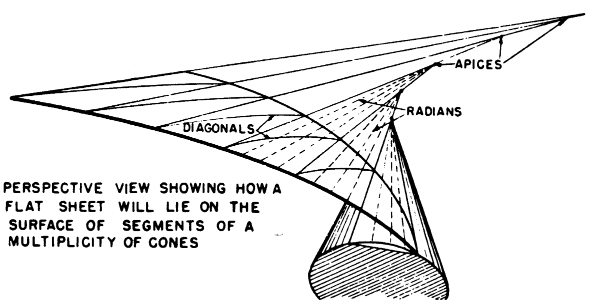
S.S.Rabl:

MULTICONIC DEVELOPMENT OF HULL SURFACES*

Any hull surface intended to be covered with sheet material—either metal, plywood or plastic, must be "developable." To be developable it must be either flat or curved to the surface of a cylinder or cone. Most developable hull surfaces are conic. The popular conception of conic development is that the designer must choose one edge of his hull surface, select an apex point and design the other edge of the surface so that it will intersect radians to this apex. Thus, with a hull bottom as an example, either the keel or chine lines are drawn and the shape of the opposite line determined by intersections with radians to the selected apex. This limits the designer to the choice of one line only.

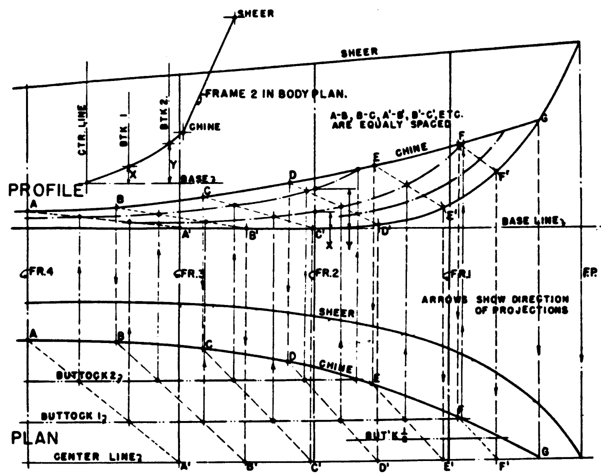
The geometric theory that any curved line is composed of a multitude of short straight lines can be elaborated for hull surface development by the concept that the hull surface is composed of segments of a multiplicity of cones having adjoining radians in common and whose apices lie somewhere out in space. For development purposes the location of these apices has no bearing on the final result. Figure 1.



~Figure 1~

To use the multiconic method, the designer lays down his lines in the time honored mode of drawing his profile and plan views. The next step is to draw the radians. As a general rule, the midship station is selected as the starting point and the first bottom radian A-A′ is drawn to the first or second frame forward of this. Figure 2.

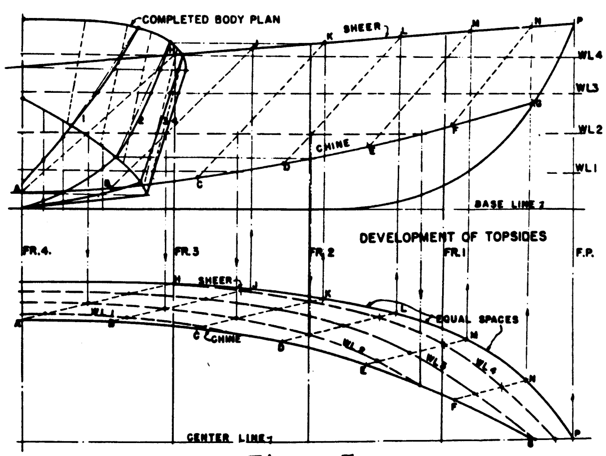
From the endings of this first radian in the profile the chine and keel-stem lines are divided into a number of equal spaces A to G and A′ to G. These points are then connected with



~Figure 2~

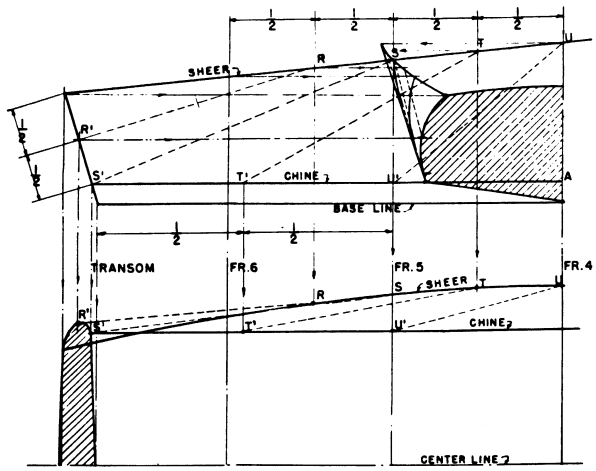
additional radians B-B′, C-C′, D-D′, E-E′, and F-F′. This equal spacing is for convenience only. In reality the radians may be spaced at random, the only requisite being that they follow a pattern similar to the ribs of a fan. From the profile these lines are projected to the plan as shown.

Convenient buttock lines are now drawn in the plan and their intersections with the radians projected back to the



~Figure 3~

* By Samuel S. Rabl; reprinted by permission of the Society of Small Craft Designers, Inc., from that organization's periodical, *The Planimeter*, March 1958.

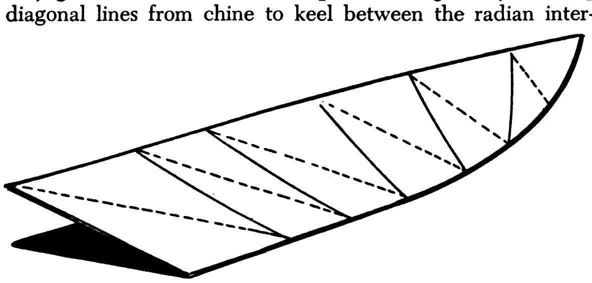


~Figure 4~

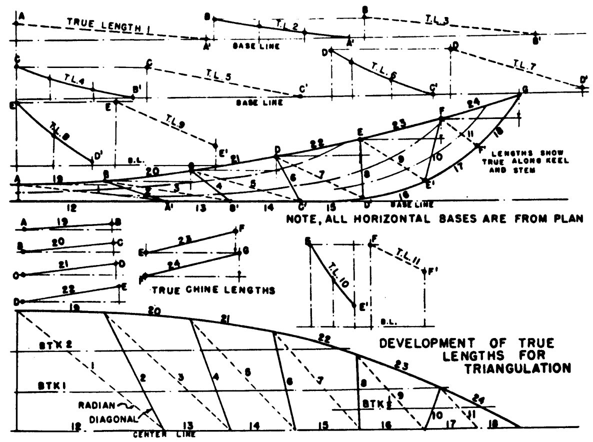
profile. From these intersections the trace of the buttocks may now be drawn. From the buttock heights in the profile, the shape of the bottom frames may be determined. (Example —X and Y on Frame 2.)

For topside development, water lines are used in lieu of the buttocks. Figure 3 and Figure 4.

It is often necessary to predetermine the shape of the hull covering sheets. This process is called "development." It is from this process that the expression "developable hull surfaces" originated. One of the more simple methods of development is "triangulation." To develop a hull surface by triangulation the surface is first divided into a series of adjoining triangles. Figure 5. The original radians, being straight, form very good sides for these development triangles. By drawing diagonal lines from chine to keel between the radian intersections, the surface is "triangulated" for development. Figure 6.



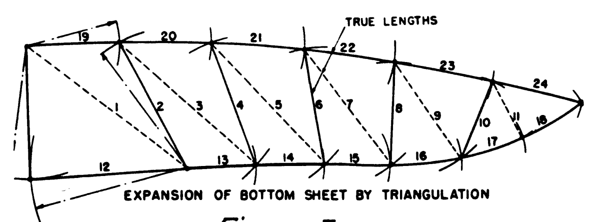
~Figure 5~



~Figure 6~

To lay out or "develop" the hull surface the true lengths of all sides of all triangles must be determined. This is accomplished by the use of right triangles. The length of one side of these triangles, as they appear in the plan, is used for the base and their differences in elevation, as they appear in the profile, is used for the altitude. By laying out these two lines at right angles to each other the length of the hypotenuse, which is the true length, is determined. The true lengths are now used as radii of arcs which are intersected to form the final flat expansion. The diagonals, which are curved, are determined from the buttock intersections much in the same manner as the frames. Their true lengths are determined by girthing the curve. By building up the triangles in a continuous line, the final shape of the sheet is determined. Figure 7.

While this method has been in use in the shipbuilding and aircraft industry for many years, it seems to be very little known by the small craft designers who need it most.



~Figure 7~