GENERAL PRINCIPLES OF THE DESIGN OF TRAWL NET

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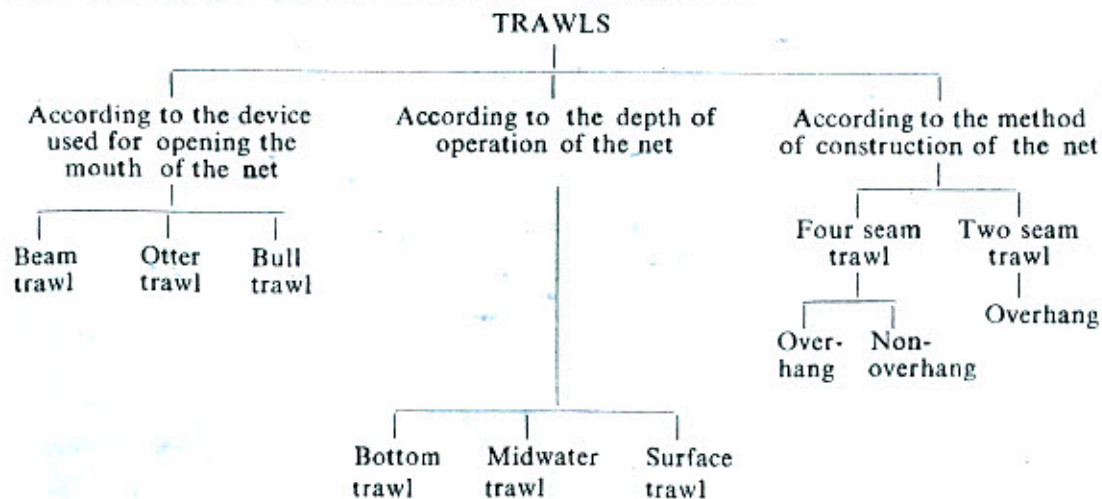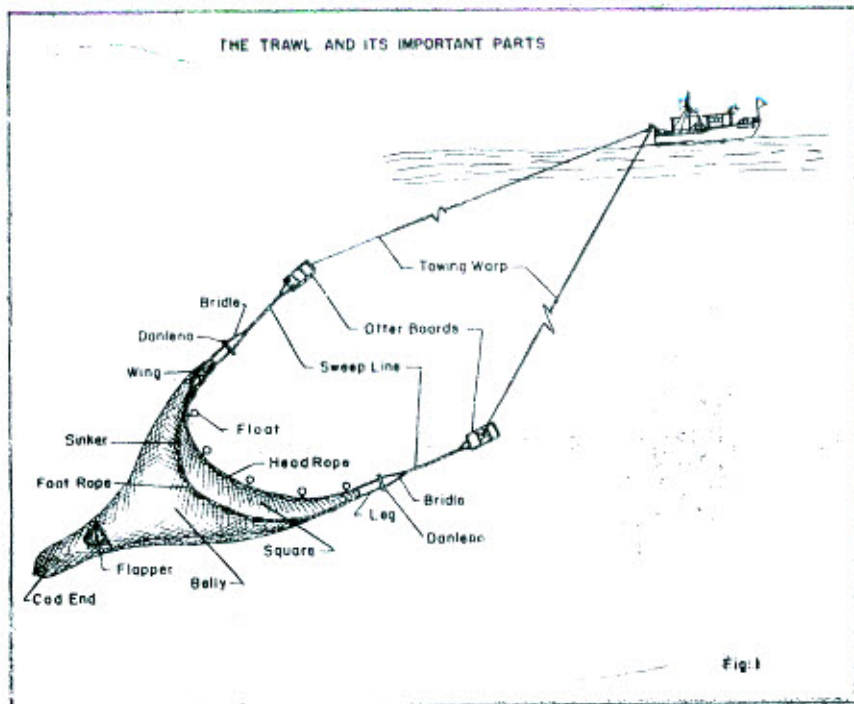*Central Institute of Fisheries Technology (Craft & Gear Wing), Cochin-5*

INTRODUCTION

Trawl is a bag shaped gear towed through water, the mouth of which is kept open by frame, beam, otter boards, kites or floats and sinkers. Sometimes opening is effected by dragging with two vessels. Trawling as a new fishing method has been recently introduced in India and trawlers of various sizes are in operation in different parts of the country. In this article the author wishes to enumerate some of the general principles followed in the trawl gear design.

CLASSIFICATION

The initial trawling gear was all for bottom fishes and in later years more complicated innovations were devised. The present day trawls may be classified as shown below:

TRAWLS

- According to the device used for opening the mouth of the net
  - Beam trawl
  - Otter trawl
  - Bull trawl
- According to the depth of operation of the net
  - Bottom trawl
  - Midwater trawl
  - Surface trawl
- According to the method of construction of the net
  - Four seam trawl
    - Over-hang
    - Non-overhang
  - Two seam trawl
    - Overhang

THE TRAWL AND ITS IMPORTANT PARTS

Fig: 1

A typical trawl net and its important parts are indicated in Text Figure 1.

DESIGN

The trawl has to be designed so as to match the resistance of the net with the pull of the boat for effective utilisation of the installed engine power. Although the designs of trawl vary, the different parts of a trawl are proportionate to its size. Miyamoto (1959) after analysing these relationships has evolved empirically the following formulae for the design of four-seam non-overhang trawls.

1. The size of the net $H = \sqrt{43.6P + 660}$
where, H = the length of head rope in feet
P = the B. H. P. of the engine.
2. The length of head rope will be distributed as:

$\left.\begin{array}{l} \dfrac{H}{5} \text{ for the Bosum} \\[3em] \dfrac{2H}{5} \text{ for the Jibs} \end{array}\right\}$ Shown in Text Fig. 2.

3. The stretched length "L" of the webbing at the upper edge of the belly is:–

$$L = \frac{H/5}{(1-S)} \text{ x } 3$$

where, S = co-efficient of hanging.

4. The dimensions of the other parts of the trawl in relation to "L" are indicated in Text. Fig. 2.

The mesh size and twine size required for the webbing of the trawl are determined according to the type of fishery and local conditions. While mounting the net to the rope, the length required for the various parts are calculated according to the hanging effected at the bosum. Generally a hanging co-efficient between 0.4 and 0.5 is used. As the horizontal and vertical spreads of the webbing are proportional to the hanging co-efficient, some of the corresponding relationships are shown below:
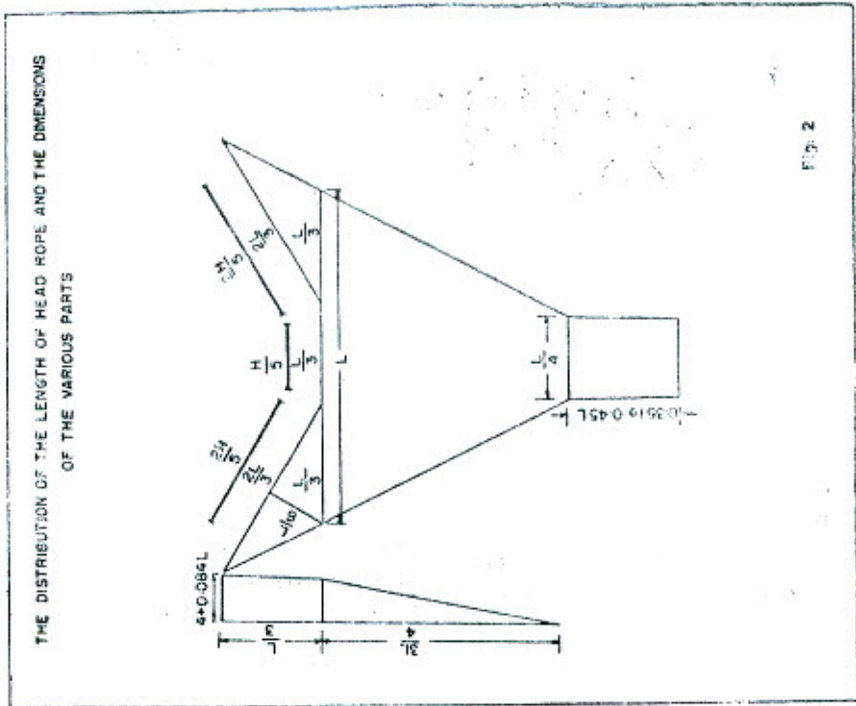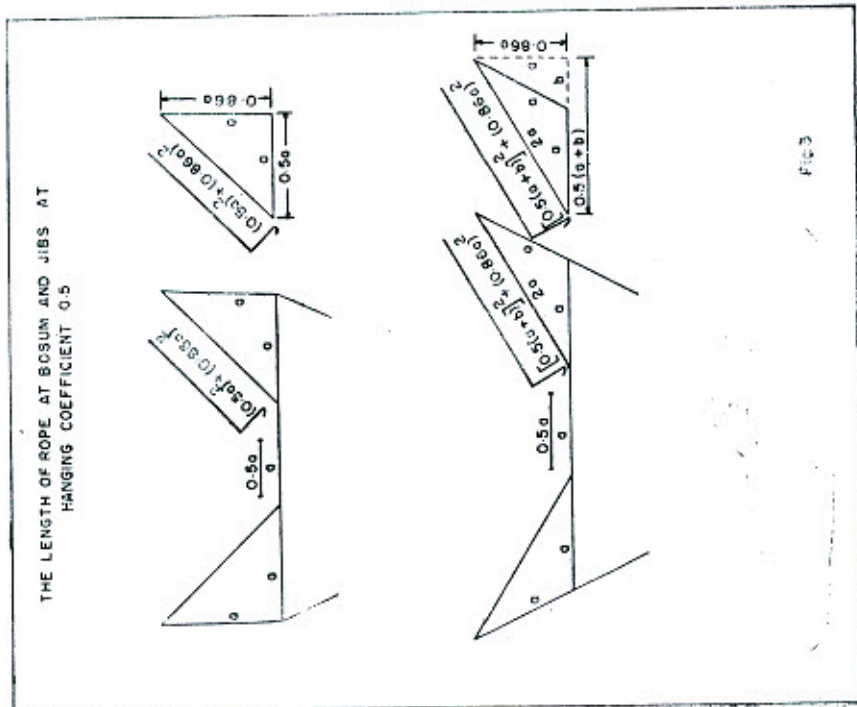
THE DISTRIBUTION OF THE LENGTH OF HEAD ROPE AND THE DIMENSIONS OF THE VARIOUS PARTS

Fig. 2

THE LENGTH OF ROPE AT BOSUM AND JIBS AT HANGING COEFFICIENT 0.5

Fig. 3

Hanging co-efficient	Horizontal spread	Vertical Spread
0.38	0.62	0.78
0.40	0.60	0.80
0.42	0.58	0.81
0.43	0.57	0.82
0.45	0.55	0.83
0.47	0.53	0.84
0.48	0.52	0.85
0.50	0.50	0.86
0.55	0.45	0 89
0.60	0.40	0.91

The length of rope required for the bosum will correspond to the ratio fo horizontal spread of the stretched length of meshes there. But the jib being a triagular piece, the length of the hypotenuse is the required length and can be calculated from the lengths of the other two sides which in turn depend on the correspoding horizontal and vertical spreads of the jib webbing (Text. Fig. 3).

The wing generally consists of straight webbing. So the length of rope will be proportionate to the vertical spread of meshes. In case of tapered wings, the length of the resultant hypotenuse has to be calculated.

CONSTRUCTION

The aim is to construct

1) A suitably long conical bag which enables waterflow evenly.
ii) To effect a smooth catenary curve at the mouth.

For this purpose, the webbings required for the trawl are prepared in sections as per specifications given for the various parts in the design (Text Fig. 4). These sections are assembled together.

According to the construction, the trawl designs can be divided into "Two-seam trawl" (Text Fig. 5) and "Four-seam trawl" (Text Fig. 6).

Larger bottom trawls are of two seam construction. They have only two major parts namely one upper and one lower. These nets are normally provided with an overhang for the upper belly.

For the four seam nets there are four parts, the upper, the lower and the two lateral sides. Nets of this type may be made with or without overhangs. In a non-overhang net both the upper and lower bellies are of identical dimensions. At times a "square" is separately made and attached to the forward part of a non-over-hang trawl, to serve the purpose of an overhang. Boats of small and medium sizes generally use four-seam nets. Some of the pelagic trawls are also of four seam construction. When the net is intended to catch mainly fish, it is advisable to provide an overhang and for shrimp net an overhang is not essential.

The mouth region of the upper part of the net is mounted to the head rope and of the lower part to the foot rope. Loops of suitable size are made on the rope with hanging twine which is thicker than those with which the webbing has been fabricated and the respective edges of the webbing are then laced to these loops. Another method is to hang the net on the "bolch line" and rig the bolch line along with the webbing to the respective ropes. A third method is to pass a thicker twine of the required length through the edge meshes of the respective parts and this twine with the meshes arranged uniformly is rigged to the relevant ropes. The foot rope is provided with the required number of lead sinkers prior to the rigging of the webbing. The distribution of floats and sinkers to the respective ropes of the trawl needs careful attention. They should be so distributed as to prevent undue sagging of the ropes. For trawls of medium size a satisfactory requirement of weight will be 0.5 to
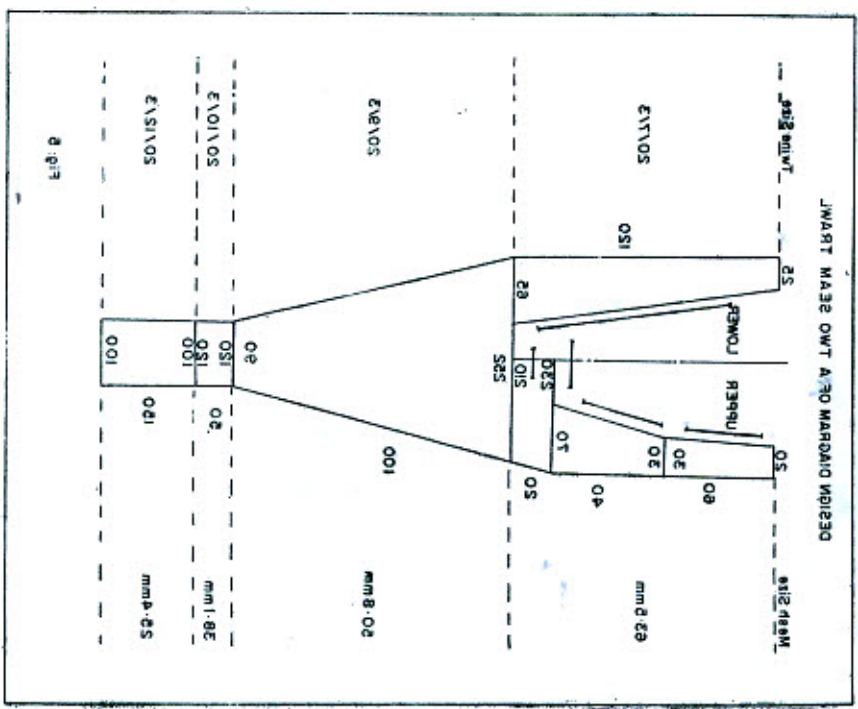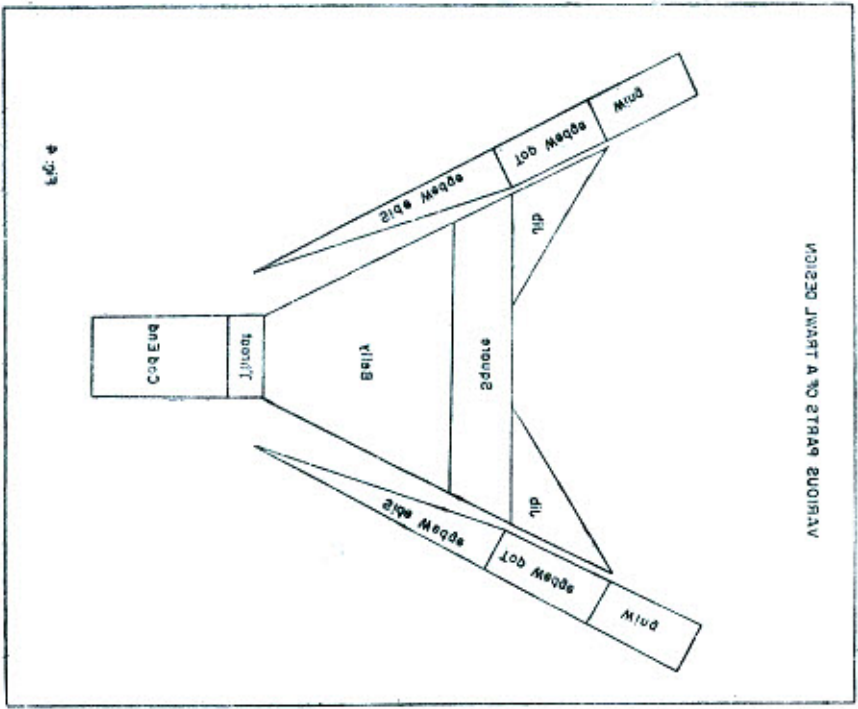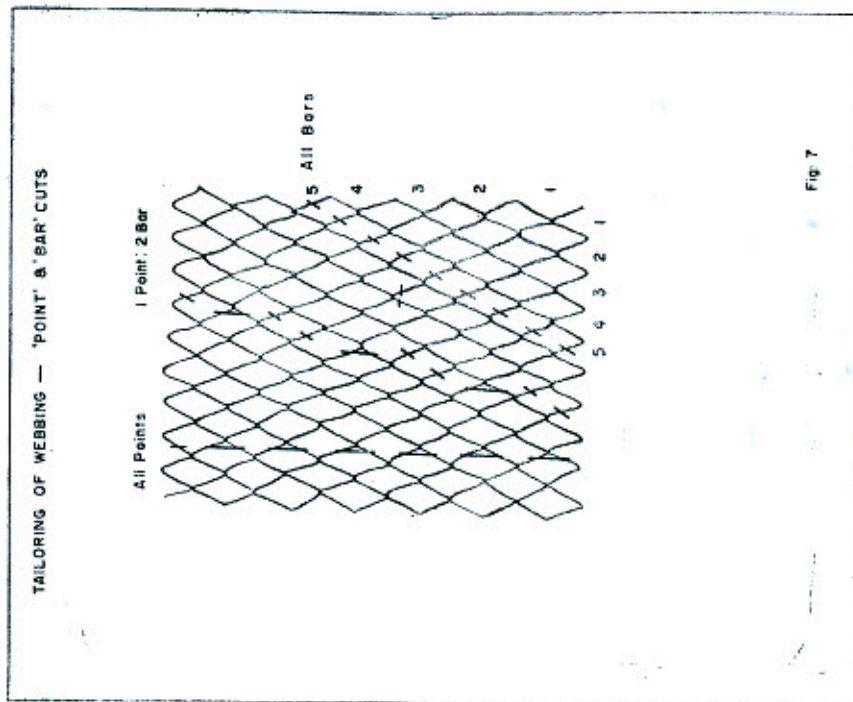
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DESIGN DIAGRAM OF A FOUR SEAM TRAWL

Fig 6

TAILORING OF WEBBING — 'POINT' & 'BAR' CUTS
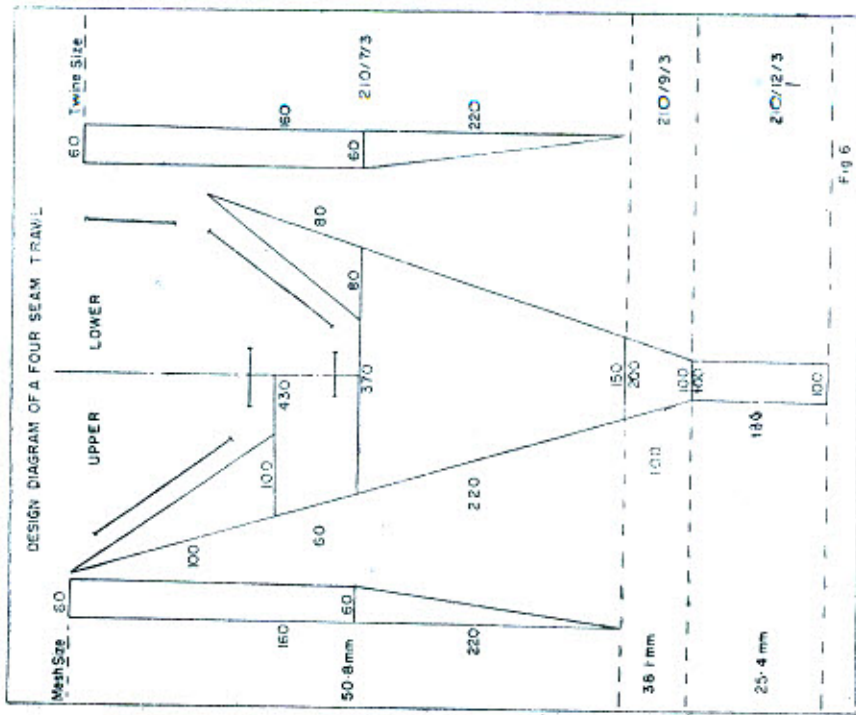
Fig 7

0.75 lbs. of weight per ft. length of the foot rope and the total buoyancy of floats required will be between ½ to 2/3 of the total weight of sinkers. Minor adjustments, if any, can be made as per results of trial operations.

After mounting the net, "eyes" are spliced at either end of the rope. The ends of the ropes, also called "legs" should be of equal length. The length of leg is usually 1/5 th of that of the head rope.

The free forward edge the webbing at the wings is provided with a "wing-tip-rope" entering between the head and foot ropes. A thin strong line is used for the wing-tip-rope, the length of which is limited to the vertical height required for the wing:

Similarly, the free edge of the cod end webbing is further provided with bigger loops made of thicker twine, through which a smooth and strong line, slightly longer than the stretched length of meshes there, is passed and the two ends of the line are joined together by splicing. This is the "cod-end-rope," used for securing as well as for releasing the catches. It is customary to provide a long float line with float, to the cod end as a precautionary measure salvage the net when fouled.

The usual rigs such as the "Dan-le-nos", sweep lines or cables, bridles, etc. are made ready according to the local conditions or according to the choice of the skipper for the attachment of the net to the otter board.

CUTTING RATE

The traditional hand braided webbings are being fast replaced by tailored machine made ones in trawl net fabrication. The general principles followed for calculating the cutting rate to tailor a webbing are indicated below:

A mesh has four legs from which two legs or one leg only is cut at a time. When two legs are cut together, it is termed "point cut". There are two types of point cuts: "N-cuts" – when the direction of cutting is at right angles to the general course of netting, and "T-cuts" when the direction of cutting is parallel to it. "Bar cuts" or "B cuts" are made when one leg only is severed at a time from the mesh. In this the direction of cutting runs parallel to the line of sequential mesh bars.

To obtain the desired taper the different types of cuts must follow each other at distinct rates in a rythmical way. The direction of the line of cutting follows approximately the hypotenuse of the resultant right angled triangle formed there and the rate of cutting can be calculated from the number of meshes that constitute the other two sides of that triangle.

Point cuts $= P = (L - N)$
Bar cuts $= B = 2N$

where, "L" is the number of meshes at the longer side of the triangle.

and "N" is the number of meshes at the shorter side of the triangle.

The rate of cutting is the ratio $\frac{P}{B}$. If this ratio cannot be simplified completely, the nearest rounded value can be used with discretion.

For example, the cutting rate is derived as follows. To cut a taper where 30 meshes are reduced in a length of 60 meshes, the number of point cuts, bar cuts and the rate of cutting are :–

$P = (L — N) = 60 — 30 = 30$
$B = 2N = 2 \times 30 = 60$
$\frac{P}{B} = \frac{30}{60} = ½$, i. e. a total of

30 point cuts and 60 bar cuts are made at the rate of 1P2B.

On the other hand the taper when 30 meshes are reduced at a length of 70 meshes will be.-

$$P = 70 - 30 = 40$$
$$B = 2 \times 30 = 60$$

$$\frac{P}{B} = \frac{40}{60};$$ i. e. 40 point cuts and 60 bar cuts are to be made and the rate will be 1P1B alternated with 1P2B so that the different cuts are distributed uniformly.

After cutting the edge meshes are strengthened with another twine of the same size and material. This is termed as "doubling the bars."

SUMMARY

The classification and the principles of design and construction of trawls in general are described. The method of calculating the length of rope required at each part for mounting the net and the requirements of floats and sinkers are given. The cutting rates to tailor machine made webbing are also indicated.