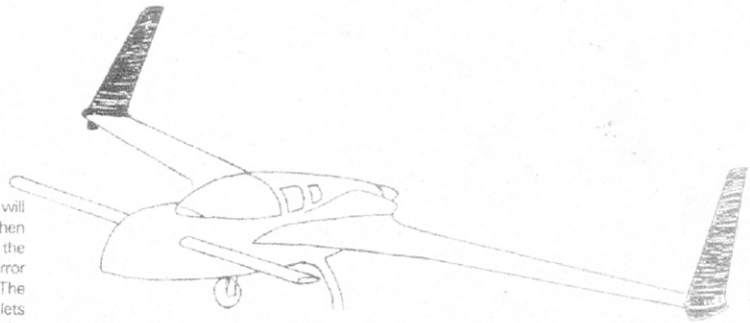
CHAPTER 20
WINGLETS AND RUDDERS

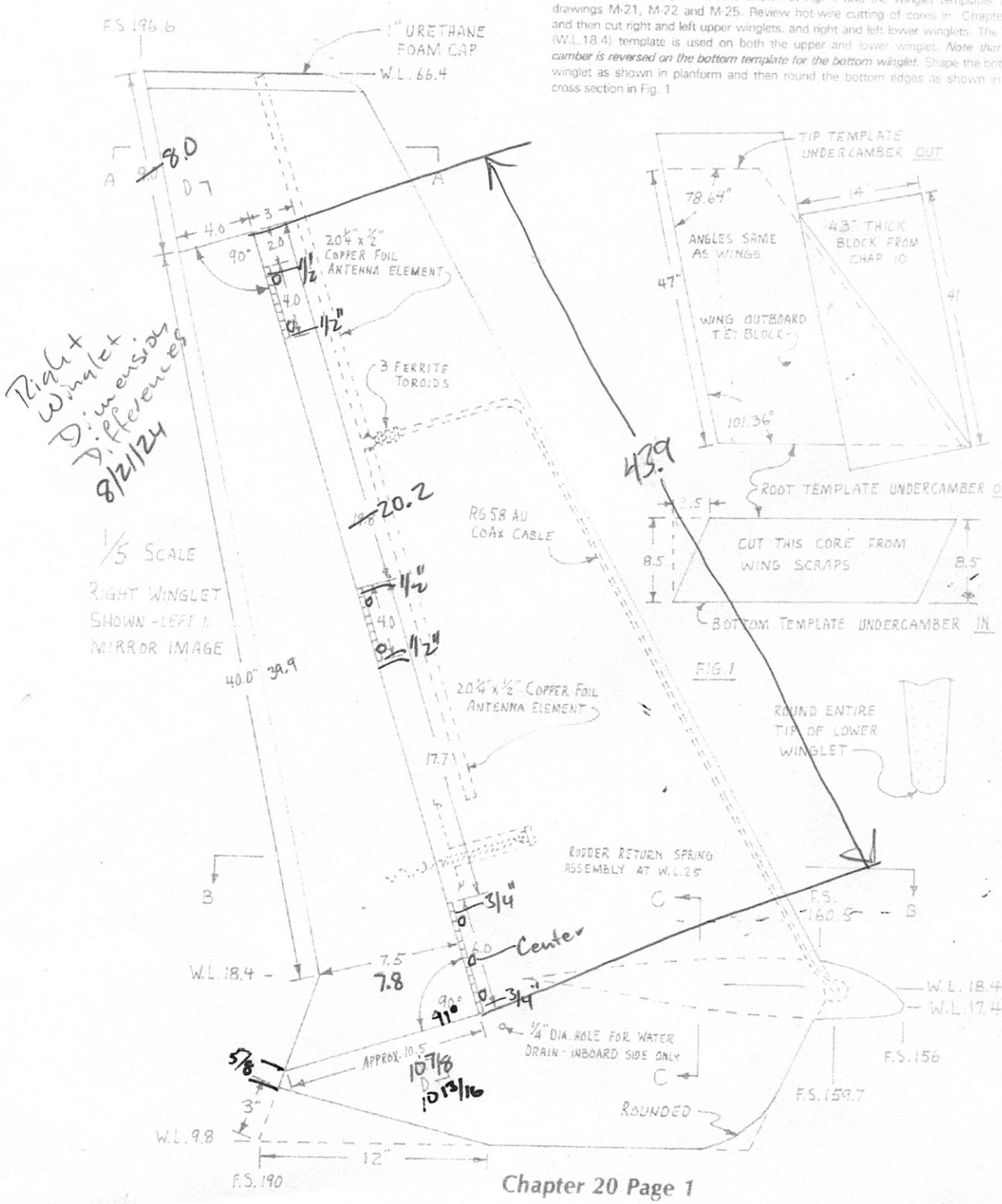


OVERVIEW

In this chapter you will build the NASA Whitcomb winglets. You will carve and glass the cores, install the top winglet on the wing, then install the bottom winglet, cut out the rudders and hook up the rudder controls. The right winglet is shown. The left is the mirror image. The upper winglet has ***undercamber facing outboard.*** The lower winglet has ***undercamber facing inboard.*** In flight, the winglets eliminate the vortex rotation which normally occurs at a wingtip. This increases the effective aspect ratio, and results in increased efficiency in climb and cruise.

STEP 1. CUTTING THE CORES

Round up the polystyrene blocks shown in Fig. 1 and the winglet templates from drawings M-21, M-22 and M-25. Review hot-wire cutting of cores in Chapter 3, and then cut right and left upper winglets, and right and left lower winglets. The root (W.L.18.4) template is used on both the upper and lower winglet. ***Note that the camber is reversed on the bottom template for the bottom winglet.*** Shape the bottom winglet as shown in planform and then round the bottom edges as shown in the cross section in Fig. 1



Right Winglet Dimension Differences 8/21/24

STEP 4. BELHORN LAYOUT

On the inboard surface of the winglet, the layout of the top rudder cut line and the "vertical" (i.e. parallel to the hinges) line were drawn as shown on page 20-1 of the plans. (Figure 9A) The vertical line was extended an inch or so farther down toward the bottom of the winglet. A perpendicular line was then drawn from the vertical cut line so it ran about 1/8" below the wing TE. (Figure 9B) (The 1/8" dimension was specific to the geometry of my conduit cove relative to the TE.) This line represented what would be the bottom of the rudder core (i.e. the mounting surface for the belhorn), as well as the top of the belhorn fork. The objective was for the belhorn to be mounted to the bottom of the rudder core such that the rudder cable ends up in the aft part of the conduit cove when the rudder is fully deflected. A parallel line was then drawn about 0.75" further down, which would be the bottom rudder cut line. This 0.75" offset provided for the glass-to-glass bond in layup #6 of the plans. (Figure 9C) The three rudder cut lines were now complete (Figure 9D) and were copied to the other side of the winglet.

Note: This bottom cut line is a bit lower than the plans location in order to provide a sufficient flange for the layup that will cover the belhorn and form a glass-to-glass edge at the skin. In an installation where the rudder has already been cut according to the plans and layup #6 completed, attachment of the belhorn will reduce the height of the remaining flange and the glass-to-glass bond of the layup that will cover and retain the belhorn. But it may still be possible to mount the belhorn at the bottom. It depends on the particular geometry, but if the glass-to-glass bond of layup #6 was done correctly, then it should be providing the required strength at the bottom of the rudder. In that case, the primary function of the additional layup over the belhorn would be to keep it secured to the rudder, so a narrower G-to-G bond might be adequate.

Figure 9

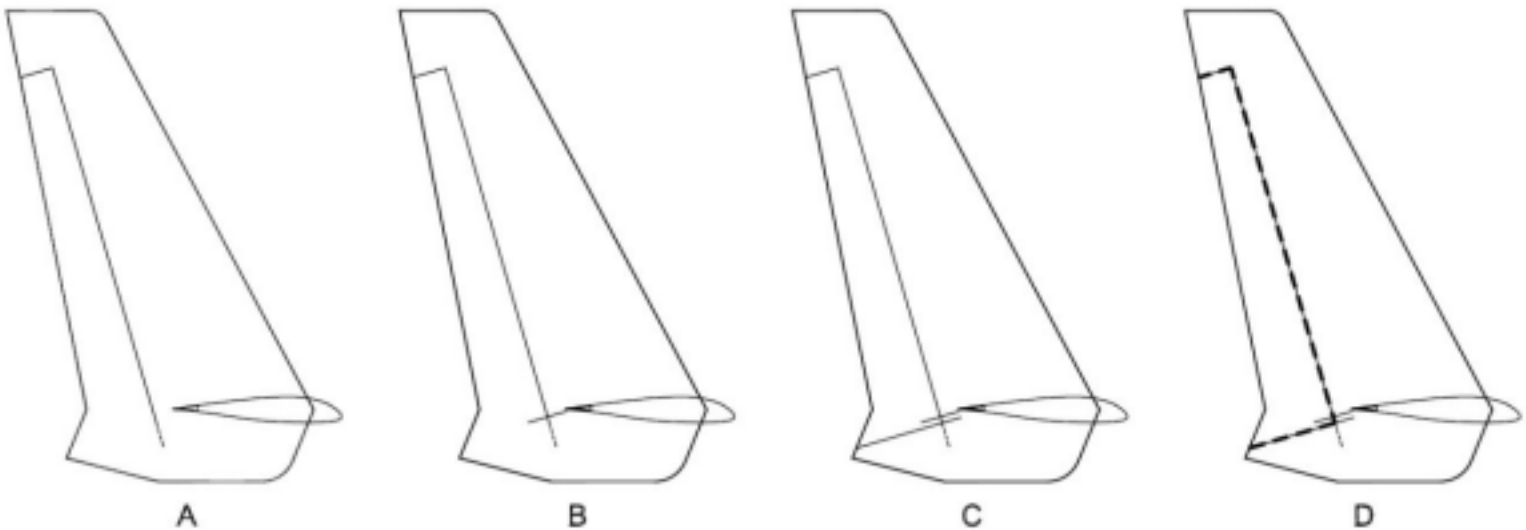


Figure 9