

Northrop Grumman B-2 “Spirit”

We are always requesting readers send in suggestions for topics for future columns, and several have asked about various aspects of the B-2 Stealth Bomber, now named “Spirit.”



A query about the feasibility of building a scale model of the B-2 without an active flight control system showed up a short while ago on one of the internet e-mail groups, Doug Bullard’s Nurflugel list. Al Bowers’ reply to the question was fascinating not only because it disproves the general consensus about the B-2 pitch stability, but because of the methods Al employed to reach a conclusion. Here’s a portion of Al’s response:

“At the time of the roll-out down in Palmdale, *Aviation Week & Space Technology* ran some rather nice photos. I was still sitting in the same office with my mentor, Alex Sim. Alex and I were chatting about the B-2, and we could not decide if the aircraft were statically stable or statically unstable. Alex said the B-2 was stable and I said it was unstable (remember that the X-29 was still flying here at Dryden and I was greatly enamored with unstable aircraft at the time).

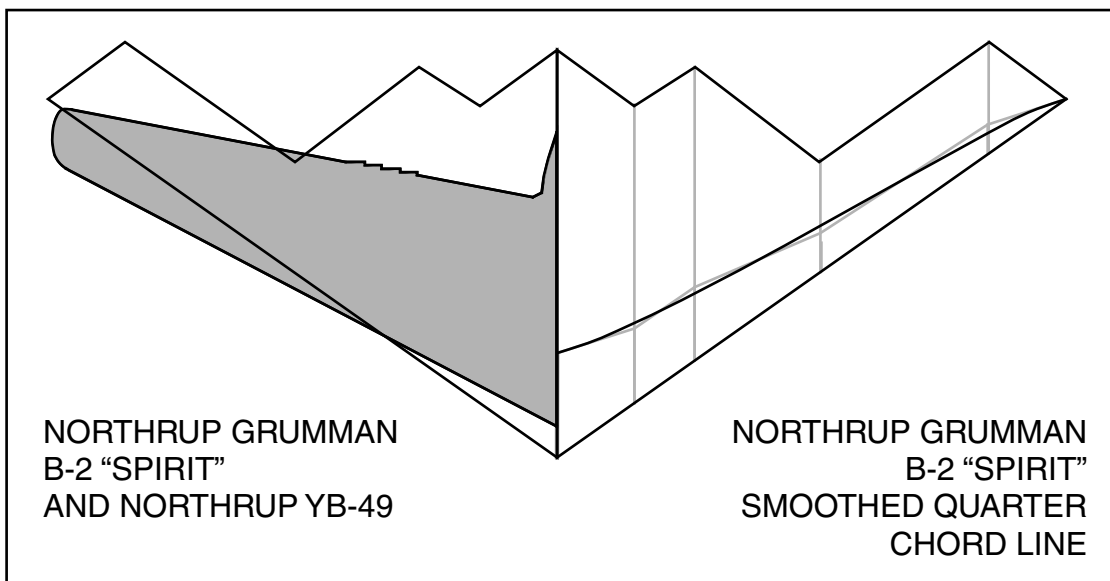
“Based on the photographs, we made a simple vortex-lattice model and estimated the CG position on the location of the main gear (typically the CG is about 15 degrees forward of the main gear for rotation at takeoff). I made the model (based on published photos) and ran the code. The B-2 is stable.”

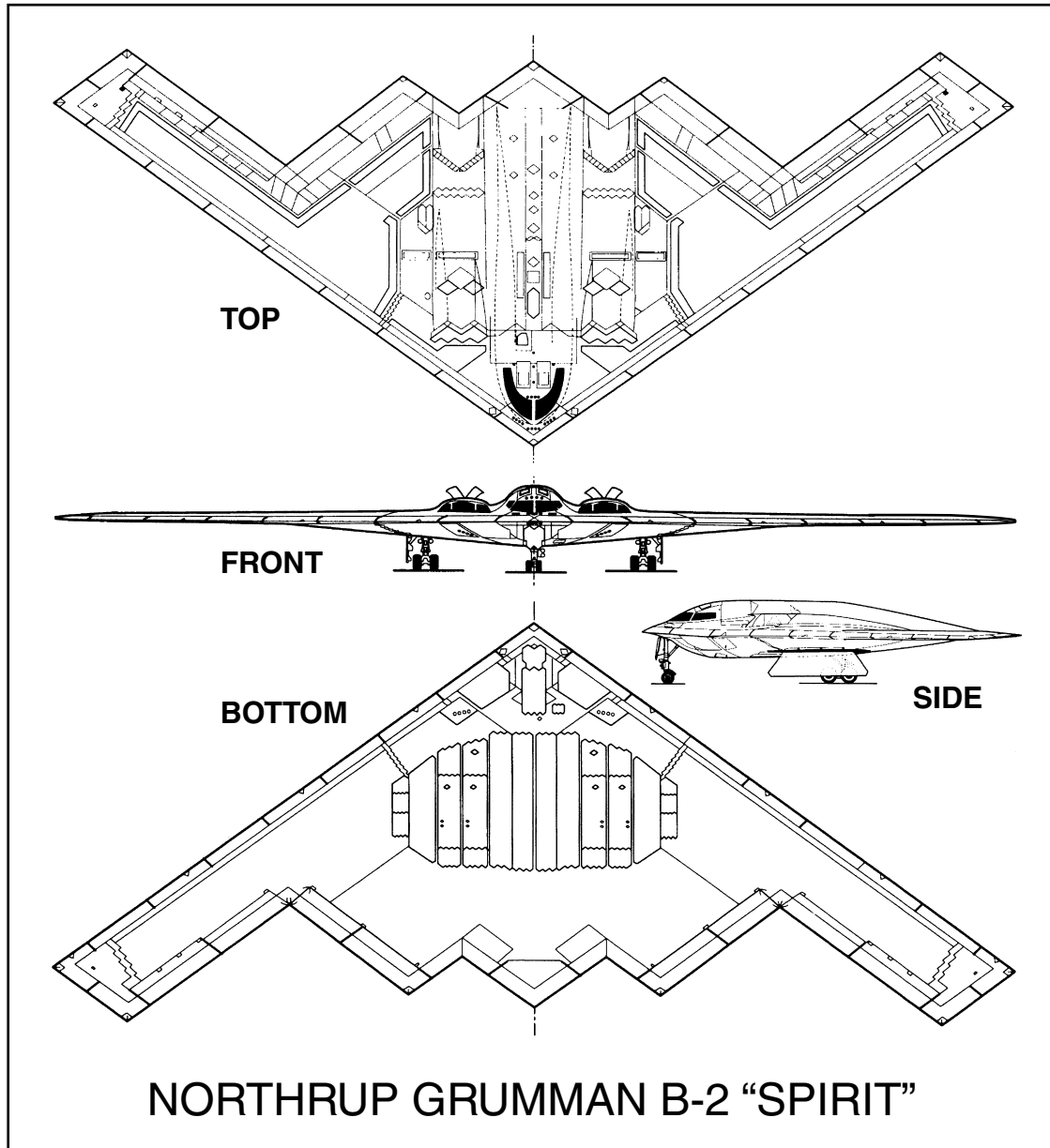
We were able to see the B-2 at relatively close range a few years ago, when one was flown into Boeing Field in Seattle. “Spirit of Washington” had its picture on the front of nearly all of the local papers, and literally thousands of people came out to see it in person at the Museum of Flight. The “Spirit of

Washington” is truly a beautiful airplane, and is one of those currently at Whiteman AFB, Missouri.

Our photographs of the “Spirit” were limited because of the curtailed number and scope of viewing sites. Still, we were able to obtain pictures of some aircraft details, and a few of our own questions about the B-2 were answered by simply being able to view the airplane first hand.

- There is a bit of twist in the outer panel of the B-2 “Spirit” wing. Since the trailing edge and leading edge of the wing actually meet at the tip, it is not easy to determine the actual amount of twist visually. However, by expanding the Air Force provided 4-view, we found it to be around two degrees.
- The wing has a very sharp leading edge, and a pronounced “droop,” in the area of the fuselage — from the center line to outboard of the engine nacelles.
- The wing surface is smooth, with no creases, despite the sharp angles in the trailing edge. All of the control surfaces, on the other hand, are made from flat plates. The front view is very reminiscent of the Northrop N1M, with the lower surface of the wing forming a very wide belly.
- The B-2 has an odd shape as seen from overhead, but plotting the wing quarter chord line gave us quite a surprise. We drew up the planform of one wing and marked the chords at all of the trailing edge discontinuities. We found all of the quarter chord points, then connected them all with straight lines. Finally, we connected the midpoint of each of those line segments and used the smoothing function in our graphics program. The result is a







The B-2 “Spirit of Washington” at Boeing Field, Seattle

surprisingly straight curve which arcs slightly backward initially, then forward near the wing tip. We’ve reproduced our graphical exercise in the included figure. That same figure contrasts the overhead view of the B-2 and the YB-49.

Specifications for the B-2 (and the YB-49) are shown in the included Table. About the only similarity between the B-2 and the Northrop YB-49 is they share the same wing span — 172 ft. The progress which has taken place over the decades separating these two aircraft is remarkable.

As many of you have probably heard, the B-2 became fully operational on April 1st of 1997. We’re not sure if April Fool’s Day was an appropriate day or not, given the known performance of the B-2 versus the government’s proclivity to abandon military projects involving tailless aircraft (YB-49, A-12 “Dorito,” etc.). At present, thirteen aircraft are deployed at Whiteman Air Force Base; a total of 21 will be sited there by the end of 1998.

Several years ago a large scale YB-49 was flown at the Slope Scale Fun-Fly in Richland, Washington. What an exciting prospect to have a B-2 “Spirit” in the same scale! If any readers of “On the 'Wing...” have completed and successfully flown a model of the B-2, regardless of size, we’d very much appreciate hearing from you!

	YB-49	B-2 "Spirit"
Span	172 ft.	172 ft.
Area	4,000 sq. ft.	5,140 sq. ft.
Engines	Eight J35-A-5 4,000 lbs. thrust each	Four GE F118-GE-100 19,000 lbs. thrust each
Weight, empty	88,100 lbs.	153,700
Weight, gross	213,000 lbs.	336,500
Speed, max.	520 mph	high subsonic
Service ceiling	42,000 ft.	50,000 ft. with terrain following
Range	4,450 miles	6,000 miles without refueling
Payload	36,760 lbs. for 1,150 miles	more than 40,000 lbs.
Crew, min.	3, 5, or 7, depending on mission	2 or 3, depending on mission
Computers	none	more than 150

References:

Jones, Lloyd S. *U.S. Bombers; B1 - B70*. Fallbrook California: Aero Publishers, Inc., 1966.

Northrop Grumman web site: <<http://www.northgrum.com>>

Nurflugel web site: <<http://www.nurflugel.com>>. (Information on subscribing to the Nurflugel e-mail list is on this site.)

United States Air Force. *USAF/B-2 Industrial Team*. United States Air Force, 1992.

Whiteman AFB web site: <<http://www.whiteman.af.mil>>

Wooldridge, E.T. *Winged Wonders; The Story of the Flying Wings*. Washington, D.C.: Smithsonian Institution Press, 1985.

