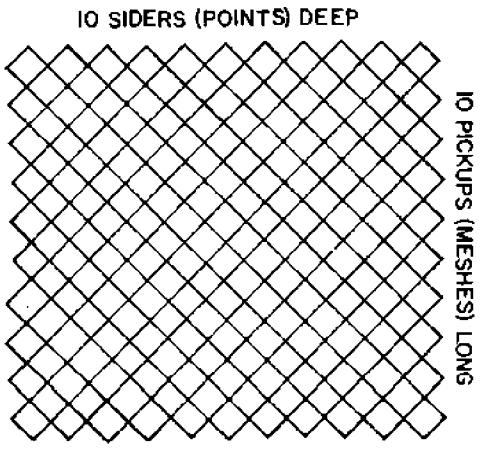


FIGURE 18. Square piece of web showing pickups and siderys. In all tapers we call the siderys *points* and the pickups *meshes*. The knots can and should be removed from the pickups, but they cannot be removed from the siderys. The pickup, or mesh side, however, should be cut with a sharp knife. Cut one strand only and pull the mesh; the knot will fall off. (The best tool for cutting new web, by the way, is a soldering gun with a cutting tip. This tool welds the ends and prevents fraying.)

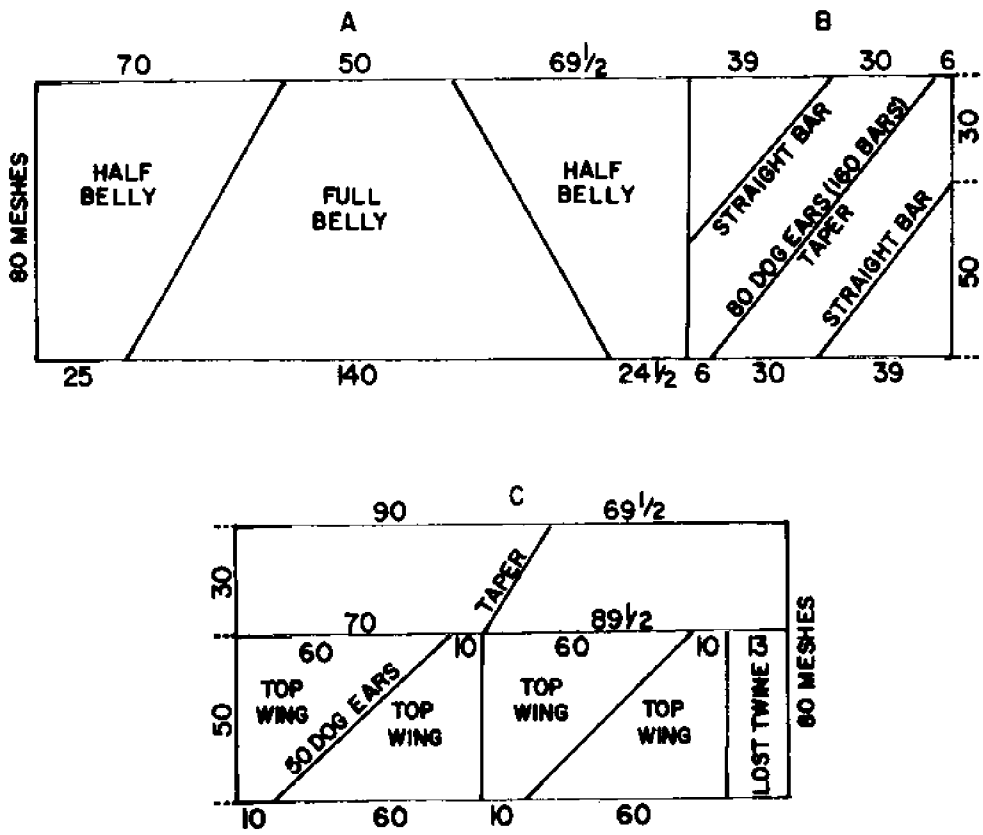


FIGURE 19. Cutting diagram for complete net plus two extra top wings. Part A shows that a total of 190½ meshes is required for two bellies. (Two meshes are lost on each pair of bellies.) In Part B a total of 78 meshes is required to make one pair of lower wings, while in Part C a total of 144 meshes is required to make four top wings, and 160 meshes to make one square. Wasted twine for the complete net totals only 13 meshes.

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