position; but the process of copying the frame lines on it is one of measuring on battens the ordinates of their intersections with water and diagonal lines, and is the same in either case. All of the frame lines are shown on the scrive-board, and the complete section of the frame surface for both sides of the ship is shown at each station. To avoid confusion of lines, either a separate board is used for the fore and after bodies, or they are drawn on the same board with their centre lines parallel and a few feet apart, and one of the two bodies inverted. All the lines already referred to as having been laid off in the body plan on the mould loft floor, including the lines of outer edges of all transverse frames, the inner edges of all in the double bottom, and the upper edges of all floor plates outside the double bottom, the projections of plate edges of inner and outer bottom, and of longitudinal frames and main longitudinal bulkheads, pro­jections of beam at side lines for all decks, and of the intersection of the beam surface of the protective deck by the plane of each frame, are copied on the scrive-board and rased in on its surface. The scrive-board thus gives complete information of the shape and dimensions of every part of each transverse frame. To completely define the frame the “ bevelling ” is required in addition, that is the angle between the two flanges of the angle bar on the edge of the frame connecting it to the outer or inner bottom plating. The bevelling is usually given at the plate sight edges; but any other convenient bevelling spots may be chosen and their positions marked on the frame lines. To obtain the bevelling at any spot a normal is drawn to the frame line in the body plan at the spot; the distance from the frame line is measured along this normal to its intersection with the next frame line towards the midship section, and this distance is set up as one of the sides containing the right angle in a right-angled triangle of which the frame space is the base. The angle of this triangle opposite the base is the supplement of the bevelling of the frame at the spot considered. When the curvature of the bottom in the plane normal to the square station at the bevelling spot considered is sensible in the length of a frame space, the normal distance measured is that between the two frame lines on either side of that at which the bevelling is to be obtained, and the base of the triangle is made equal to twice the frame space. The bevellings for each frame are marked on a bevelling board, the angles between the straight lines marked on the side of the board and the straight edge of the board representing both the bevelling and its supplement. In the frame bars there is no doubt as to which of these two angles the workmen are to regard as the true bevelling, since the flanges of the frames are all turned towards the midship section, so as to make the true bevelling always greater than a right angle, or “ standing ” as it is usually expressed, in contradistinction to “ under ” bevelling, which is less than a right angle.

Special bevelling frames are used in marking the bevelling boards, by which the construction of the triangles is reduced to setting off the normal measurement between the frame lines and drawing the hypotenuse directly on the bevelling board. The flanges of the angle bars on the inside edge of the frame, or the “ reverse ” frame bars, usually point the same way (that is towards the midship section) as the flanges of the frame bars, throughout the double bottom, in order to facilitate the construction of the bracket frame. Where the breadth of the longitudinals is constant, therefore, the bevelling of these angles on the inner bottom is the supplement of that of the frame angles. But throughout the double bottom neither bevelling differs much from a right angle. When the longitudinals taper in breadth separate bevellings must be taken for the inner angles by a method similar to that already described for the frame angles. Outside the double bottom the reverse angle, or inner part of the split zed bar, is cither unconnected to anything but the floor plate, or else connects to a horizontal flat, and does not require bevelling.

The bevellings of the short angle bars which connect the bracket or floor plates of the transverse frames to the longitudinals are also obtained by measuring in the body plan at the middle of the inter- section of the longitudinal surface with the plane of a frame station the normal distance to its intersection with the plane of the next frame station, and setting it up as one side of a right-angled triangle of which the frame space is the base.

To check the spread oí the transverse frames during their erection, half-breadth staffs and height oí breadth staffs are issued from the mould loft, or their lengths may be taken off the scrive-board. These give the coordinates of the intersections of the longitudinal sight edges with the frame lines, referred to the middle line of the body plan and a level line through the underside of the keel at each station. The frames are brought to and held in their correct positions as shown by these staffs by shoring them in the vicinity of the longitudinals.

Shoring ribbands are not universally employed, the longitudinals at some shipyards being relied upon to keep the transverse frames in their correct relative position while framing the ship. When they are used, one is usually placed a few inches below and parallel to each deck edge and longitudinal sight edge. For the ribbands under the deck edges, the beam at side line is projected into an uncontracted half-breadth plan, a flexible batten is ent to the line, and on it are marked the positions and directions of the ordinates representing the traces of the planes of the frames. The ribband batten is then used to mark the positions of the frames on the ribband itself, generally made of pitch pine about 6 in. square in section. The position where the upper edge of the ribband is to come is marked on the scrive-board and the marks' transferred to the frame angles when they are bent. When the frames are erected at the ship they are brought into their correct positions as shown by the marks on the ribband, the upper edge of which is kept to the marks on the frames. The frames and ribband are temporarily secured together, until the plating is fitted, and the whole kept in its proper position by shores. The ribbands under the longitudinals lie for practical purposes in diagonal planes, which must be rabatted in order to get the positions and directions of the frames correctly marked on the ribband battens. The ribbands arc marked, secured to the frames and shored, similarly to those under the deck edges.

A beam mould is prepared for each deck, the upper edge of the mould showing the round down or camber of the longest beam in relation to a level line marked on the mould. The mould is applied to the body plan on the mould loft floor or on the scrive-board in its correct position at each frame station and the ends of each beam are marked on it, the ends being short of the frame lines by an amount which varies with the nature of the frame, but sufficient in any case to clear the inside of the flange of the frame bar. Bevelling-boards are supplied showing the angle at each frame station between the upper edge of the beam and the frame line for guidance in forming the beam arm, which is usually two and a half times the depth of the beam, and the form of which is shown by a separate mould. When placing the beams in position at the ship their height is given by the beam end lines shown on the scrive-board and transferred to the frames when bent to the lines on the scrive-board.

The beam mould for the armour deck shows the length of the sloping part and the shape of the knuckle, with only a short length of the middle horizontal part. On the horizontal arm of the mould vertical lines are drawn at a given distance from the middle line at each frame station.

It is essential that the shape of the longitudinal frames should be obtained with considerable accuracy, especially when half­breadths and heights measured to their sight edges are largely relied upon for keeping the transverse frames to their designed spread during erection.

As already stated, the longitudinal surface does not much differ from a surface generated by the normal to the ship’s surface as it travels along the curve of the longitudinal sight edge. The surface generated by the normal is developable provided the sight edge is a line of curvature, which is approximately ensured by the method of drawing it, and it is found by experience that no error of practical importance is involved in developing the surface of the longitudinal by the following approximate method.

Fig. 108 shows part of the body plan in which the frame lines are numbered 1 to 7, the projection of the longitudinal sight edge is shown by *a b c d e f g,* and the projections of the traces of the longitudinal surface with the planes of the frames are shown by the straight lines *a1 aa2, b1 bb2, c1 cc2, &c.*

The curves *a1 b1 c1 d1 e1 f1 g1* and *a*2 *b2 c2 d2 e2 f2 g*2 both cut all the traces at right angles, so that they are involutes of their envelope. Their positions are chosen at convenient distances beyond the inside and outside of the group of frame lines, which defines the length of longitudinal which is to be developed in one operation.