POWERED SAILPLANE

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Fuselage

The fuselage, in the plan view, is divided into two parts. The forward section, which is elliptical, fairs into a straight-tapered section which forms the rear portion. The cross-section is circular throughout. The fineness ratio is 8.11. This geometry was chosen because of its simplicity in reference to lofting, layout, tooling and fabrication. The lofting and layout problem was reduced to a minimum in that a simple mathematical system could be used for the master loft lines and general layout. This geometry possesses good aerodynamic qualities and also reduced the time required for the strength analysis of the basic structure.

The basic structure is of semi-monoque design and is of all metal construction. The forward section skins were stretch-formed to compound curvature on an epoxy resin impregnated fiberglas stretch die. The rear section skins were taper-rolled to shape. The landing gear is composed of a fixed main wheel which carries the major landing loads, and a small steerable nose-wheel. The turning radius is equal to the semi-span and turning is controlled through the rudder pedals. The main wheel and attach structure meet CAR 05.241 requirements, while the nose-wheel installation is covered by CAR 03.245.

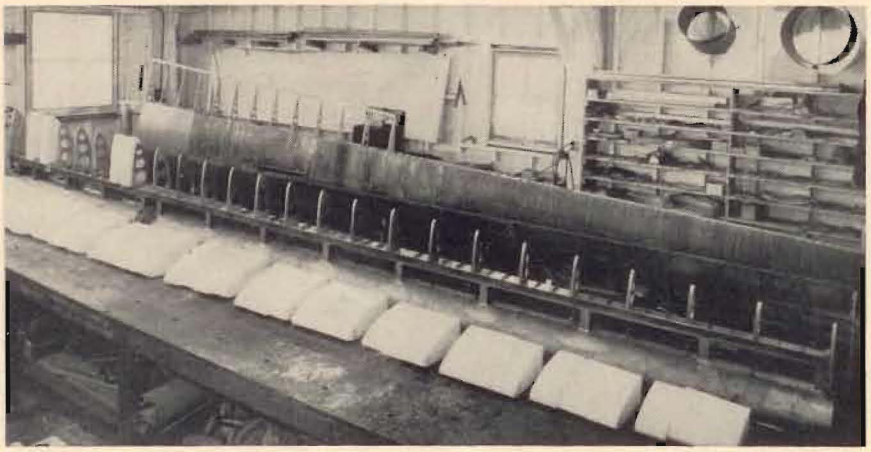
The flight station is of the tandem seating arrangement and is fitted with dual controls and instrumentation. Body-contoured seats are installed for pilot comfort. The cockpit enclosure is a one-piece stretch-formed Plexiglas covering. The entire control sytem is fitted with ball bearings throughout and is cable actuated aft of the flight station.

An interesting sidelight on the comparison of all-wood construction vs. all-metal construction developed from this project. The original prototype fuselage was constructed of wood and offered an interesting evaluation. It is estimated that the wood design and layout involved almost one-third less engineering and layout time. Broader tolerances, simpler form blocks for bulkhead fabrication, ease of fairing and contouring of stringers and frames, and the simplicity of modification required less detail design and layout. In production, of course, wood has many drawbacks.

Empennage

Vertical Tail

The vertical tail is conventional in design using a rudder constructed of wood and covered with fabric. A VHF radio antenna is built integral with the rudder. The leading edge of the vertical fin also includes the use of "Styrofoam." Only two ribs are used in this leading edge structure, one at the root, the other at the tip. Preformed 2024T-3 skin is used for covering. Bending loads are carried by two beams which project into the fuselage and become frame members also. The rudder controls are so designed as to permit removal of the rudder without disturbing the control rigging.



At this advanced stage of construction are shown the Styrofoam pieces cut to rough size. After insertion in the leading edge, they are contoured to shape.

Horizontal Tail

The horizontal tail uses the NACA all-movable design and has proven to be remarkably efficient. The flight characteristics are excellent. Prediction of hinge moment (and stick force) from wind tunnel data has proven to be very reliable using this type of unit.

A wide range of control "feel" and effectiveness can be obtained by proper selection of tab area and by controlling the gearing ratio of tab deflection to total horizontal surface deflection. This system can be either a fixed design or a type which is adjustable in flight. A fixed arrangement is, however, usually sufficient for the flight speed ranges of conventional sailplanes. The tab is also used for longitudinal trim control. Reference 9 gives more detailed information. The horizontal tail consists of two surfaces divided at the center by the fuselage. Both surfaces attach to and are driven by a common torque tube projecting from the fuselage. The surfaces are removable for trailing purposes. The controls remain rigged at all times.

In planform the surfaces are slightly tapered, the ratio $C_t/C_r = .625$. The primary hinge line is at the twenty-five per cent chord element line. The tab hinge line is located at the eighty per cent chord element line of the root airfoil and projects normal to the plane of symmetry.

The construction of this unit, too, uses "Styrofoam" in the leading edge "D" section and has but two ribs also.

The construction of each unit consists of a box beam for supporting the primary loads and includes quick-attach fittings at the root section. The rear portion of the surface uses hydroformed ribs and is fabric covered except for the tab which is all metal. The assembly is full static-balanced by an internal counterweight. Polyester resin impregnated fiberglas is used for fabricating the tail cone fairings.

Flight Characteristics

The flight handling and stability characteristics of the "HUMMINGBIRD" have proven to be satisfactory during take-off, climb, level flight, dive, and landing with or without power. Transition from one flight condition to another can be accomplished smoothly with no abnormal or exceptional use of the controls.

The elevator control shows a stable stick force gradient throughout the trim speed range from the stalling speed, V_{so}, to the design dive speed, V_E. Short period oscillations are heavily damped.

Stall behavior is normal with a downward pitching motion occurring at the stall in straight or curvilinear

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