

BACK TO THE FUTURE
ACTIVE AEROELASTIC WING TECHNOLOGY
& THE X-53
AN APPROACH TO MORPHING

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ABSTRACT

This paper provides a summary of references for the development of the full scale development of Active Aeroelastic Wing Technology on the X-53 test aircraft, better known as the Active Aeroelastic Wing (AAW) F/A-18 Flight Research Program.¹⁻³ Goals of the AAW Flight Research Program were to demonstrate, in full scale, key AAW parameters and to measure the aerodynamic, structural, and flight control characteristics associated with AAW.

AAW Technology is multidisciplinary technology in that it integrates air vehicle aerodynamics, active controls, and structural aeroelastic behavior to maximize air vehicle performance. The concept uses wing aeroelastic flexibility for a net benefit and enables the use of high aspect ratio, thin, swept wings where the wing's aeroelastically deformed shape is controlled for optimum performance. This makes it possible to achieve the multi-point aerodynamic performance required of future fighters⁴.

AAW Technology is a design approach and employs wing aeroelastic flexibility for a net benefit through use of multiple leading and trailing edge control surfaces activated by a Digital Flight Control System (DFCS). At higher dynamic pressures, AAW control surfaces are used as "tabs" which promote a favorable wing twist instead of the reduced control generally associated with aileron reversal caused by trailing edge surfaces. The energy of the air stream is employed to twist the wing with very little control surface motion. The wing itself creates the control forces. An AAW wing is expected to experience less twist than a conventional wing, which twists in opposition to the control force generation.⁵

As AAW technology attempts to promote and use favorable wing twist response at high speeds, the concept is viewed as a return to an idea first pioneered by the Wright Brothers.⁶ Overall benefits of AAW technology to future systems include substantially increased control power, reduced aerodynamic drag, reduced aircraft structural weight, and increased design latitude in terms of wingspan, sweep, and thickness. The technology was proved in full scale using the X-53 aircraft, as modified F/A-18.

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Figure 1. The X-53 Active Aeroelastic Wing Flight Research aircraft



Figure 2. The X-53 performing 360° roll to prove AAW technology

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