A Case Study of the Boeing B-47 Stratojet

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Outline

- The political and economic climate
- The evolution of the B-47
- B-47 innovations in aerodynamics, stability and control, and structures
- The legacy of the B-47
At This Time in History ...

- It’s 1943 and World War Two is raging
- Aircraft production in the U.S. is staggering
- 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

- 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

- Designs submitted in 1944
  - North American B-45
  - Convair B-46
  - Boeing B-47
  - Martin B-48
Evolution of the B-47

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

<table>
<thead>
<tr>
<th>Model #</th>
<th>Date</th>
<th>Wing</th>
<th>Engines</th>
</tr>
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<tr>
<td>413</td>
<td>Jan. 1944</td>
<td>Straight</td>
<td>4 Turbojets</td>
</tr>
<tr>
<td>422</td>
<td>early 1944</td>
<td>Straight</td>
<td>4 Turboprops</td>
</tr>
<tr>
<td>424,425</td>
<td>early 1944</td>
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</tr>
<tr>
<td>426</td>
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<td>Straight</td>
<td>4 Turboprops</td>
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<td>432</td>
<td>Dec. 1944</td>
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<td>4 Jets in Fuse.</td>
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<tr>
<td>446</td>
<td>Sept. 1945</td>
<td>Swept</td>
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<td>6 Jets in Fuse.</td>
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<td>450</td>
<td>Oct. 1945</td>
<td>Swept</td>
<td>6 Jets under wings</td>
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Evolution of the B-47

Image from: The Politics of the U.S. Strategic Bomber Program
The Production B-47

Podded Engines on the Wing

Podded Engine Advantages

- Interference drag was reduced in the wind tunnel
- Strut weight was minimal
- Increased span loading
  - Reduced the wing root bending moment
  - Reduced wing weight
- Forward mass increases flutter resistance
- Increased accessibility for maintenance
- Increased passenger safety in case of an engine fire
Pitch-up Problems (Dana)
Longitudinal Stability (Dana)
The Yaw Damper (Dana)
The Flexible Wing

- Long range transonic cruise requirements:
  - Large span for minimum induced drag (116 ft.)
  - Thin airfoils for minimum wave drag (12%)
- This led to a very flexible wing
- 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
- Acted as a shock absorber to reduce gust loads
The Legacy of the B-47

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

Boeing 720
1960

Boeing 777
1996
References


