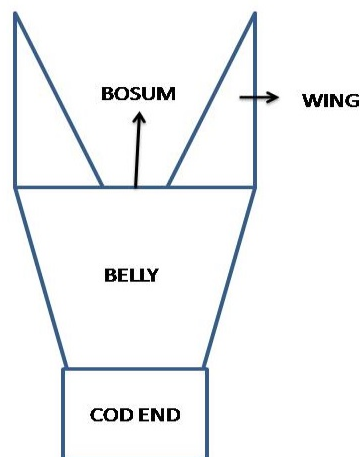


CLASSIFICATION OF TRAWL GEARS. 2 SEAM TRAWL; 4 SEAM TRAWL AND WING TRAWL. DESIGN AND CONSTRUCTION OF WING TRAWL. RIGGING OF TRAWL GEAR

Anirudh Kumar

Trawling

- ✓ Fishing is the art of catching aquatic living beings.
- ✓ Various methods are adopted for the capture of fishes.
- ✓ Due to advancement of Science and Technology many progressive changes have been introduced in design, construction and operation of fishing gear.
- ✓ The introduction of trawls and trawling is one of the important developments in the history of fishing technology.
- ✓ The modern trawl net is basically a large conical shaped; bag netting which is drawn along the sea bed just above the bottom or in the water column to catch bottom fishes or shell fishes.
- ✓ Initially trawling gear was all for bottom fishes and in later years more complicated innovation were devised.
- ✓ The present day trawls may be classified as under.
- ✓ The size of a trawl net may be defined by the length of the foot rope, headline or the number of meshes around the fishing circle, and the mesh size at that point.
- ✓ Mesh sizes are usually at their largest in the mouth of the trawl and progressively reduce towards the cod end.
- ✓ It is a dragged gear towed through the water either at the bottom or subsurface water.
- ✓ It contributes more than 20% of world marine catch.
- ✓ In case of India, trawl nets are operated by more than 65% of mechanized boats.



Classification of trawl net:

The trawl net classified based on several features:

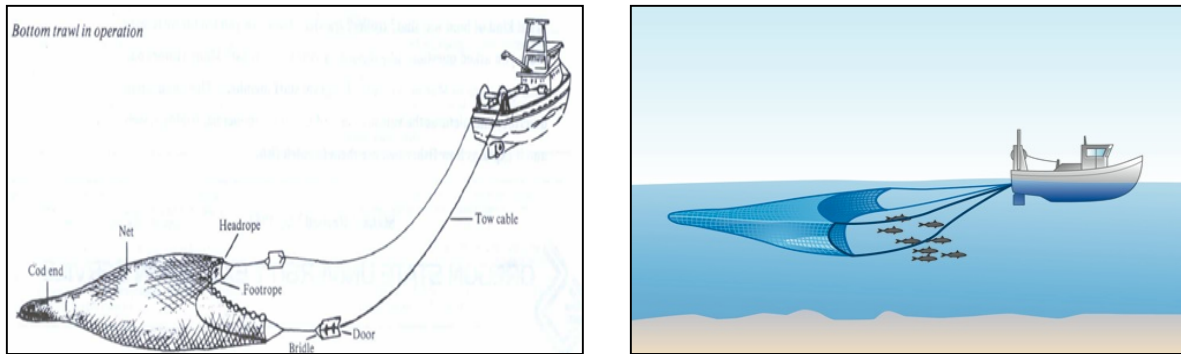
1. According to catch in the trawl:

Shrimp trawl:

- ✓ The trawl net which is involved in catching of shrimps.

Fish Trawl:

- ✓ The trawl net which is involved in catching of fish.



(Source : FINE)

Fig. A. Shrimp (bottom) trawl net B. Fish (Midwater trawl net)

2. According to construction:

Two seam trawl:

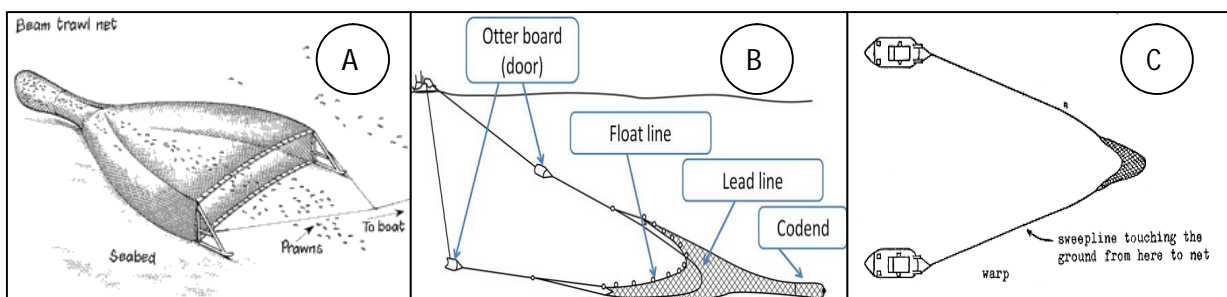
- ✓ The trawl net which is consists of two panels i.e. upper panel and lower panel.
- ✓ Both the panels joined together laterally.

Four seam trawl:

- ✓ The trawl net which is consists of four panels i.e. upper panel, lower panel and two side panels.

Six seam trawl:

- ✓ The trawl net which is consists of six seams.



(Source: Com fish)

Fig. A. Beam trawl net B. Otter trawl net C. Bull trawl net

3. According to mouth opening:

Beam trawl:

- ✓ The mouth of trawl net held open with the help of a wooden beam.

Otter trawl:

- ✓ The mouth of trawl net open horizontally with the help of wooden or metallic otter boards.

Bull trawl:

- ✓ The mouth of trawl net held open horizontally by two boats pulling in opposite direction.

4. According to depth of operation:**Bottom trawl:**

- ✓ The trawl net which get operated over bottom portion of the sea.

Midwater trawl:

- ✓ The trawl net which get operated in subsurface area of the water body.

5. According to the number of trawl net operated from a single boat:**Single rig trawl:**

- ✓ One trawl net gets operated from a single boat.

Double rig trawl:

- ✓ Two trawl net gets operated from a single boat.

Multi rig trawl:

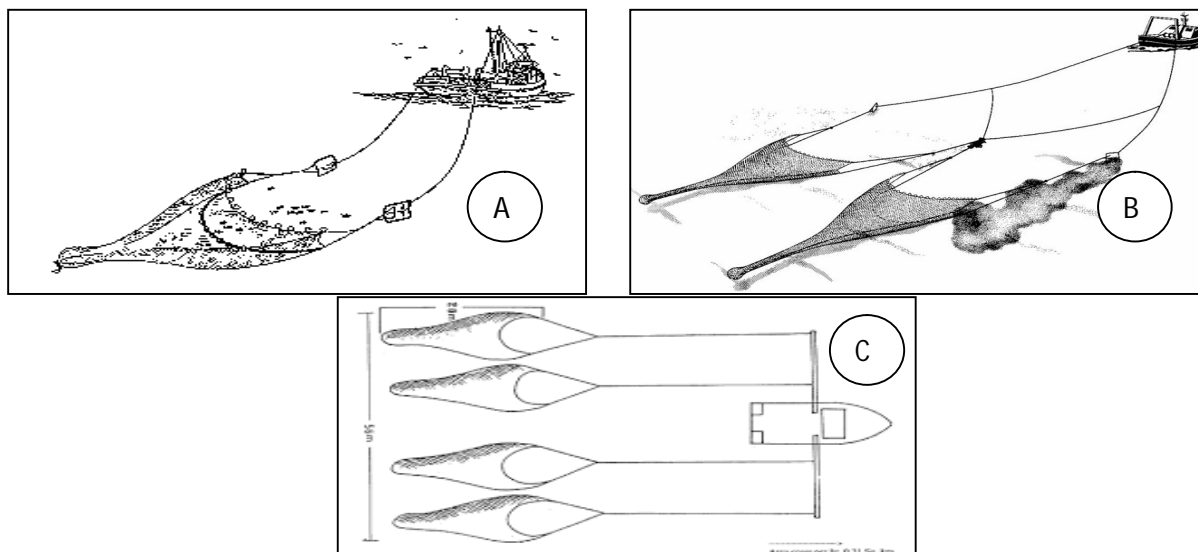
- ✓ More than two trawl net gets operated from a single boat.

6. According to mode of operation:**Side trawl:**

- ✓ The trawl net which get operated from side portion of the trawler boat.

Stern trawl:

- ✓ The trawl net which get operated from back portion (stern) of the trawler boat.



(Source: FAO)

Fig. A. Single rig trawl B. Double rig trawl C. Multi rig trawl

7. According to attachment of otter boards:

Hoover rig trawl:

- ✓ The trawl net where otter boards are directly connected with wing portion of the net.

Vigneron Dahl trawl:

- ✓ The trawl net where otter boards are connected with wing of net with the help of bridles.

TRAWL NET PARTS:

WARP:

- ✓ Warp is a rope or cable with distinguishing marks at regular interval used for towing the net.

OTTER BOARD:

- ✓ It is a device used in pair for keeping the mouth of a trawl net horizontally opened during operation.
- ✓ Otter board is also called as trawl doors

SWEEP LINES:

- ✓ Ropes or wires attached between the end of the net and the otter boards.
- ✓ The help to some extend in directing the fish into the track of the net.

LEGS OR BRIDLES:

- ✓ The head rope and foot ropes are extended for a short length beyond the wing of the net
- ✓ These extension lines are called as leg or bridle.
- ✓ They are attached to otter boards directly or through sweep lines during the operation of the net.

WINGS:

- Wings are the side extension of the trawl net between head and foot ropes beyond the mouth of the net.
- The wings prevent to escape the fish from sides and guide them towards the cod end of the net.

HEAD ROPE:

- This is the rope by which upper edge of belly and inner edge of top wings are attached.
- This rope is also called head line, float line or cork line.
- Floats are attached with this rope to get buoyancy for lifting of upper part of net.
- The size of trawl net gets decided by the size of head rope.

FOOT ROPE:

- The rope by which lower edge of belly of lower panel and the inner edge of the lower wings are attached.
- This is also called ground rope, ground line, foot line or lead line.
- Weight/sinkers are attached with this line.
- With the help of floats and sinkers mouth of trawl net get open in vertical direction.

JIBS:

- The triangular piece of webbing attached on either side of upper and lower bellies at their junction with wings to provide a smooth curvature at the mouth of the net are called jibs.
- Jibs are also called as wedge or quarters.
- These are made in pairs, one for each side.
- The trawl without the jibs may undergo unequal strain at the junction of wings and bosom during operation.

BOSUM:

- The middle portion of trawl mouth between the wings of upper and lower panel.

SQUARE:

- The front portion of upper part of trawl which overhang the lower part of the net.
- The function of the overhang is to prevent the escape of fishes.
- It is also called over hang.

TOP BELLY:

- It is also called top body or upper belly.
- It is the main webbing of the upper part of the bag of trawl net.
- It is the portion of webbing between the square and throat or cod end on upper side of the trawl.

LOWER BELLY:

- It is also called bottom belly.
- It is the main webbing of the lower part of the bag of trawl net.

THROAT:

- It is a portion of webbing placed in between the belly and cod end.
- It is also called an extension piece, intermediate or lengtheners.

COD END:

- It is the terminal bag of trawl net where the catch of net gets accumulated.
- Made up of strong twine and smaller mesh size.

TOP WEDGE:

- This is the lowest extension piece of wing in four seam trawl.
- It extends from jibs to square.

SIDE WEDGE:

- It is a longitudinal piece of webbing seamed between the upper end and lower belly on both sides.
- Generally it extends to entire belly length in four seam trawl.

FLAPPER:

- ✓ A panel or panels of netting inserted inside the trawl to prevent or restrict the escape of fish from the aft part of the trawl.
- ✓ This is usually positioned in the after part of the belly or extension.

APRON:

- The webbing attached at fore part of cod end as a chaffing gear is called apron.
- It prevents the cod end from abrasion when net get operated.

SELVEDGE:

- The webbing of a net with few rows of bigger meshes made up of thicker twine called selvedge.

BLOCH LINE:

- A line or thin rope of strong construction to which the webbing is initially is hung prior to rigging.

LACING TWINE:

- It is strong twine used for seaming or joining the longitudinal or adjacent edge of webbing.

COD END ROPE:

- A rope used for seaming of the cod end during the net operation and opening of cod end after operation to release the catch from net.

TICKLER CHAIN:

- Iron chain attached with foot rope in case of shrimp trawl to disturb the bottom and to induce the shrimp and fish to enter inside the net.

BOBBINS:

- It is a spherical shaped roller attached with foot rope.
- It helps to prevent the gear from entangling with seabed by rolling smoothly on the uneven floor.

Bunt –

- ✓ This is a continuation of the lower wing that is attached beneath the square.

Lifting Bag –

- ✓ A cover over the cod end that is normally made of a larger mesh size and is used to strengthen the cod end whilst lifting the catch aboard.

Chafers –

- ✓ Pieces of netting; rubber matting or hide that are attached to the lower side of the cod end and bellies to reduce damage from ground contact.

Dolls –

- ✓ Pieces of stranded rope that are cow hitched through the meshes on the underside of a trawl or chaffer to help protect the net from damage.
- ✓ These are usually used on nets that are being worked on stony ground, and are most commonly found on the underside of beam trawls.
- ✓ Dolls also help to block the meshes hence reducing the effective mesh size.

Fishing Line –

- ✓ The lower framing rope at the mouth of the trawl to which the foot rope, bobbins or ground rope is attached.

Bolsh –

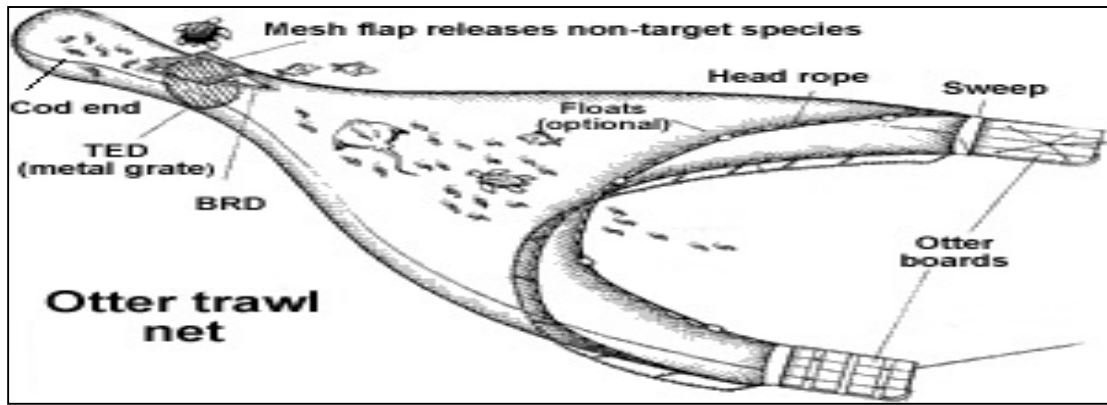
- ✓ A rope that may be inserted between the wings and a framing rope.

Wing Lines –

- ✓ Ropes that frame the wing ends of a trawl.

Belly Lines and Selvedge Lines –

- ✓ These are ropes that run along seams in the trawl to give additional strength.
- ✓ The trawl is held open vertically by the floats attached to headline.
- ✓ It retains contact with the sea bed by the weight of the ground rope.
- ✓ The trawl is held open laterally by the otter boards, which also act as a major weight force to keep the gear on the sea bed.
- ✓ A series of sweeps and bridles connect the otter boards to the trawl.
- ✓ These may have considerable length and are used to herd the fish to the mouth of the trawl.
- ✓ Tensions in these wires may also be adjusted to control the engineering performance of the gears



DESIGNING OF TRAWL NET:

The design of trawl net has been given by:

1. MIYAMOTTO (1959)
2. GEORGE AND NAIR (1964)

1. MIYAMOTTO DESIGN OF TRAWL NET:

He has established the relationship between horse power of the engine and size of the trawl net.

$$H = 43.6 P + 660$$

Where,

H = Length of the head rope in feet

P = BHP (Brake horse power) of the engine.

The belly is the largest part of trawl webbing, the length of its upper edge 'L' is taken as the basic length, which is calculated as:-

$$L = \frac{\frac{h}{5} \times 3}{1-S}$$

Where,

L = stretched length of upper edge of belly in feet

S = Hanging coefficient of bosom

The proportion of other portion of the trawl in relation to 'L' gets calculated:

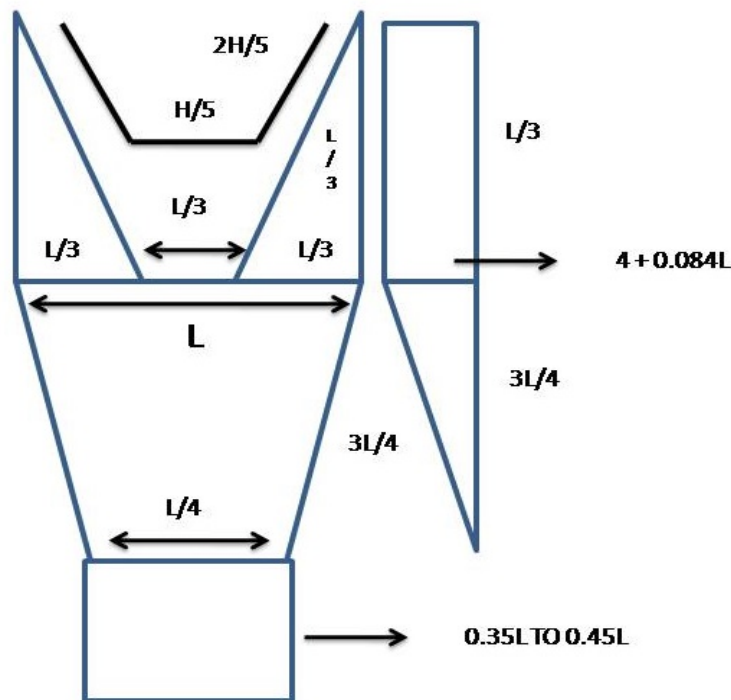


Fig. Proportion of various parts of trawl net

1. Length of webbing for bosom = $L/3$
2. Height of webbing for wing = $L/3$
3. Width of webbing for wing = $L/6$
4. Depth of webbing for belly = $3L/4$
5. Width of lower part of belly = $L/4$
6. Length of cod end = $0.35 L$ to 0.45
7. Length of side piece = $L/3 + 3L/4$
8. Width of side piece = $4 + 0.084 L$

- The stretched length of various sections of net expressed in feet can be converted to inches by multiplying with 12.0.
- Dividing the stretched length of various sections with the corresponding mesh size in inches would give the number of meshes for each section.
- Distribution of head rope/ foot rope to be at bosom and wings will be $H/5$ and $2H/5$ respectively

GEORGE AND NAIR METHOD (1964):

- ✓ According to this method, the relation between length of head rope (HR) and horse power of an engine (P) is given by the equation

$$HR = 0.5 P + 28 \text{ feet}$$

- ✓ The relation between belly width (L) and the head rope length is expressed as –

$$L = 0.7 HR + 6 \text{ feet}$$

- ✓ The proportionate dimensions of the depth of belly (D), the length of bosom (Bm), minimum width of belly (B), width of side wedge (W) and length of wing or jibs (J) in relation to the maximum width of belly are as follows:-

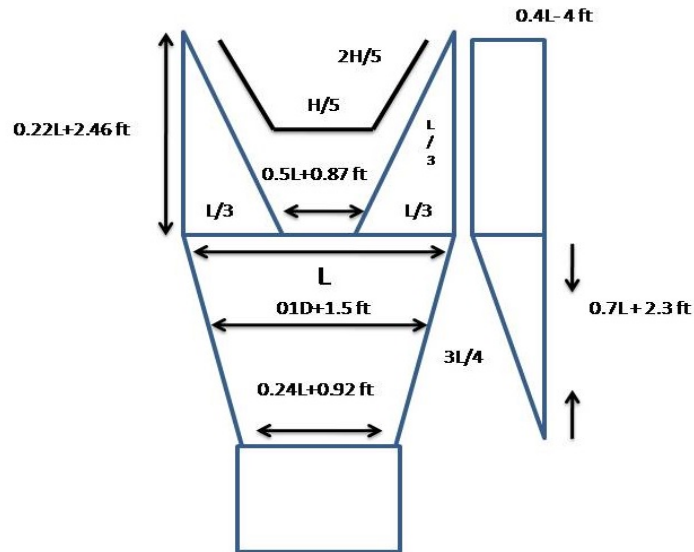


Fig. Proportion of varies parts of trawl net

$$D = 0.7 L + 2.3 \text{ feet}$$

$$B_m = 0.5 L + 2.87 \text{ feet}$$

$$B = 0.24 L + 0.92 \text{ feet}$$

$$W = 0.4 L + 4.0 \text{ feet}$$

$$J = 0.22 L + 2.46 \text{ feet}$$

- ✓ For an overhang trawl, the depth of upper belly (D) exceeds the lower belly by the depth of the squares (S).
- ✓ The relationship between D and S are expressed as-

$$S = 0.1 D + 1.5 \text{ feet}$$

- ✓ The relationship between total extra buoyancy of floats (F) and the length of head rope (HR) as well as total weight of sinkers (W) and the length of footrope (FR) are expressed by the following equation-

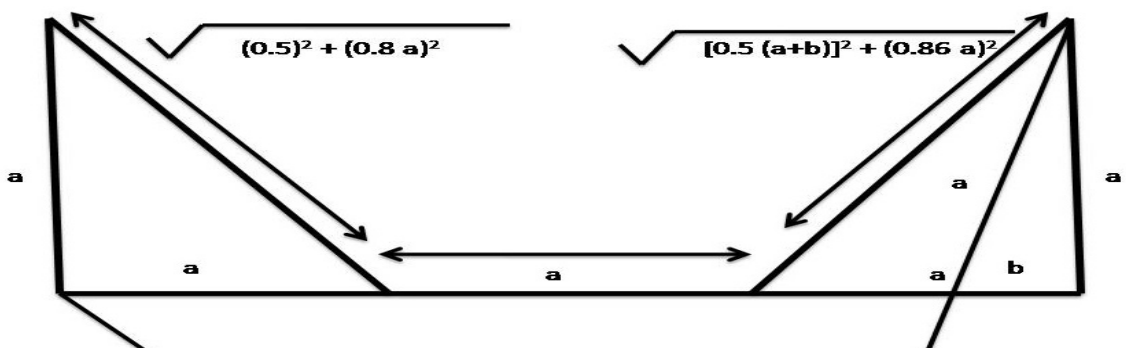


Fig. Distribution of head rope length of trawl net

1. At bosom = $0.5 a$
2. At wing = $(0.52)^2 + (0.86a)^2$

Where,

a = Width of bosom/ wing base/ wing height

- ✓ The distribution length of head rope in nets with slanted wings is given by the relation-

$$b = 0.5 (a+b)^2 + (0.86 a)^2$$

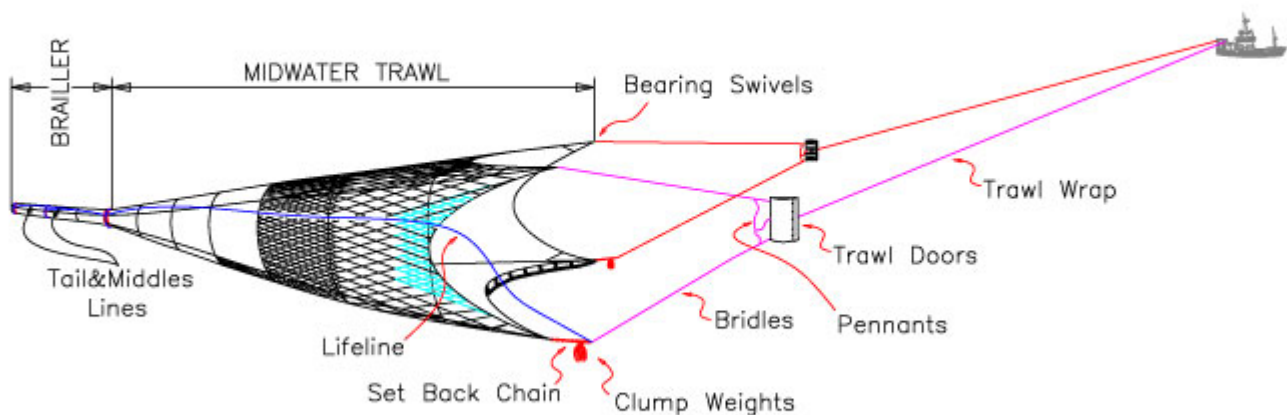
= Length of additional extrapolated wing base to make the slanted wing as a right triangle.

MESH SIZE:

- The mesh size of trawl decreases from the wing to cod end in 3 to 4 stages depending on the design.
- Mesh size at various sections of the trawl is decided based on the size of the fish to be caught.
- Fish trawl have large meshes varying from 5 – 20 cm, while shrimp trawl have smaller meshes ranging from 4 – 5 cm.
- It is recommended to fix square mesh panels in the cod end or entire cod end is made up of square meshes to allow the escapement of under sized fishes.

RIGGING OF TRAWL GEAR:

Diameters of Ropes & Chandlery may vary with H.P
all variations can be supplied



Bridles has to be long enough to open design of net
Most Bridles vary from 40-80m long

SELECTING NETTING MATERIALS

- The material most widely used in demersal trawls is Polyethylene.
- This is usually blue, orange or green in colour, and may be constructed in a twisted or braided form.
- The cod end section of the trawl is most commonly constructed from braided twine, and is often made in the form of double netting.
- Polyamide or Nylon netting is widely used in the construction of Beam trawls, Mid water trawls and Shrimp trawls.
- All synthetic materials are subject to shrinkage, which may have several causes, and could lead to a net contravening a fishing gear regulation.
- Polyethylene is subject to shrinkage caused by prolonged periods of storage in direct sunlight.
- Polyamide may be subject to shrinkage by submersion in water unless adequate heat setting processes have been undertaken during the twine and netting manufacture.
- Contact with chemicals, hot water pipes etc. may also cause problems.
- Another form of shrinkage is caused by dimensional change.
- This is particularly common with braided twines that are used in close contact with a sandy sea bed.
- The sand particles find their way into the lumen of the twine causing an increase in diameter and reduction in length of the twine bars.

Rigging of otter boards

- Otter boards are rigid sheer devices which are used to keep; the trawl mouth, bridles and warps horizontally open.
- They keep the bottom trawl in contact with the sea bed and help to maintain the fishing depth of the mid water trawls.
- Otter boards were first used trawling in 1894 in Scottish waters.
- By the end of the century otter trawler had become popular.
- Originally otter boards were attached directly to the wings of the net.
- By around 1920, Vigneron-Dahl system was introduced.
- In this system otter boards were attached to wing by means of sweep lines and bridles.
- There was an increase in the catch rate, the effective swept area and through the herding effect of sweep lines, bridles and otter boards on fin fishes.
- Otter boards contributes about 25% of the total drag of trawl system and is responsible for about 16% of total fuel consumption in trawling operation.

Equipment:

- For stern trawler winch should have at least two main drums and two warping heads.
- In order to ensure a working deck clear of running wires the winch may be mounted at forecastle level so that the wire run over the heads of crew members on the working deck.

Towing and Handling warps and doors

- A smooth run of warps from the winch to the gallows is necessary.
- The required blocks and sheaves must be arranged in the working area to permit easy spooling on the winch and a smooth run over the gallows with minimum changes in the direction.
- A pair of gallows to be mounted at each side of the working deck at the aft and alternative method for towing support is to have a gantry structure which will leave the working desk completely free of towing blocks.

Net drum

- In this method the net is wound aboard on to the drum.
- The deck space required is limited when compared to other method.
- Here the space required to mounting the drum plan the area needed to dump, clean, sort trawl catch.

Winch:

- Requires at least two main drums for the warps and two warping heads for handling the codend.

Trawl drum:

- Must be large enough to wind on the trawl and the bottom gear.
- This may be fitted in between the gallows.

Gallows:

- Situated on each side of the aft deck, and is usually tripod in structure.
- This is often are made portable and pinned into socket at their base.

Boom:

- The boom must be of sufficient length to bring the cod end aboard in the required position.
- A separate topping winch for the boom will be useful.

Operation

- While towing, the warps pass atwartship from the winch round rail mounted sheaves to the gallows and doors.
- During hauling, otter doors are pulled up to the gallows and are attached to the warps. Independent wires are disconnected from the towing brackets and are connected to leads from drum. Drum rotates to take pull and ground cables are disconnected from blackstrap and wound on to the drum.
- The mouth of the net is wound on drum. A ring strap is used to lift body and vessel turns to star board. Bull rope being taken forward to bring cod end along side. Trawl along side, the body is lifted to fill cod end. Cod end lift is taken by second whip. Full cod end is lifted and dumped and return to the water and filled again.

Stern Trawling With gantry

Operation is similar to that of side trawling but carried over the stern.

- ✓ Small stern trawlers are usually single decked with transform stern
- ✓ Wide, clean working deck aft
- ✓ Wheel house and leaving room forward
- ✓ Forwarded engine room
- ✓ Fish holds are below the working deck
- ✓ Aft the fish hold fuel tanks are located to allow control of trim
- ✓ Some vessels will have engine room aft and fish hold forward
- ✓ The winch is sited abaft the wheel house
- ✓ Gallows are situated aft on each side of the stern