The Flying Wing

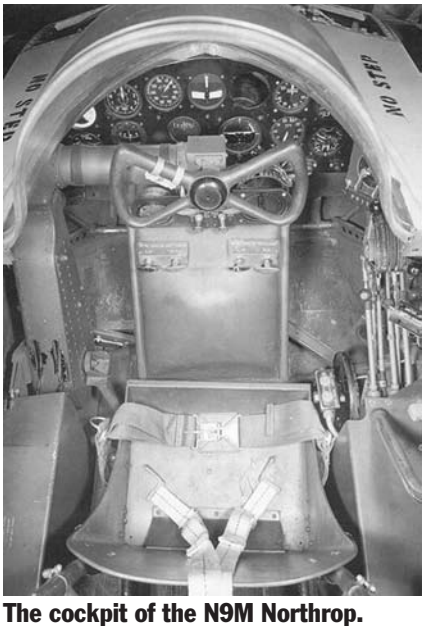
BY JACK MORRISSEY

Yes, it is different. It looks like someone started to build an airplane and then forgot parts here and there. Where's the horizontal stabilizer? The vertical stabilizer? Shouldn't the engines be out front? The concept is so different, but the main lifting body, the wing, is where it is supposed to be, and that's all there is, and that is all it needs.

John K. Northrop, one of our earlier pioneers in aviation, and the founder of Northrop Aviation, had the idea way back in 1923. He envisioned a wing carrying all of the loads, plus holding all of the controls, everything in one unit only. A wing! If you want to remember one basic principle regarding flying, you must never forget Bernoulli's principle. When air meets the leading edge of a wing, it must split. Some air goes over the top of the wing, and some goes underneath the wing. Air must travel a greater distance over the top of the wing, as it is curved and presents a

The fourth N9M restored by the Chino Planes of Fames Aircraft Museum, currently in storage at Chino.

The fourth N9M restored by Chino Planes of Fame Museum and on display.



The cockpit of the N9M Northrop.

longer surface. The underneath, or bottom of the wing, is straight, so the air has less area to travel over. The airflow over the top is faster, thus creating a low-pressure area. The airflow underneath the wing is slower, thus creating a high-pressure area. The net force (the difference between the two) is what pushes the wing up. It's called lift!

The fourth N9M flying after the completion of the restoration by the Chino Planes of Fame personnel.

For reasons based upon a lack of total understanding of the flying wing principle, there are still a lot of aviation people who do not react favorably to a flying wing. To these skeptics, without the normal horizontal and vertical stabilizer it just doesn't look like an airplane should. But when you picture the classic airplane, with a vertical and horizontal stabilizer at the rear of the aircraft, you should know this: The aircraft can stall. An accidental spin can be entered by turning within a narrow circle at a slow speed. Vertical acceleration loads can become critical at high speed in turbulence, and they will be amplified if the wing loading is low. The largest part of most fuselages exists only for the purpose of linking the tail assembly to the aircraft and add nothing but weight for no other apparent contribution. In a Fauvel flying wing these constraints do not exist. To quote Jim Marske, a noted designer of sailplanes, "When you see a flying wing take off for a flight, do you think, what a brave man to fly such a dangerous machine. Believe me, that is what I think when I see a tailed sailplane go off on tow."

A high percentage of fatalities involving general aviation aircraft (and warbirds fall into this category) happen in accidents due to stalls, and spins, at a low altitude. In the domain of motorless flight, a sailplane is more stall-resistant, which proves to be a great asset for the pilot who wishes to exploit weak thermal conditions close to the ground. In the case of the flying wing, there is the ability to fly "low and slow" as unexpected stall breaks will translate into simple up-and-down motion of the aircraft, or what we today call "porpoising." In spite of all popular thought, it is necessary to accept the fact that a flying wing will provide the strongest structural design for a given weight. Think about this long and hard.

The AV-36 glider, built and flown by Fauvel, was calculated to have the coefficient of 12 (the number of *g*'s it can pull) before structural failure can occur. This high *g*-loading was coupled with a mass weight of only 225 kilograms. Almost unheard of!

You should have a better understanding now of why John Northrop was so intrigued with the design of the flying wing—all loads and controls within the wing, and having the fuselage and tail section disappear. A number of small-scale demonstrators were built and flown to further evaluate this new and exciting concept.

Then, on April 11, 1941, (prior to World War II starting) the United States Army Air Forces (USAAF) asked the various aircraft manufacturers for proposals on a high-altitude bomber with the following requisites: the ability to carry a 10,000-pound bomb load halfway across a 10,000-mile range; a maximum speed of 450 mph at 25,000 feet; a cruising speed of 275

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The YB-49 on the ramp at Edwards Air Force Base.

mph; a service ceiling of 45,000 feet; and a maximum range of 12,000 miles at 10,000 feet. First to be notified with this request was Boeing Aircraft Co. and Consolidated Aircraft Corp. Consolidated's submission eventually emerged as the B-36 bomber.

Northrop was not contacted until May 27, 1941. The USAAF requested that Northrop submit studies on a flying wing with requirements for an 8,000-mile range at 25,000 feet and 1 ton of bombs. This was followed by further requests for a cruising speed of 250 mph, with a service ceiling of 40,000 feet and a bomb load of 10,000 pounds. A little less demanding than the USAAF's original request to Boeing and Consolidated.

The development and construction of the first flying wing for the USAAF incorporated all of the benefits of the wing concept. It provided an extremely low drag factor, as it was almost a total lifting body. Subsequently, because the wing is also the airframe, the total aircraft is one large lifting body, with a strong absence of items that cause drag.

So, the flying wing had low drag and high lift. It could carry any size load faster, farther, and cheaper than any of the current USAAF inventory at that time When it came to the construction, it proved to be relatively simple, with few structural parts, which led to a much lower cost for construction than conventional bombers. The offensive load could be distributed throughout the entire airframe for a much better weight distribution. In combat, whether the flying wing was attacked from the front, rear, or either side, it presented a much smaller profile than anything else of its size.

In August 1941, slightly more ambitious requirements were again submitted to Northrop. The project (designated NS-9) received the initial support from the USAAC (United States Army Air Corps).

The order was confirmed in October 1941. The contract issued to Northrop a purchase order for engineering data, model tests, and a one-third flying scale model. On November 22, Northrop received a con-

The prototype YB-49. From an engine-driven to jet-driven bomber.

The YB-49 Jet Flying Wing Bomber on air tests over the Mojave desert.

tract for a single XB-35 prototype and an option for a second one. First delivery for the XB-35 was to be November 1943, with the second prototype due April 1944. Detailed design work on the XB-35 began in early 1942, and the XB-35 full-scale mock-up was approved on July 5, 1942. Work proceeded with the USAAF ordering two additional N-9Ms—one in early 1943 and then one more in mid-1943. Quite a few of the design details were worked out on the N-9M before being incorporated into the XB-35.

The N-9M's history was as follows. The first crashed on May 19, 1943, killing its pilot. The second model, while in flight, had the canopy fly off, but the pilot landed without a mishap. The life of the third was shortened by mechanical failures, but the fourth managed to survive all these years. Its first flight was on September 21, 1943. The fourth N-9M was restored over a period of 12 years by volunteers of the Chino Air Museum Planes of Fame and flew again after 45 years on November 11, 1994. Its

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new civil registration was changed to N-9MB.

When Northrop initially looked at its production facilities, they were found lacking. Enlarging the Hawthorne plant was out of the question at that time, so Northrop negotiated with the Glenn L. Martin Company for assistance. Northrop indicated it would fabricate the XB-35 and the YB-35s, with Martin handling the production of the B-35s at its plant in Baltimore, Maryland. A contract for 200 B-35s was initially planned in November 1942 and was formally issued on June 30, 1943. The first production B-35 was scheduled for delivery by June 1945. During the construction phase the "Y" designation stood for prototype and the "X" designation for experimental.

Unfortunately, things went downhill in early 1944. The B-35 program was way behind schedule, and preliminary tests indicated the XB-35 would fall short of the projected range by at least 1,600 miles. Then the maximum speed was found to be at least 24 mph slower than had been predicted. Martin was experiencing a severe shortage of engineers, as many were falling under the draft and were entering the armed forces. With this shortage of engineers came delays in setting up the tooling. All of this forced Martin to reschedule delivery of the first B-35 until 1947. With all of this, the USAAF concluded the B-35 would be too late to contribute to the war effort and subsequently canceled the contract for production with Northrop in May 1944.

However, cooler heads in the Air Technical Service Command came to the conclusion that the flying wing was worthwhile for test purposes, so Northrop was advised to build, for starters, six YB-35s. The prototypes were built on the XB-35 pattern, but with certain individual differences. Two of the YB-35s were fitted with Allison J35-A-5 jet engines. In the ensuing production some advanced specifications were added that resulted in redesignations. From those with dual counter-rotating propellers, problems arose that necessitated the dual counter-rotating propellers being replaced with single-rotation propellers and a simpler gearbox arrangement. Without going into a lot of testing details, the end result of all of the propeller testing showed that the B-35 with propellers was much too slow for the jet age and really outdated. By mid-1948 everything was headed for the jet-testing benches.

By August 1949 the remaining B-35s were scrapped, and in November the Air Technical Service Command canceled plans for any further conversions to jet propulsion. But all of this technology and testing was not in vain. Forty years after the demise of the B-35, the skies saw all of the years of testing, engineering, failures, hopes, dreams, and hardship come to fruition with the B-49. The B-49 served us extremely well in various theaters of operation around the world, and fortunately the concept kept moving on. Now when you see the B-2 stealth bomber overhead, you will know where most of the flying-wing technology came from. A lot of uninitiated spectators seeing the B-2 overhead immediately tend to think of Buck Rogers, outer space, futuristic aircraft, and aircraft beyond their comprehension, but what they really see is the culmination of an idea that intrigued John Northrop back in the 1920s, and it was his determination and dedication that turned the concept into one of the world's leading stealth bombers.