



A Case Study of the Boeing B-47 Stratojet

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Outline

- u The political and economic climate
- u The evolution of the B-47
- u B-47 innovations in aerodynamics, stability and control, and structures
- u The legacy of the B-47



At This Time in History ...

- u It's 1943 and World War Two is raging
- u Aircraft production in the U.S. is staggering
- u Aircraft development is rapid
 - Piston engine technology reaching limits
 - Turbojet engines show promise
 - Britain and Germany have advantage
 - Reports of German fighter jets prompt U.S. to consider jet bombers



Origins of the B-47

- u **Air Corps Design Competition, 1944**
 - Design high speed jet bomber, 500 mph +
 - 8,000 pound payload
 - Range of 2,500 to 3,500 miles
 - Service Ceiling of 40,000 feet
- u **Designs submitted in 1944**
 - North American B-45
 - Convair B-46
 - Boeing B-47
 - Martin B-48



Evolution of the B-47

- u B-47 began as straight wing design
 - Limited top speed to under 500 mph
- u Operation Paperclip
 - Adolph Busemann
 - Swept wing theory in 1935
- u Engines and more engines
 - Fuselage and wing mounted
 - Four or six?



Evolution of the B-47

Model #	Date	Wing	Engines
413	Jan. 1944	Straight	4 Turbojets
422	early 1944	Straight	4 Turboprops
424,425	early 1944	Straight	4 Turbojets
426	early 1944	Straight	4 Turboprops
432	Dec. 1944	Straight	4 Jets in Fuse.
446	Sept. 1945	Swept	4 Jets in Fuse
448	Sept. 1945	Swept	6 Jets in Fuse.
448-2-2	Sept. 1945	Swept	6 Jets in Fuse.
450	Oct. 1945	Swept	6 Jets under wings



Evolution of the B-47

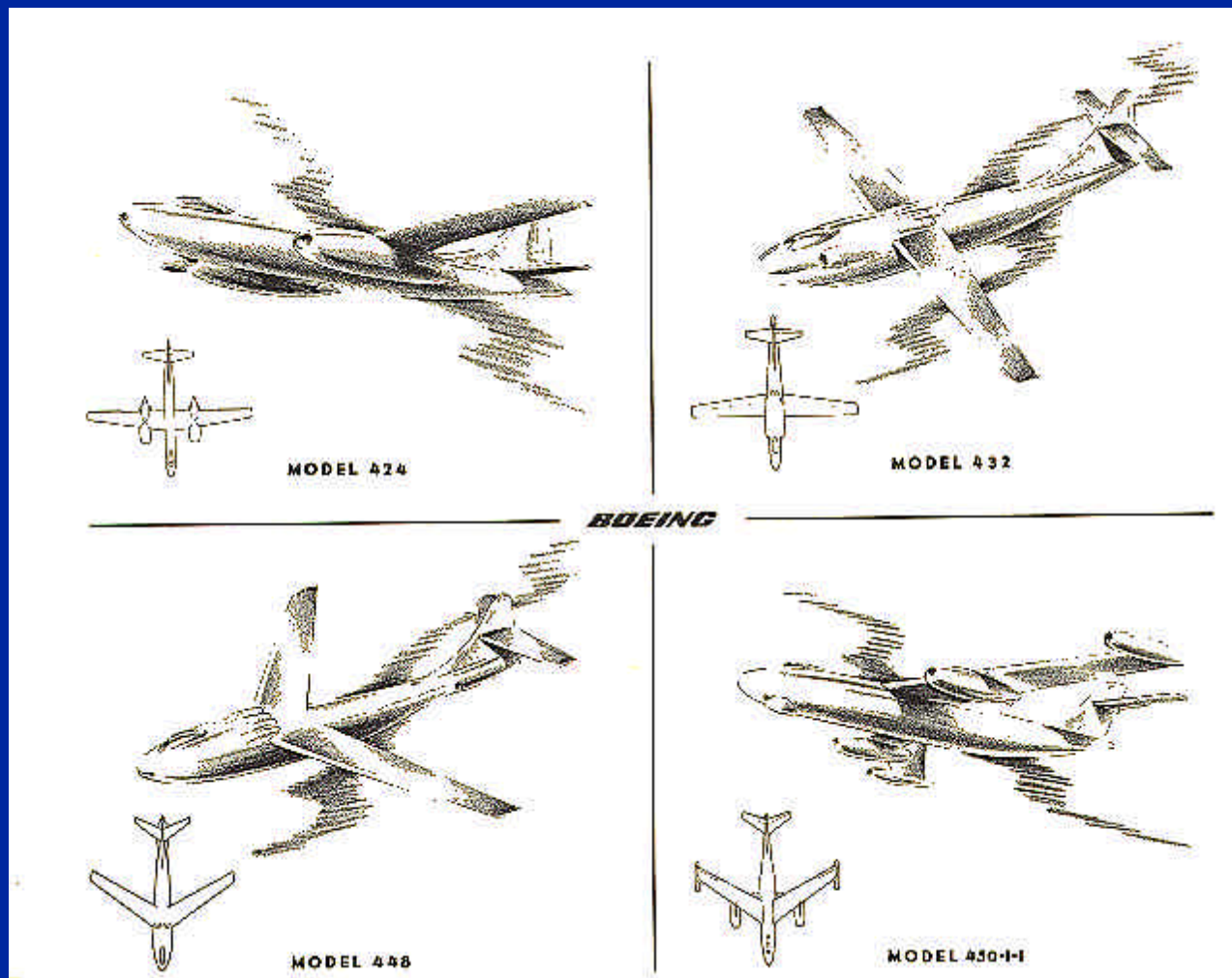
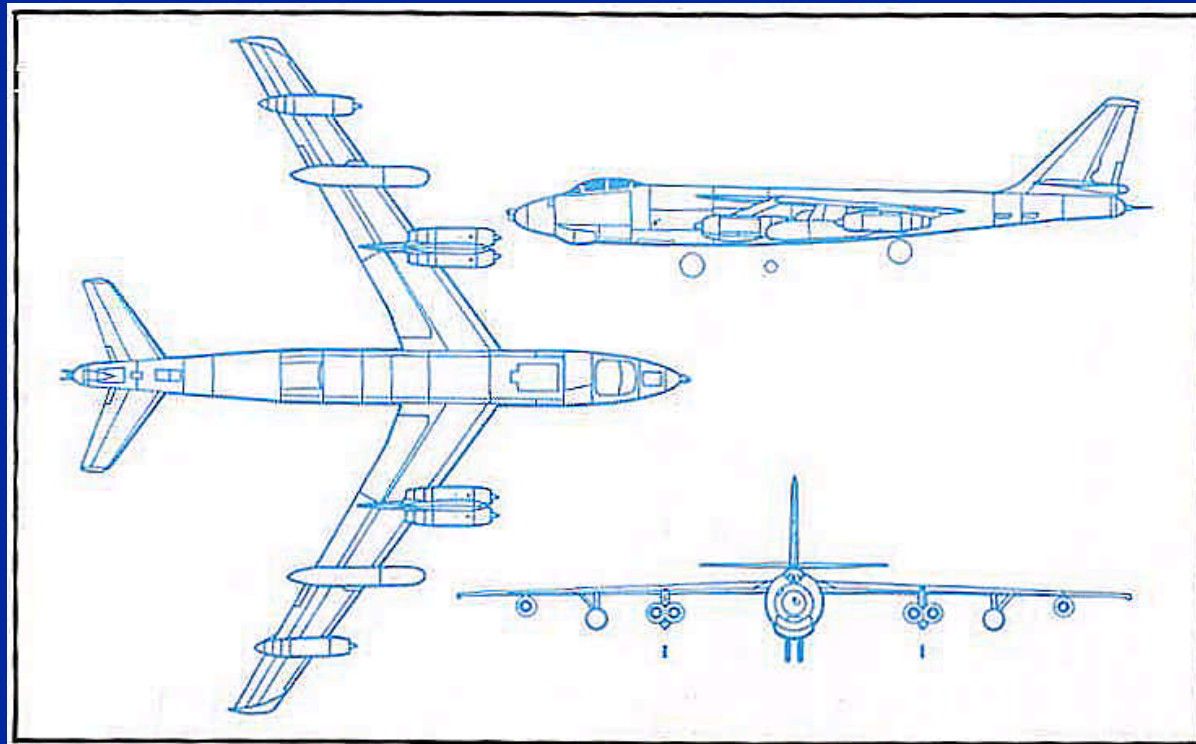


Image from: [The Politics of the U.S. Strategic Bomber Program](#)

Michael E. Brown, 1992.

The Production B-47



Images From: [American Warplanes](#), Bill Gunston, 1986.



Podded Engines on the Wing



Image From: [American Warplanes](#), Bill Gunston, 1986.



Podded Engine Advantages

- u Interference drag was reduced in the wind tunnel
- u Strut weight was minimal
- u Increased span loading
 - Reduced the wing root bending moment
 - Reduced wing weight
- u Forward mass increases flutter resistance
- u Increased accessibility for maintenance
- u Increased passenger safety in case of an engine fire



Pitch-up Problems (Dana)



Longitudinal Stability (Dana)



The Yaw Damper (Dana)



The Flexible Wing

- u Long range transonic cruise requirements:
 - Large span for minimum induced drag (116 ft.)
 - Thin airfoils for minimum wave drag (12%)
- u This led to a very flexible wing
- u The load distribution was shifted inboard at high g's
 - This allowed an 8 ft. span extension at each tip without changing the original wing structure or engine locations
- u Acted as a shock absorber to reduce gust loads



The Legacy of the B-47

- u The B-47 led directly to the development of the 707
- u Today's commercial transports follow the design paradigm of the B-47/707



Boeing 720
1960



Boeing 777
1996



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