

LOUDON SAILPLANE

UTG 1

The following pages contain excerpts from an article concerning the Loudon project which has been prepared for publication by Messrs. Czerwinski and Shenstone, the senior designers on the project; and certain other notes to assist prospective builders of the sailplane to evaluate the problem.

The tracings are held by the Soaring Association of Canada (Box 851, Ottawa, Ontario) and are available for the cost of printing plus a small handling charge which will bring the total to about \$25. Bona fide amateur constructors will be encouraged to build the machine on entering into an agreement with the Soaring Association of Canada to this effect.

A technical description of the Loudon sailplane follows:

A. GENERAL

The University of Toronto Loudon is a Canadian designed advanced training sailplane. The prototype first flew in November 1949, and since that time has obtained several successes. The most outstanding are:

- 1950 F.H. Brame's flight cross country 118 miles
- 1952 J.W. Ames's goal flight cross country 76 miles
- 1952 P.B. Tingskou local flight 5 hours 18 m.
- 1952 P.B. Tingskou flight cross country 80 miles
- 1952 J.W. Ames's flight in Elmira 5 hours 4 m.
- 1953 P.B. Tingskou two cross country flights of over 40 miles

The total time flown up to the end of 1953 was over 200 hours.

The Loudon was designed to fulfil modern requirements for an advanced trainer and proved to be much superior in performance and handling qualities to pre-war parallel types, such as the British Cadet and the German Grunau Baby. A good advanced trainer today should combine fairly good cross country flight performance with good low speed characteristics, permitting the less experienced pilot to stay in the air sufficiently long in average weather conditions. It should be especially suitable to cover the performance required to obtain the Silver "C" Certificate.

The structure should be sturdy enough to withstand many landings and short distance transport and simple enough to guarantee a reasonably low production price. It should be restricted to standard material and simple production methods in case someone wants to build it at home or in a private workshop. As might be expected, in view of the required performance, the Loudon's wing has the moderate span of 45 ft. and aspect ratio of 11.6. The airfoil section used in NACA 4416 over the rectangular portion of the wing with a linear transition to NACA 6412 at the tip. The geometric washout at the root is 4° which assures a good over-all low drag wing characteristic.

The wing plan form, consisting of rectangular central part and moderately tapered tips, gives a close approximation to the elliptical shape required for obtaining a good aspect ratio efficiency, although, of course, the twist has also an important influence on the effective aspect ratio.

B. THE WING STRUCTURE

The left and right wings are connected together by a transport joint at the fuselage. It consists of an inverted V-shaped welded fitting bolted permanently to the fuselage main bulkhead, to which the left and right wing spar-root fittings are pinned, plus a simple rear attachment fitting, bolted to the rear fuselage bulkhead. The wing spars are attached to the V-shaped fitting by four pins (two on each side) which take the whole bending moment. The two pins aft of the spar in combination with the lower forward pins take all loads and moments acting in the plane of the wing. For the sake of simplicity and stiffness, all the forces acting in the plane of the wing plus torsion are taken by a welded steel tube tripod bolted to the spar which has a D nose type leading edge. Thus, a very simple scheme was devised which was easy to manufacture, design and stress. The D nose leading edge structure consists of simple ribs covered with diagonal birch plywood in order to obtain the maximum torsional rigidity. The nose ribs of semi-triangular design are spaced 6" apart. The portion of the wing aft of the main spar is fabric covered over the ribs spaced 12" apart. The dive brakes are located a few inches aft of the main spar and consist of metal plates operating on the upper surface of the wing only, hinged to steel brackets and actuated by cables.

The ailerons are of conventional diagonal rib design, operated by cables connected to an independent bellcrank system in each wing. The ailerons have differential, deflecting 30° up and 15° down. The wing tips are equipped with small steel tube skids, which protect the wing tips when operating the glider from paved runways and provide a very convenient handle for ground crews.

C. FUSELAGE

The fuselage is built entirely of wood. Spruce and birch were used for frames and other structural members, and birch plywood for skin and webs. The fuselage is of conventional semi-monocoque design having a load carrying skin with longerons, frames and stringers. A special method of covering the fuselage frames with plywood was developed in which the fuselage skin was scarf-jointed into long bands (strips) to cover almost the full length of one quadrant of fuselage. Before final gluing, the front portion of these strips was pre-formed to suit the greater double curvature of fuselage in the cockpit region. Thus, an almost perfectly smooth shell was obtained which took much less working time to assemble.

The plywood covering has the grain arranged at 45° to the fuselage axis in order to ensure the greatest possible torsional stiffness. The pilot's seat and single wheel undercarriage axle are supported on two beams arranged between the corresponding frames or bulkhead. The pilot's floor is removable which allows easy cleaning of the cockpit interior.

The tail unit attachment consists of a horizontal slot in the fuselage into which the stabilizer is inserted and held firmly by two bolts, joining the upper fin post with the lower portion through the tubular fittings attached to the rear face of the stabilizer spar. This sort of attachment proved to be very simple and sturdy. The front short spar of the stabilizer is clamped between wooden blocks arranged on top and bottom in the fuselage slot.

The undercarriage consists of a wheel located behind the main bulkhead and the skid mounted underneath the pilot's seat. The skid is elastically supported by a rubber air-inflated tube, enclosed between two fabric strips permanently attached to the fuselage and the skid. The tow hook is of the Ottfur type, arranged right in the nose of the fuselage. The tail skid is made of steel and is fitted with a small wheel for easy operating from paved runways.

D TAIL UNIT

The tail unit structure was designed along more conventional lines, except for the already described horizontal tail-fuselage attachment. The elevators of diagonal rib design are joined by means of a short piece of steel tube, to which a control horn is attached. The rubber has a light alloy control horn, having the main spar recessed to accommodate the elevator axis, and is hinged to the fin post by two fittings. The stabilizer and fin are plywood covered; the elevators and rudder are covered with fabric.

E CONTROLS

The elevators and ailerons are operated from a control unit consisting of a horizontal tube mounted underneath the pilot's seat, to which a control stick and V-shaped aileron bellcrank are attached. The control stick is directly connected by means of cables to a bellcrank in the rear portion of the fuselage, from which the elevators are operated direct by a push-pull rod. The ailerons have a completely separate control circuit in each wing, which, by means of two push rods, are connected with the V-shaped bellcrank in the fuselage. The differential aileron movements of 2:1 ratio are obtained by the geometry of the V bellcrank and the push rod system.

The rudder is operated by a conventional pedal and cable system. The airbrakes arranged only on the upper surface of each wing are connected by means of cables with an operating lever mounted on the left side of the pilot's seat.

F FLIGHT TESTING AND PERFORMANCE

The Loudon prototype has full approval of the Canadian Department of Transport as a Class 11 glider, according to C.A.R. -05 requirements. This makes it fit for any sort of flying and manoeuvres within the specified speed range and weight limits except cloud flying. Initially it was intended to design it as a Class 1 glider, but unfortunately almost at the end of the design work, the requirements for the Class 1 glider were changed and it was too late to modify the already well advanced design. However, the few spots and dimensions which required strengthening by the latest C.A.R. -05 spec. were modified on the production drawings, so that it should not be difficult to change the classification in the future.

The prototype was approved for a C.G. range from 30.2% to 36.4% of the mean wing cord at 585 lb. all-up-weight. The above range accomodates pilots weighing from 130 to 200 lb.

The Loudon was flown for the first time on November 5th, 1949, at Oshawa Airport, Ontario, on which day five flights were made, as a result of which the sailplane was accepted as airworthy for the continuation of the already approved test programme.

The performance obtained in test flight shows a little improved minimum sinking speed and a slightly higher sink in the region of higher speeds. The estimated minimum sink was 2.1 ft/sec. as compared with the calculated 2.25 ft/sec. The best gliding angle proved to be almost the same as calculated.

The Loudon does not show any tendency to fall off to one side when flown in steady partial stall with the stick fully back and normal rudder. When reducing the speed in straight flight, the glider can be flown as slow as 22 m.p.h. and although the sinking speed is two or three times the minimum, steady flight can be maintained.

The spinning characteristics are such that the glider does not show any tendency to spin or spiral dive. Several attempts were made to spin it in either direction without success. The glider can be made to stall and lift a wing into a spin, but it recovers in a spiral dive in about a quarter turn without moving the controls from the cross control position.

In aero tow, the low stalling speed obviates any tendency to stall in tow and adequate control can be maintained at all times. Very great care was exerisised when testing the glider at high speeds. In order to get the speed readings correctly, two trailing static bombs were used for two speed ranges, one covering speeds from 30 to 50 m.p.h., the other one from 60 to 100 m.p.h. The design gliding speed of Loudon is 100.5 m.p.h. and the glider was flown up to 103 m.p.h., which covers adequately the corresponding C.A.R. - 05.2 requirement.

A similar test was repeated with extended spoilers in which case, however, the maximum speed should not exceed 1.67 times stalling speed. As the stalling speed with spollers fully extended is about 35 m.p.h., the maximum test speed should be $35 \times 1.68 = 58.6$ m.p.m. The glider was in this case flown up to 71 m.p.h. which well covers requirement. It is worth while to mention that in all high speed flights a high control stick force and a forward stick position is required to maintain a steady flight condition. It is particularly noticeable at the maximum speed at full range of C.G. positions.

The glider is fully manoeuvrable and controllable at all speeds between stall and maximum certificated speed, and forward and aft C.G. locations. The glider has been looped at speeds from 75 to 95 m.p.h., stall turned entering at a wide range of speeds and landed from a high speed climbing turn entered at 90 m.p.h. at 20 ft. altitude. The spoilers have been used at varying amounts up to full travel at speeds from stall to 71 m.p.h. in free flight and tow, both in turns and in straight flight. No difficulty was experienced in maintaining full control at all times, and no buffeting was noticed.

The glider is a statically and dynamically stable about all three axes. The dynamic stability was checked by sharply moving the control stick or rudder in steady flight and observing the path and speed of recovery to normal flight condition. In each case a high damping effect was evident with oscillations levelling out very fast. It is particularly noticeable in roll.

On basis of all tests in flight, the following placard speeds were approved by D.O.T.:

- Placard maximum speed.....90 m.p.h.
- " maximum auto-winch speed.....65 "
- " " aero tow speed.....90 "
- " " speed for operation spoilers....65 "

The prototype Loudon slider fulfilled the U.S. Civil Air Regulation CAR-05 fully in every respect.

Department of Transport Type Approval is reproduced below:

DEPARTMENT OF TRANSPORT
AIR SERVICES BRANCH
OTTAWA, CANADA

26 Issue 1
University of Toronto
UTG-1

AIRCRAFT TYPE APPROVAL

November 7, 1952

Manufacturer: Aeronautical Department,
Faculty of Applied Science and Engineering
University of Toronto,
Toronto, Ontario

Model UTG-1 Single Place Training Sailplane

Type: Class 11 Glider

Airspeed Limits: Glide or dive 90 mph True Ind.
spoilers open 65 mph True Ind.
Airplane tow 90 mph True Ind.
Auto-winch tow 65 mph True Ind.

C.G. Range Front limit 80.3 inches aft of datum
Rear limit 84.0 inches aft of datum

Datum: 93.1 inches forward of centerline of main U/C axle

Levelling Means: Top of fuselage between main spar and rear joint fitting
is horizontal.

Maximum Weight: 562 lbs.

No. of Seats: One

562
198
364

80.3
93.1

12.8

84.0
93.1

9.1

ms

AIRCRAFT TYPE APPROVAL UNIVERSITY OF TORONTO UTC-1 (cont'd)

Baggage: None

Ballast: Zero to 13 lbs. lead on rear face of front bulkhead.
see approved loading schedule.

Control Surface

Movements:	Elevator	26°up	23°down
	Aileron	26°up	11°down
	Rudder	32°left	32°right
	Spoilers	80°up	0°down

Serial Nos.

Eligible: No.1 and up

Required Equipment: Airspeed indicator

Certification Basis: United States CAR 5 as amended to June 1942

Landing Gear-Main: One Goodyear 5.00 x 4.00 tail wheel with AWT 4-ply tire and tube.

NOTE 1: The following placard must be installed in full view of the pilot:

MAXIMUM PILOT WEIGHT = 198 lbs.
 MINIMUM PILOT WEIGHT = 159 lbs.

THESE WEIGHTS APPLY WHEN NO BALLAST OR ADDITIONAL EQUIPMENT IS CARRIED. FOR MAXIMUM AND MINIMUM PILOT WEIGHTS WHEN BALLAST OR ADDITIONAL EQUIPMENT IS CARRIED SEE APPROVED LOADING SCHEDULE.

signed..... H.S. Rees
 Chief Aeronautical Engineer
 Department of Transport

It was found that many combinations of equipment and pilot weights will cause the c.g. to fall within specified limits and the gross weight not to be exceeded. Such combinations are of course airworthy and hence have not been tabulated or presented as an approved list as intended by the last paragraph of the Type Approval.