TERMS PERTAINING TO SHIP STRUCTURES

(Also see Ship Terms and Definitions - a dictionary of ship parts)

SHELL ----The principal function of the shell is to act as a watertight skin. It also gives strength to the construction of intermediate parts.

TRANSVERSES ----These are the ribs or frames of the ship, and when placed in position, give the principal shape or contour, Transverses are not all the same distance apart; amidships, where there is the greatest strain, they are spaced more closely. The transverses are cut or notched where they connect on the shell, to allow the longitudinals to pass through. They are strengthened by clips at these points.

LONGITUDINALS ----These run fore and aft from bulkhead to bulkhead, except in the shelter and upper decks, where some are broken by hatch interference. They give strength and rigidity to the framework and shell. They are connected and welded at the flange of the channel to the shell or deck.

BULKHEADS ----The vertical partitions that divide the hull into separate compartments are called bulkheads. Some are watertight. These water-tight bulkheads are so arranged that in case of accident at sea, water would be confined to one compartment only. The collision bulkhead in the front end is constructed to withstand heavy strain and shock in case the bow be staved in.

DOUBLE BOTTOM ----The double bottom extends from the flat keel to the tank top. It is strongly constructed and is water tight so that in case of accident causing an inrush of water into the double bottom, the ship would still be able to keep afloat. The principal parts of the double bottom are the flat keel, vertical keel, floors, intercostal girders, bilge, brackets, tank top, longitudinals, bounding bars and angle clips.

OTHER PRINCIPAL PARTS ----From the tank top to the upper deck the principal parts are: bulkheads, pillars, deep tanks, bulk head stiffeners, girders, brackets, bounding angles, bar clips, shaft tunnel, engine settings, longitudinals, man-holes and covers

LINES DRAWING ----A plan showing, in three views, the moulded surface of the vessel.

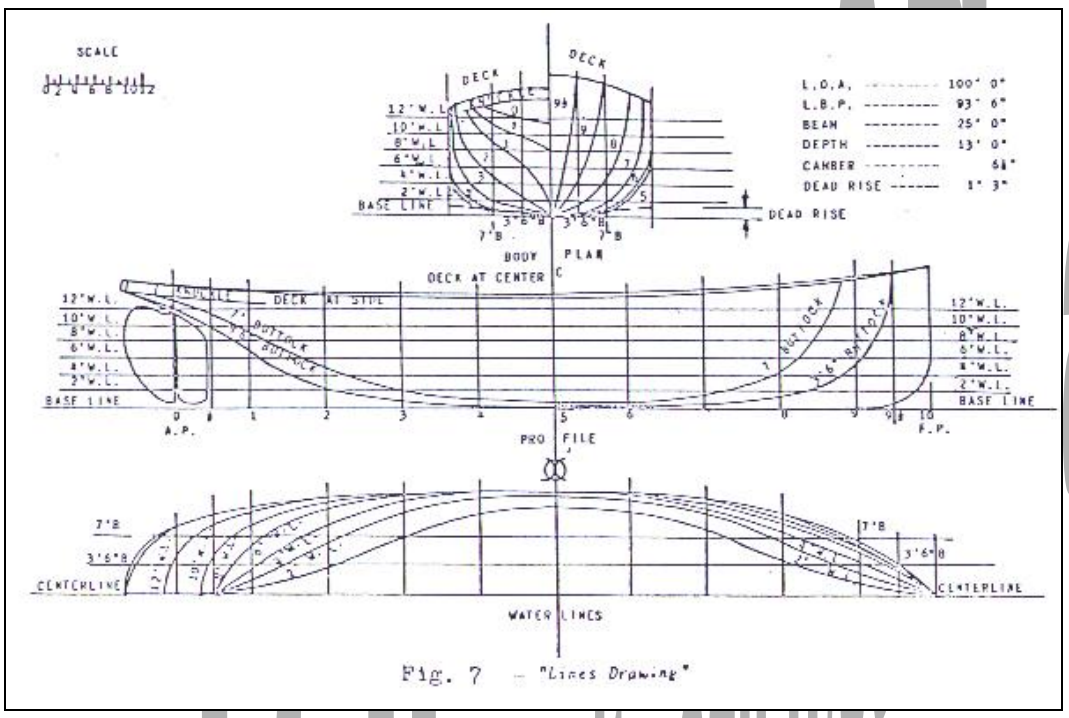
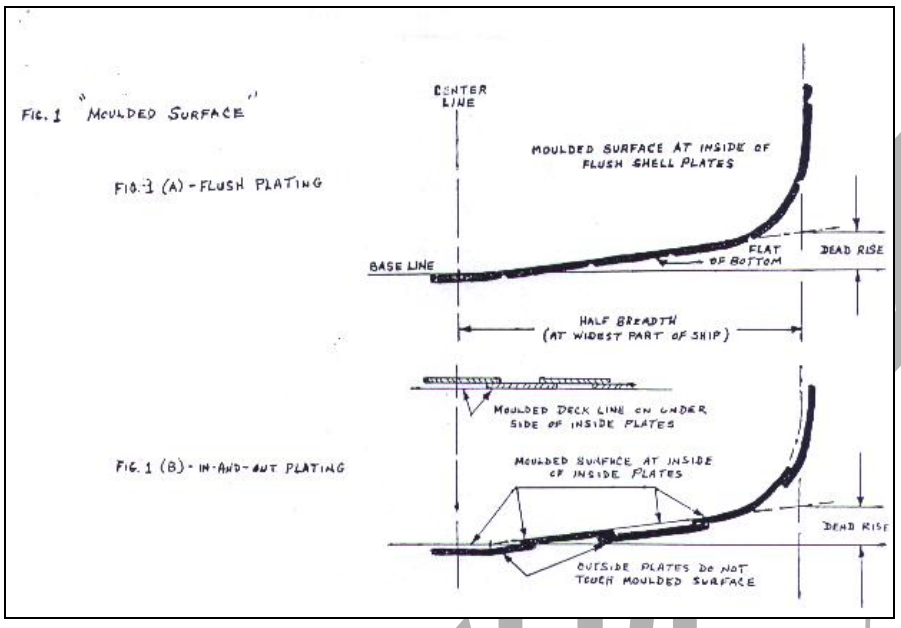
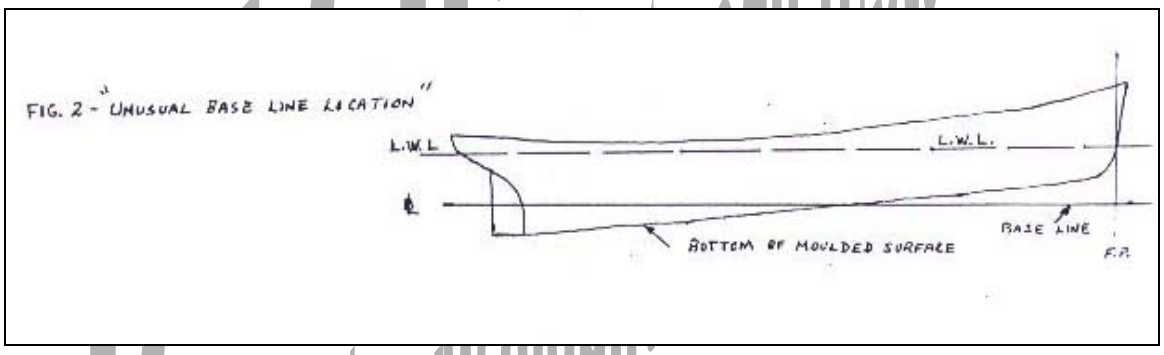


Fig. 7 – "Lines Drawing"

MOULDED SURFACE ----The inside surface of the skin, or plating, of a ship. The moulded surface has no thickness, and is fair and smooth. Actually, when the ship has been built, the thickness of the plating will extend outside of the moulded surface. "Outside" strakes of plating do not touch the moulded surface if they have a liner against the shell frame. The heel of each shell frame is in this moulded surface (unless joggled). It should be remembered that this moulded surface is not an actual part of the ship. It is almost exactly the shape which a thin piece of sheet rubber would take if stretched tightly over the shell frames and main deck beams with no plating in place.



BASE LINE ----A straight horizontal line at or near the bottom of the moulded surface from which vertical heights are measured. Usually, the base line is the very lowest part of the moulded surface. In Fig. 2 is shown an exception.



WATERLINE ----The intersection of the moulded surface with a horizontal plane at a given height above the base line. The six foot water line is exactly six feet higher than the base line.

These intersections are shown in the half breadth plan in the lines drawing. They should not be confused with the "load line" marked on the outside of a ship when built. Shipfitters use a waterline merely as a height above the base line and in this sense waterlines are marked on bulkheads, frames, and other members, for the purpose of properly setting and aligning the structure.

CENTER LINE ----A straight line running from bow to stern, midway between the sides of the ship. All transverse horizontal dimensions are taken from the center line. The center line as applied to a transverse bulkhead is a vertical line in the middle of the ship.

BUTTOCK ----The intersection of the moulded surface with a vertical plane at a given distance from the centerline of the ship. Buttocks are shown in the profile in the lines drawing. Shipfitters use a buttock merely as a distance from the centerline. Thus, they have buttocks marked on bulkheads, decks, foundations, etc., for setting and alignment. The buttocks and the waterlines which are marked on the steel members for regulating and setting are usually of some dimension expressed in even feet. That is, they would mark the 10'0" W. L. (waterline) and the 24'0" Btk. (buttock) rather than a 10'7" W.L. or a 23'6" Btk.

FRAME LINE ----The intersection of the moulded surface with a vertical plane perpendicular to the centerline (transverse plane). Frame lines are shown in the body plan of the lines drawing. They get their name from the fact that shell "frames" or ribs usually are made to this shape and installed transversely in the ship. The lines drawing consists of three views; a half-breadth plan, a profile view, and a body plan (See Fig. 7). These views each show only one side of the ship (usually, the port side), because all dimensions for the starboard are equal and to the opposite 'hand'; that is, the ship is symmetrical about the center line.

PROFILE ---- A view looking at the moulded lines from starboard to port. The waterlines and the frame lines are straight when observed from this direction. The deck line, or "sheer" curve (Figure 4) shows up clearly in the profile, which for this reason is sometimes called the sheer plan.

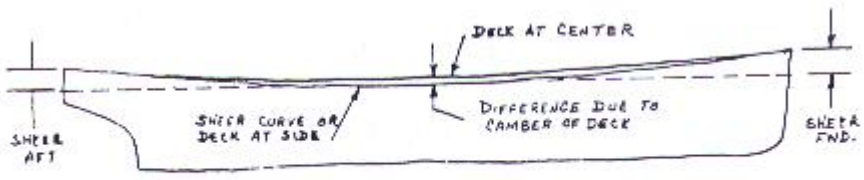


FIG. 4 -- Sheer Curve

BODY PLAN ---- A view showing the shapes of the frame lines. The body plan is made in two parts. The right-hand part is a view looking directly aft at the for'd port side of moulded surface, while the. left-hand part is a view looking directly forward at the after half of the port side. This arrangement prevents the frame lines at the after end from obliterating or fouling the frame lines at the forward end. This view shows buttocks and waterlines straight, while the frame lines appear in their true shape.

HALF-BREADTH or **WATERLINE PLAN** ---- A view looking down on the moulded surface. Here the frame lines and buttocks appear straight, while the waterlines show their true shape. To save space, only the port side is shown.

LOAD WATERLINE (L.W.L.) ---- The waterline at which the ship will float when loaded to its designed draft.

FORWARD PERPENDICULAR (F.P.) ---- A vertical line at the point where the load waterline crosses the foremost part of the moulded surface.

AFTER PERPENDICULAR (A.P.) ---- A vertical line usually at the after end of the rudder post. If there is no rudder post, it usually is taken at the center of the rudder stock.

LENGTH BETWEEN PERPENDICULARS (L.B.P.) ---- The distance from the forward perpendicular to the after perpendicular. To the designers, this length is very important, since upon it largely depends the amount of power needed to drive the ship.

LENGTH OVER ALL (L.O.A.) ---- The total length of the ship from one end to the other, including bow and stern overhangs.

MIDSHIP SECTION ---- A transverse section exactly half way between the F.P. and the A.P. Almost invariably, this is the widest part of the ship.

PARALLEL MIDDLE BODY ---- The straight part at the center of the ship where the water lines and buttocks have no curvature; that is, where all the fore and aft lines are parallel.

DEADRISE ---- The rise of bottom. It is the difference in height between the base line and the point where the straight line through the bottom flat surface intersects the vertical line through the side of the moulded surface at its widest point. (See A and B in Fig. 1; also, Fig. 3) BEAM -- The width of-the ship (moulded surface) at the widest point. (See Fig. 3)

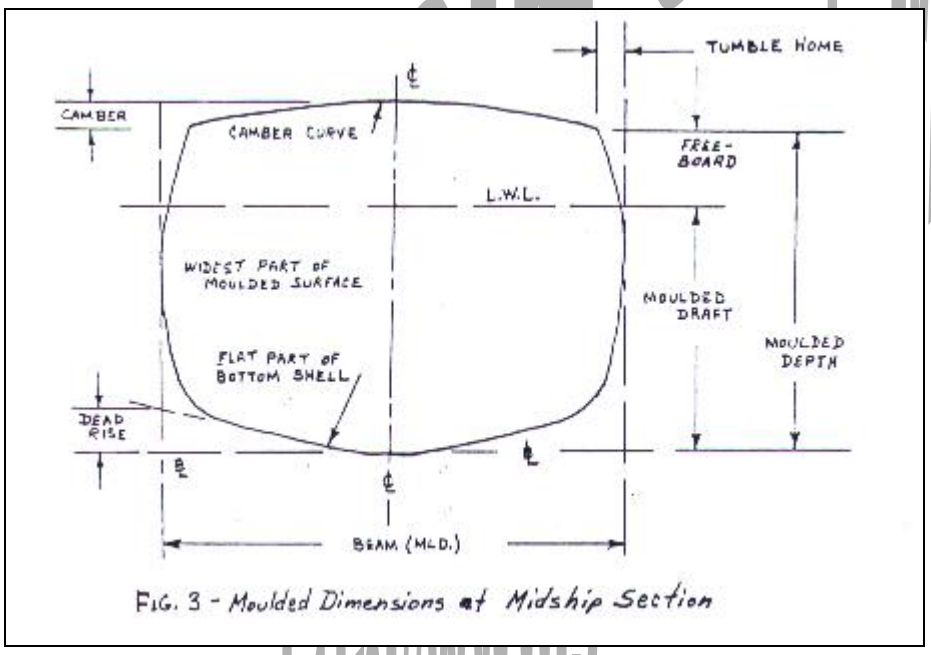


FIG. 3 - Moulded Dimensions at Midship Section

DEPTH ---- The height of the ship at the midship section from the base line to the moulded line of the deck at side (underneath).

DRAFT (Moulded) ---- The height from the base line to the load water line.

FREEBOARD (Moulded) ---- The difference between the moulded depth and the moulded draft. (It is the height of the side of the vessel which is above the water when she floats at her load water line).

CAMBER ---- The curvature of the deck transversely. It is measured by the difference in height between the deck at center and the deck at side.

TUMBLE HOME ---- The amount the top of the side shell slopes back toward the centerline between the point of widest breadth and the deck at side (see Fig. 3)

SHEER ---- The curvature of the deck at side as shown in the profile. The amount of sheer forward is the difference in height between the deck line (at side) amidships and the deck line at the forward end (see Fig. 4) The amount of sheer aft is the difference in height between the deck (at side) amidships and the deck at the after end. The line of the deck at center, in the profile, is higher than the line of the deck at side, owing to the camber, or transverse curvature of the deck. In Fig. 4 is illustrated the difference between the deck at the side and the deck at the center, owing to camber. The camber curve, as usually designed, is a circle of very large radius, but sometimes it is made as a series of straight lines, as in Fig. 5. The camber curve is the moulded line of the deck.

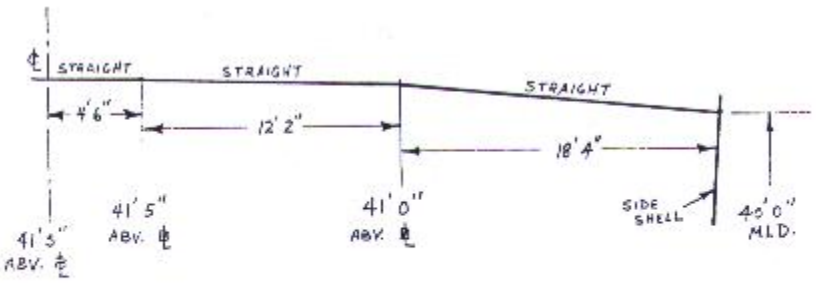


FIG. 5 -- Camber Curve — (Composed of Straight Lines)

MIDSHIP SECTION AND OFFSETS ----The midship section of a ship, as stated before, is a transverse section taken halfway between the forward perpendicular and after perpendicular. Figure 6 shows the midship section of a type of oil tanker, giving the outline of the moulded surface at this section and also the spacing of the shell longitudinals and the longitudinal stiffeners. The camber of the deck is shown, as well as the deadrise and the bilge radius. This shape and spacing applies throughout the parallel middle body of the vessel (in this example, from frame 26 to frame 44, Table X) As illustrated, the shell longitudinals are three feet apart except for one space at the top of the side shell and four spaces in the bilge. The longitudinal bulkhead stiffeners are three feet apart except for three spaces at the bottom. The deadrise is nine inches. The moulded beam is seventy feet. The moulded depth is forty feet. The bilge radius is six feet. The camber of the deck is 1'5" in straight lines. There is no tumble home. The stiffeners (longitudinals) heel inboard on the bottom shell and upward on the side shell and longitudinal bulkhead. In Fig. 7 are given the midship section offsets for this tanker. Offsets are measurements of distance from the base line or from the center line to any point in the moulded surface. Half-breadths are measured transversely from the centerline. Heights are measured vertically from the base line. From the table of half breadths, we see that at frame 26, the 8 foot waterline is exactly 35 feet from the centerline. The 2 foot waterline is only 32' 9-3/4" from the centerline at this frame. (The offset 32-9-6 means 32 feet - 9 inches - 6 eighths of an inch or 32 feet 9-3/4"). From the table of heights, we see that at frame 44 the four foot buttock is only 5/8 of an inch above the base line, and the 24 foot buttock is 6-1/8 inches above the base line. These midship section offsets apply from frame 26 to frame 44, which is the extent of the parallel middle body. Table X shows the offsets for the tugboat whose lines are illustrated in Fig. 7. At each frame station are tabulated the half-breadths for the 2-foot, 4-foot, 6-foot, 8-foot, l0-foot and 12-foot waterlines, and also for the deck at side. The heights of the 3'6" and 7'0" buttocks are also given for each frame station from #0 to #10. The table of offsets for an ordinary cargo ship or tanker consists of many pages and usually includes the following items: profile, frame spacing, midship section, camber curves, stem and stern profile, rail profile, detail of frames at bossing, half-breaths, heights, and sight edges. Sight edges are the longitudinal edges of shell (or deck) plates which are visible on the outside of the

hull. It should be remembered that in practically all ships. the frame spacing is different in different locations, and before taking any measurements a drawing should be consulted.

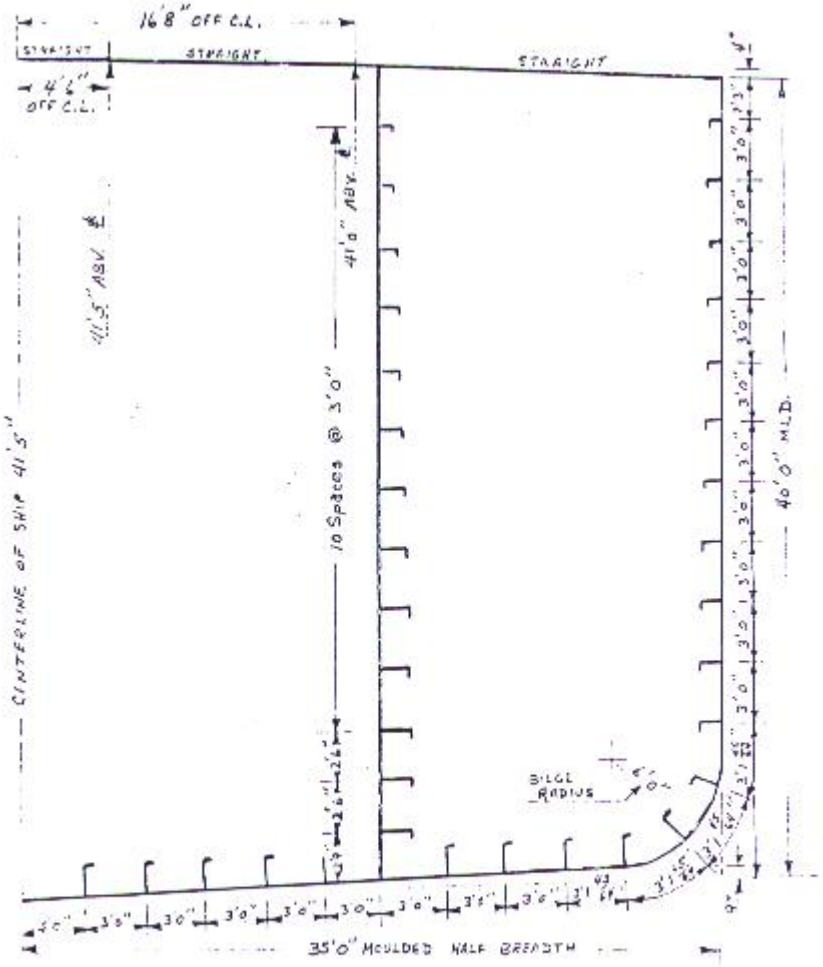


FIG. 6 -- Midship Section of an Oil Tanker

Table X -- Midship Section Offsets

HALF-BREADTHS ON WATERLINES AND DECKS					
Frame	2' W.L.	4' W.L.	8' W.L.	12' W.L.	16' W.L.
26-44	32-9-6	34-4-5½	35-0-0	35-0-0	35-0-0
Frame	20' W.L.	24' W.L.	28' W.L.	32' W.L.	36' W.L.
26-44	35-0-0	35-0-0	35-0-0	35-0-0	35-0-0

HEIGHT ON BUTTOCKS & DECKS					
Frame	4' Butt	8' Butt	12' Butt	16' Butt	20' Butt
26-44	0-0-5	0-1-6	0-2-6½	0-3-7½	0-5-0
Frame	24' Butt	32' Butt	UPDK-SIDE	UPDK C. LINE	
26-44	0-6-1	1-5-3	40-0-0	41-5-0	

LOCATING FRAME LINE AT BULKHEAD ----When it becomes necessary to set a transverse bulkhead or other member by means of a frame line marked on the adjacent members, the frame line must first be determined at the bulkhead itself. (See Fig. 8) In other words, it must be found out whether the face side (smooth side) of the bulkhead is to be directly on the moulded line, or whether the stiffener side of the plating is to be on the moulded line. This information must be obtained from the drawings. No specific rule will cover all cases, and the frame line is sometimes on the forward side of the bulkhead, and sometimes on the after side. In case of a discrepancy between two drawings showing the same member (for instance if the shell drawing shows the bulkhead plating aft of the frame line, while the bulkhead drawing shows the plating thickness forward of the frame line) the shell plan shall be assumed correct for the purpose of setting the bulkhead.

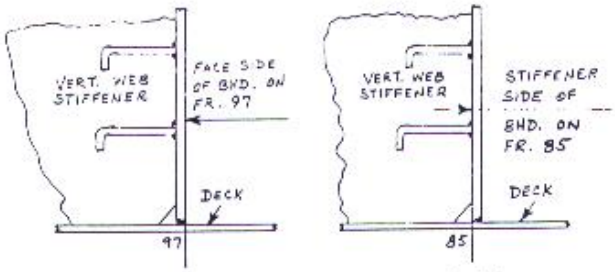


Fig 8 -- Examples of Frame Line Location for Transverse Bulkhead

CORRUGATED BULKHEADS ----In setting the more recently adopted type of corrugated bulkheads, as in Fig. 9, the drawing must be consulted for location of frame line. Here the moulded line may be on either the face side or the stiffener side of the bulkhead, at the extreme width of the web bulkhead stiffeners. In this type of corrugated bulkhead, the depth of the corrugations varies at different heights on the bulkhead. The deeper corrugations at the bottom supply the increased bulkhead stiffness which is required owing to greater pressure of water (or other liquid) in the lower part of the tank.

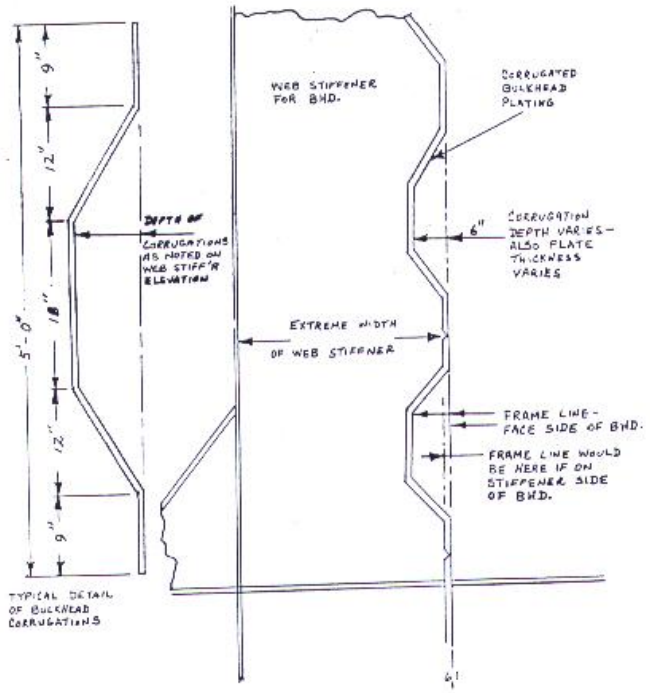


Fig 9 -- Frame Line Location at Corrugated Bulkheads

SCRIBING AT CORRUGATED BULKHEAD ----When it is necessary to scribe a large bracket or other plate to fit in the corrugations of a bulkhead, the following precautions must be taken to assure a neat fit. The bracket shown in Fig. 10 must be scribed off to move 2" to the left. If there were no corrugations, this would be a simple matter of marking a vertical line on the bracket with a 2' spacer to give the proper cut.

This line would be similar to that shown at "a" and at "c" in Fig. 10. However, the sloping sides of the corrugations, as at "b" and "d" cannot be marked off with the same 2' spacer, because the opening thus burned out would be too large. The measurements for scribing at the sloping surfaces (that is at "b" and "d") must, therefore, be taken in a horizontal direction as shown.

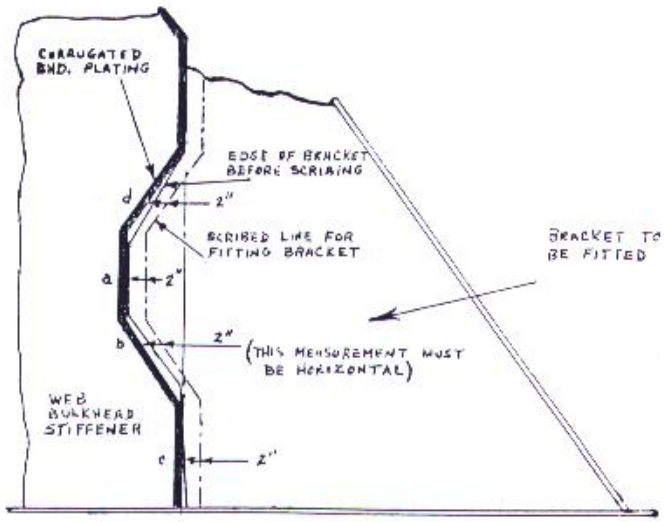


FIG. 10 -- Scribing a Plate to Fit Bulkhead Corrugations