



(Photo by Dick Stouffer)
Bill and Maurine Durand.

INTRODUCING THE Durand Mark V

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HERE IS A unique but purposeful combination of the old and new — a negative stagger cabin biplane with modern full span flaps, spoilers, stabilator, forward sliding canopy, tricycle landing gear, and all metal construction. It obviously isn't a radical airplane, but still its appearance is unusual enough to give it a very distinctive identity. Instead of being a derivative of a preceding airplane, the Durand Mark V is a fresh concept planned from the start as a practical airplane for the amateur builder and private pilot to build and fly. As the designer, I'd like to share with you some of the thinking behind the Mark V.

In developing this new design my underlying philosophy can be summarized as adapting the machine to its builder-pilot and his passengers instead of making them conform to the machine. Consequently performance aims became more qualitative than quantitative. I have rated gentle flying characteristics, short field capability, personal comfort, cross country usefulness, occupant safety, and structural simplicity more important than extremely light weight, high cruising speed or other strictly competitive numbers. Its mission is basi-

cally daytime VFR pleasure flying with lots of visibility, but the shallow panel which allows the excellent forward view can also accommodate the necessary instruments and avionics for occasional IFR flying, too.

The Mark V's low cowl line is designed to afford a panoramic view with the horizon well above the flat, horizontal top of the panel. The absence of door posts and overhead obstructions results in a sense of openness, especially with the good rearward visibility provided by the large rear window behind the baggage deck.

In addition to visibility, one of the design considerations was to provide the pilot with helpful visual attitude references. As an example the slope of the nose cowl ahead of the panel parallels the ground line between the tail skid and main gear. So, for a pilot of average stature, this flat surface will align with the horizon when the airplane is in the correct attitude for minimum speed touchdown. Also, it is hoped that the straight top of the instrument panel will make the transition from left to right seat flying less awkward for the average pilot since it eliminates the reversal of visual reference presented by the more common rounded instrument panel.



(Photo by Jack Cox)

OTHER DURAND DESIGNS

Bill Durand has been designing airplanes for the past 44 years. The Mark V, as the Roman numeral implies, is the fifth. The first four are described below.

TOP: Date 1934 Omaha Aero Club Glider

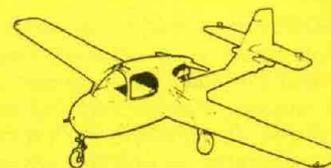
My first full size aircraft design. Its maiden flight was also my own first solo (after 4½ hours dual in a Waco). Spruce and muslin construction. Auto tow launching. Cost to build \$120.00. Lost in a windstorm after three seasons of flying.

SECOND: Date 1940 Durand A-45

2 p.c.m. powered with Szekely 3-cyl. 45 hp engine. Steel tube, wood, and fabric construction. Built as a self-education project while in college. Designed in 1936-38 to CAA airworthiness requirements with intent to manufacture on a limited basis if no job was immediately available after graduation. Was traded in on my first car. Subsequently partially wrecked by a buyer who had made only a small down payment to the car dealer. On his return flight from his first cross-country, he landed in high alfalfa. In attempting an uphill take-off he struck a farm building, breaking the propeller and one wing. After crude repairs he attempted a second take-off, made an involuntary circling flight due to misalignment of the repaired wing, and nosed over when he bounced to a landing in the alfalfa field again. He left immediately to join the Royal Canadian Air Force. (Believe it or not he had nailed the broken prop together.)

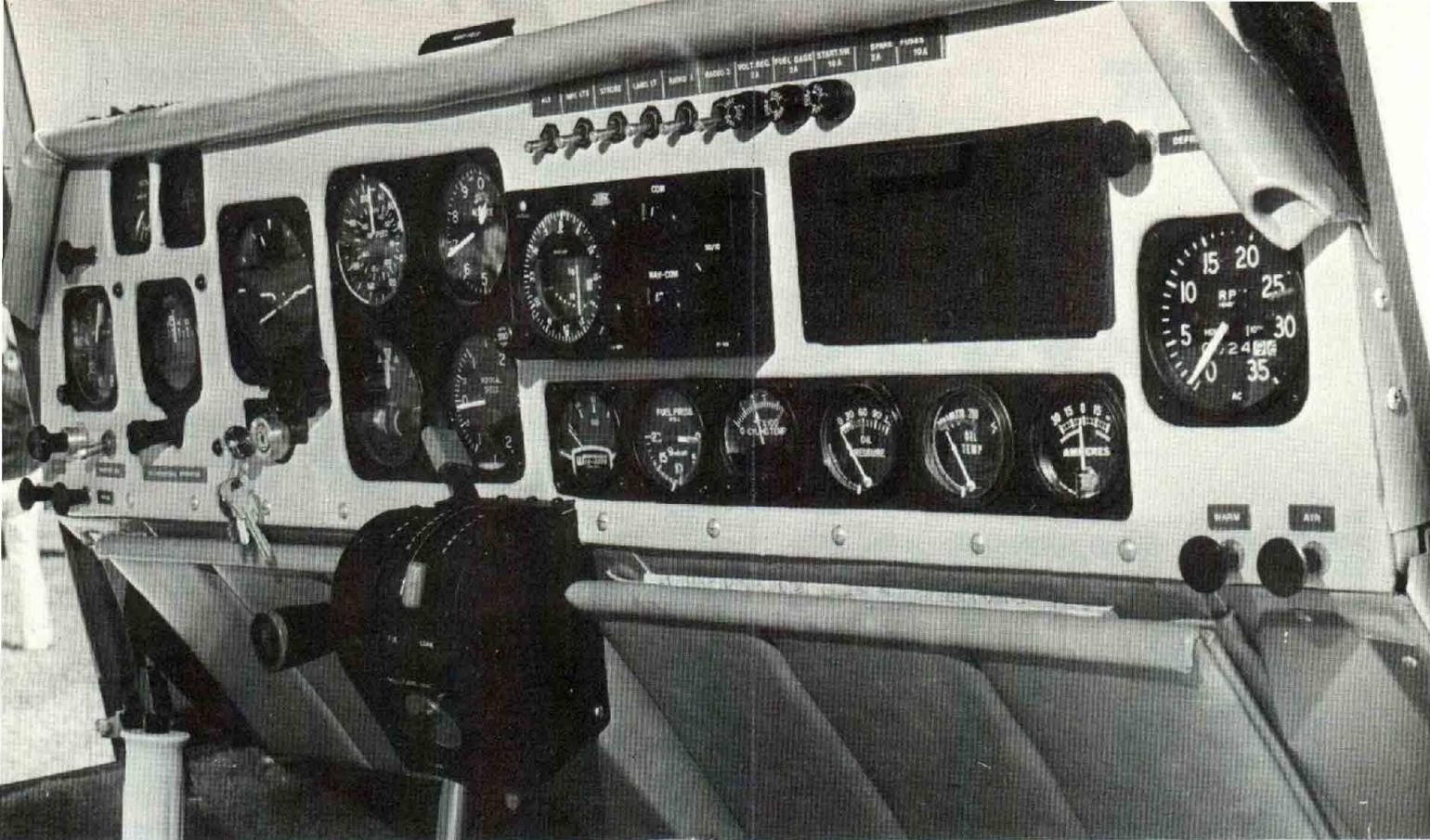
THIRD: Date 1942 University of Omaha C-40 Project

Single-place sport plane with Continental 40 hp engine. Steel tube fuselage, fabric covered cantilever wood wing. This project was financed by the university where I was teaching and was used in my aerodynamics classes, aircraft drafting, aircraft woodworking, welding, and engines classes during the period of intensive training for defense plants, particularly the Glenn L. Martin-Nebraska plant in Omaha. Project was sold to an FBI man from the east around '46 or '47.



FOURTH: Date 1948 Durand Aircraft Inc. XD-85

Post-war design. All metal with fuel-injected Continental 85 hp engine and full electric system. A production type design. Our corporation of around forty stockholders including a number of skilled engineers and shop personnel hoped to establish a local plant to utilize the large pool of experienced labor made available by the closing of the bomber plant after the war. The design was begun in 1945 and the prototype was in the test flying stage when it was decided to abandon commercial production plans because of the sudden and almost complete collapse of the light-plane industry at that time. The prototype had been damaged slightly and the directors reluctantly decided to dismantle the airframe and sell engine, wheels, and instruments to pay off some company debts.



(Photo by Dick Stouffer)
Mark V cabin details. The padded areas under the instrument panel swing out to double as map pockets. As you will read in the text, every item in the cabin was designed for a specific purpose or reason.

It seems that most experienced pilots instinctively prefer stick control with its natural universal movement as compared to the wheel or yoke which requires a combination of push-pull and rotation. So the simpler but sportier controls were selected for the Mark V. Individual dual sticks are provided in lieu of a single stick of the tee or wye style. The other controls are dual pedals, a centrally mounted brake lever below the panel, and a central throttle quadrant that also contains the mixture lever, parking lock and carburetor heat knob. Sloping below the panel and on either side of the throttle quadrant are spring-loaded map pockets whose outer faces constitute padded knee panels.

The four-position flap lever and the trim lever are located between the seats. The trim lever controls the anti-servo trim tab on the stabilator and acts as a miniature control stick. By its own position it indicates the amount of trim without requiring the complication of an additional follower and position scale. This is typical of a number of other details that combine desirable functional features with simplified construction.

I suppose that most pilots prefer toe brakes, but I, personally, dislike them. It seems that too often I'm riding them unintentionally. This problem was disposed of by opting for a hand lever, requiring only a single master cylinder, in combination with a steerable nose wheel controlled by the rudder pedals.

Even rudder pedals without toe brakes can be mildly annoying. From the pilot's standpoint it's not bad pushing on a pedal, but it's uncomfortable bending one's ankle backward to accommodate the opposite pedal. And from the passenger's standpoint it is disturbing to feel the pressure of a rearward moving pedal for he is certain that he must be interfering with the controls and have his feet in the wrong place. With these factors in mind, the Mark V pedals were designed to act differen-

tially, the "active" pedal having full forward travel, and the "inactive" pedal having only a small rearward travel. This was accomplished without any additional complexity or weight since it was only a matter of geometric layout.

Similarly, many elements of the Mark V design were influenced by my personal dissatisfaction with various features of the other airplanes that I had built, owned, or flown. One of these was the customary lack of easy ingress and egress. The Mark V's forward sliding canopy and low threshold have proven to be a good solution allowing equal convenience from either side, limitless headroom, and no necessity or temptation to step on the seat cushions. An overhead cam latch locks the canopy in closed position, and a secondary notch holds the canopy open slightly for good ventilation when taxiing.

I have observed that in most small airplanes the in-flight ventilation is a noisy affair with a direct rush of wind into the cabin. Mark V cabin air is supplied from plenums located on either side of the instrument panel, which serve to mix cool and heated air in any desired proportion and to reduce noise by slowing the air while increasing its static pressure. A diverter directs plenum air to defroster outlets adjacent to the windshield if desired. Pilot and passengers have individual controls. Cabin exit airflow is controlled from the rear ceiling console which also houses the radio speaker and cabin and panel lights.

Designing a homebuilt poses a different set of problems than designing a production airplane. Pilot convenience and creature comfort are common to both, but with a homebuilt airplane the builder, purchasing department, and pilot are all one person. His factory is probably limited to a spare room or basement in his house where noisy, dusty or smelly operations may be highly objectionable or even unhealthful. His flying ex-

perience may be limited and his experience as an airplane builder, nil.

Everything considered, the pop-riveted all-metal biplane seemed to offer the right combination of compact dimensions, generous wing area, and simple, clean odor-free construction resulting in a really durable machine. Since the biplane's smaller span is coupled with a correspondingly narrower wing chord inherently limiting the center of pressure travel, a shorter, lighter, and less expensive fuselage can be built without sacrificing stability. Except for final assembly the prototype actually was fabricated on a 4' x 8' plywood table in a 14' x 15' shop which also contained a work bench, drill press, stove, rest room and our local EAA Chapter library - really a far cry from Cessna's facilities, I'm sure!

In spite of being conveniently compact, the biplane structure results in a relatively wide distribution of major flight loads within the airframe. Aerodynamically, the cantilever monoplane is more efficient, but the biplane configuration is particularly well-suited to a certain amount of juggling by the designer to achieve superior handling characteristics. I was personally pleased that the biplane possessed these attributes to justify my secret desire to build one anyhow! My own flight training began in a Warner-powered Waco F back in 1934, and I must admit to sharing a certain nostalgic attraction for bipes. Further, all four of my earlier designs were monoplanes. Now the Mark V was to be something special.

The design was on the drawing board for about three and a half years before construction was begun. Stress analysis and weight and balance calculations paralleled the continual modification of the layout to achieve the simplest and most direct solutions to the problems associated with airplane design. Actual construction provided shop testing of the plans so that dimensional errors, inadvertent omissions, etc. could be noted and corrected. In a few instances parts were redesigned either as an improvement or to make the construction easier in some respect.

The airplane has been planned specifically for the builder having limited shop facilities, no more than average mechanical ability, and flying proficiency typical of the average weekend pilot who flies principally for pleasure and relaxation. Its 44 inch wide cabin is designed to accommodate two full size people in comfort and to carry their full size luggage. Attractive styling consistent with simple construction adapted to amateur skills was an important design criterion as was durability to permit outdoor storage for extended periods — perhaps regularly. Exceptional visibility was given especially high priority not only for safety but for the pure pleasure it affords. And, in recognition of our "I'd rather be flying" preference, maintenance requirements were minimized. Easy access for routine servicing and quick but thorough pre-flight was given special consideration. Since the airplane was going to be based and test flown at my own backyard grass strip, Durand Sky Ranch, short field capability was a must. Even though one may operate regularly from larger airports, it's comforting to know you could get into a small field in an emergency — and out of it again, too!

The final negative stagger biplane configuration combined all of the desired utilitarian features with some very desirable aerodynamic characteristics, for example: inherent flare-out at touchdown, flaps that don't require retrimming the airplane, and excellent anti-stall properties. Perhaps not to be compared directly with practicality or aerodynamic soundness, but nevertheless of immense satisfaction to the owner-builder-pilot would be the uncommon good looks of the airplane. Though its actual cruising speed is not ex-

traordinary, the airplane has the appearance of a potentially fast machine when seen on the ramp or in the hangar. This and its factory-built appearance will, I'm certain, give a big boost to the amateur builder's ego and pride of ownership.

I made the first test flight of the prototype on June 28, 1978, and as of this writing thirty-one hours have been accumulated. This includes one flight to an arbitrary 10,000 foot altitude and, with the authorization of FAA ferry permits, the 950 mile round trip to Oshkosh from Omaha. To date flight testing appears to indicate that all of the specific design objectives are being met.

The airplane's allowable gross is 1840 pounds and it is powered with a 150 hp Lycoming O-320. Its cruising speed is about a match for the Cherokee 140, but the take-off run is shorter, the climb faster, and with full flap the approach and landing is about 15 mph slower.

It flies hands-off very nicely.

On the basis of the attention it attracted at Oshkosh, one of the most interesting features of the Mark V is the use of spoilers instead of ailerons for roll control. This and a number of other interesting and innovative design features will be detailed in future issues of *SPORT AVIATION*. In the meanwhile additional flight testing is proceeding to explore performance limits and to discover and correct any mechanical bugs or maintenance items. When this has been accomplished, I intend to offer my plans for sale to those who may share this personal concept of what constitutes a practical and useful homebuilt.



(Photo by Dick Stouffer)

This close-up shows the full span flaps and a spoiler. The flaps have a differential action, top to bottom units, so as to minimize pitch. Spoilers are located on the lower wings only. The large canopy slides forward to permit access to the cabin.



(Photo by Dick Stouffer)

Despite being a strut braced biplane, the Mark V is a fairly clean machine . . . as this picture indicates.



(Photo by Dick Stouffer)

The cabin is entered by stepping up on the wing from the front — via the fixed steps.



(Photo by Dick Stouffer)

Nose gear detail. All three landing gear legs are off-the-shelf Scotchply, sawn to shape. Grumman American Trainers use the same material. The muffler is an inexpensive but sturdy automotive unit.

ABOUT THE AUTHOR

William H. "Bill" Durand is a native of Omaha and except for a brief sojourn in Denver during the World War II era, has lived there all his life. Enthralled with aviation during the Lindbergh/Chamberlin/Byrd heyday, Bill took up modeling, later opened up a model shop and did so well he was able to put himself through the University of Omaha. He received a B. S. in math and physics in 1938 and did post graduate work in physics at the University of Minnesota in 1939.

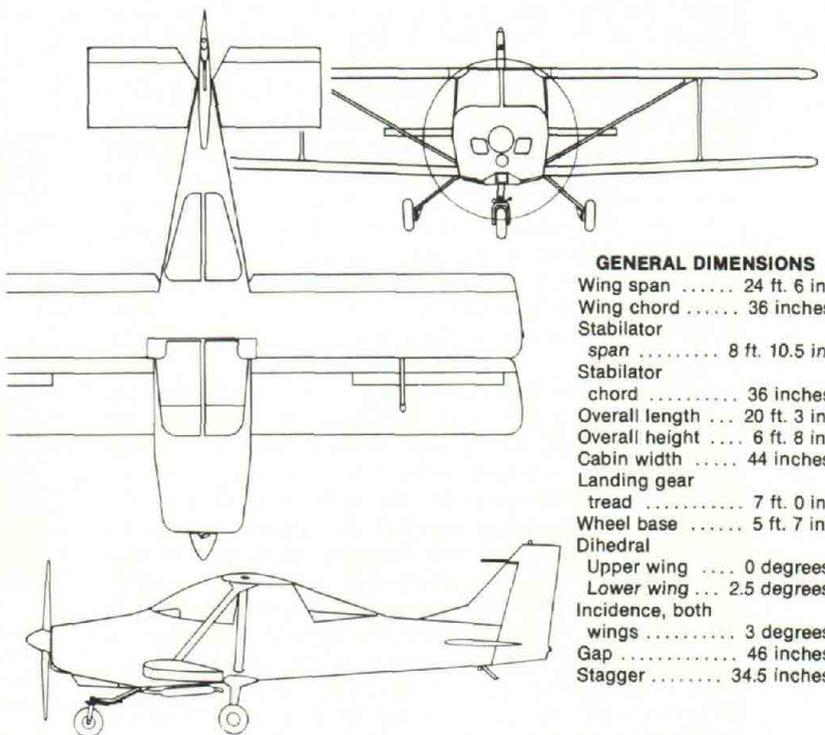
Bill became a college professor in 1940 and taught at the Universities of Omaha, Colorado at Boulder and Omaha again until 1958 when he resigned to form Durand Associates, Inc., which he still heads today. The engineering and design practice firm is involved with such diverse projects as machine design, homes, factories, stores, banks, shopping centers, grain elevators and bridges.

Throughout his academic and professional career, Bill was also involved with aviation, designing and building a number of airplanes (see box). He soloed in 1934 in his own glider after 4½ hours of dual in a Waco biplane and received his Private license in 1940 in a 40 hp Taylorcraft. During World War II, he obtained all the CAA ground school instructor ratings and headed the University of Omaha's aeronautical division of its engineering department. This included the Civilian Pilot Training program and the ESMWT aircraft construction and inspection courses.

Bill purchased an 80 acre farm north of Omaha in 1941 and built an airport on it. He moved there in 1946 and shortly the place became known as the Durand Sky Ranch.

The Sky Ranch has been home for EAA Chapter 80 for many years and Bill served as president in 1967 and again in 1969. The subject of this story, the Durand Mark V, started out as a Chapter project, but over the years became Bill's alone. He has had a great deal of willing assistance from Chapter members all along the way, however.

Bill and his wife Maurine — plus a number of Chapter 80 members — were swamped with questions at Oshkosh concerning the Mark V. This and some follow-up articles should satisfy the curiosity of those who were not there.



Three-view Drawing — DURAND Mark V BIPLANE

GENERAL DIMENSIONS	
Wing span	24 ft. 6 in.
Wing chord	36 inches
Stabilator span	8 ft. 10.5 in.
Stabilator chord	36 inches
Overall length	20 ft. 3 in.
Overall height	6 ft. 8 in.
Cabin width	44 inches
Landing gear tread	7 ft. 0 in.
Wheel base	5 ft. 7 in.
Dihedral	
Upper wing	0 degrees
Lower wing	2.5 degrees
Incidence, both wings	3 degrees
Gap	46 inches
Stagger	34.5 inches

AIRCRAFT
IN ATTENDANCE
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ADDITIONAL CLASSICS	
N242B	Hello Courier
N424L	Meyers 145
C-FLWG	Morane-Saulnier 502
N5160	Rawdon T-1
N711SV	Stampe
N25MB	Stampe SV4

Robert T. Griffin, Waxhaw, NC
L. A. Waite, Durand, MI
Frank Masak, Scarboro, Ont., Canada
Jack Chastain, Creve Coeur, MO
John Hanson, Manistee, MI
Don Good, St. Joseph, MO