



F-22 External Fuel Tank Portable Transport

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ABSTRACT

The United States Air Force (USAF) has a long tradition of projecting its combat air power overseas, which we expect to continue for the foreseeable future. The USAF's premier air superiority fighter, the stealthy F-22 Raptor, has the ability to carry two 600-gallon external fuel tanks to enable long range "ferry" missions into combat areas of operation (AOR). These tanks are essential to the F-22's ability to engage in short-notice combat operations far from the homeland, but because they attach to the underside of the wing with modular wing pylons, they compromise the aircraft's low radar cross-section – a key combat advantage of this 5th generation fighter. In this work, novel approaches are being developed to rapidly remove these tanks in between ferrying and combat operations, to include the ability to re-load the tanks after combat operations for return ferry. The researchers are working in close collaboration with the 192nd Fighter Wing to understand the operational need and use cases. This poster describes the unique requirements and solution concepts under consideration.



Challenges During Development

- Size limitations on the F-22: 4 briefcases (26"x 13"x 3.5" and 16"x 13"x 3.5")
- Hard to communicate with deployed fleets and gather classified information
- No detailed drawings with dimensions online, research is limited
- Power limitations – any electrical equipment stored inside the aircraft needs to undergo extensive testing and analysis

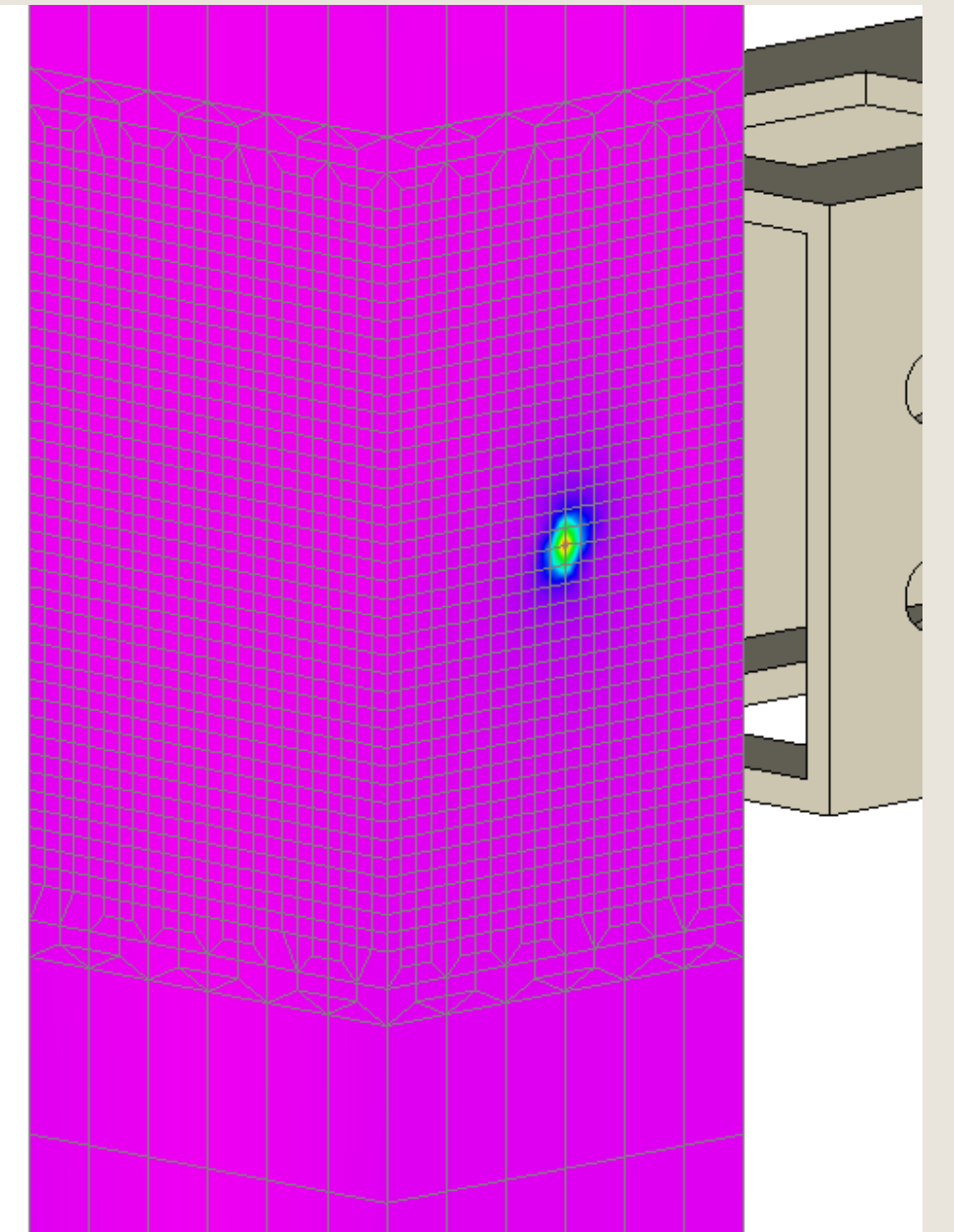
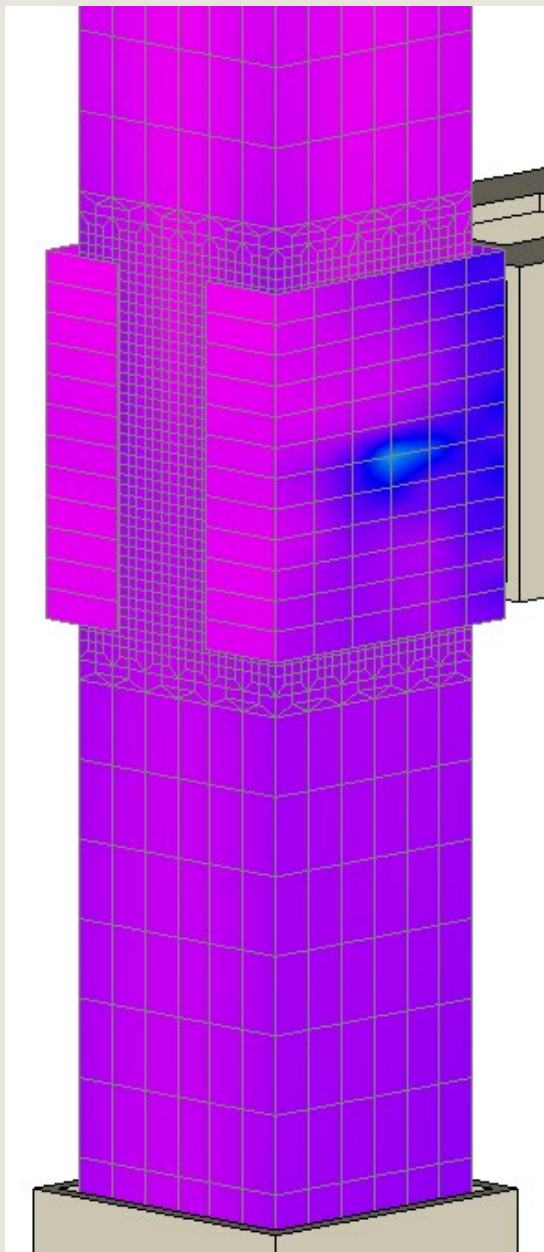
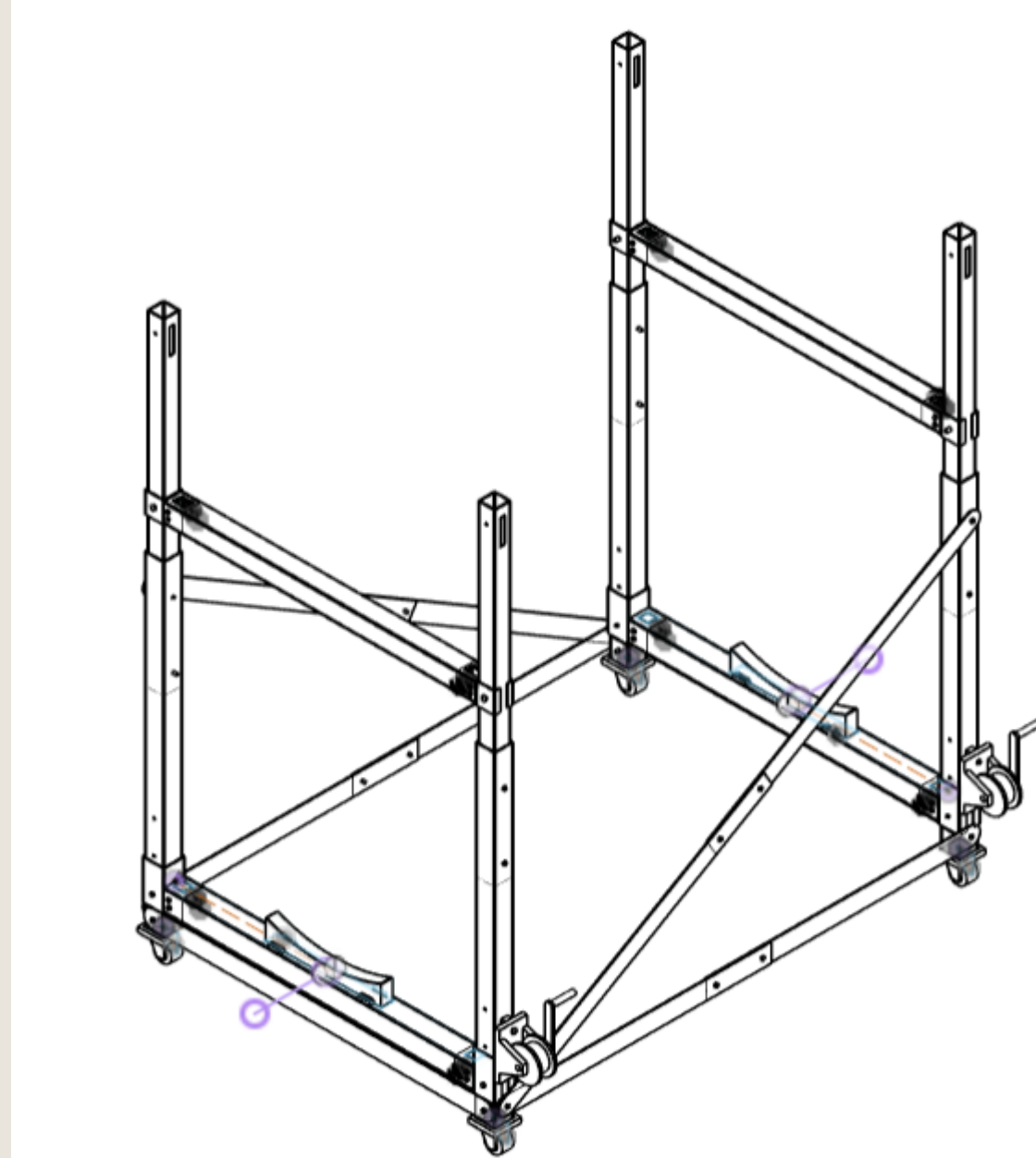
Background

The footprint and manpower that accompanies a fleet of F-22s overseas is 20-30 people and takes ~12 days to transport all the maintenance supplies to the forward base. In future conflict, cargo aircraft will have other obligations and will not be as readily available to support the F-22s. This has spurred the development of more self-sufficient uploading/downloading of the external fuel tanks.

- The fuel tanks can be jettisoned in the case of emergencies if an F-22 is flying into combat
- The external fuel tanks extend the range by 600 miles, allowing F-22s to fly farther without endangering tanker aircraft

Analysis, Design Process

Mind Map, Morph Matrix, 6-3-5 Method, and Transformational Design Methodology were used to generate many concepts. After an initial filter, three concepts were compared using a decision matrix. The selected design was further developed in CAD software and analyzed for technical viability. This included Finite Element Analysis and static, impulse, and stability calculations to ensure an overall acceptable factor of safety.



Final Design & Manufacturing

An approximately 80 lbs collapsable stand capable of holding the required load with a minimum factor of safety of 1.4. This design uses a winch and pulley system to raise and lower the fuel tank and pylon.

This system was made with a combination of using premade stock parts, computer numerical control milling, and manual milling.

The system is currently in a phase of testing and iteration as the team works to ensure all components function as designed and will be safe to operate by all end users. This includes:

- Proof loading one side of the stand with a universal testing machine
- Statically loading the constructed stand and ensuring proper function of the winch/pulley system
- Clocking assembly/loading time
- Simulated employment with the 192nd FW.



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Future Innovations & Impact

The development of a compact fuel tank support system would decrease the footprint of a deployed F-22 fleet, making them more agile in combat environments. Their reliance on cargo aircraft and heavy equipment would be removed with maintainers potentially flying commercial airlines and the F-22 equipment being self-contained on the aircraft.

Additionally, this system will ideally remove much of the physical strain placed on maintainers that have been leading to joint problems and other medical issues.

This system could also be modified to accommodate other fighter aircraft and their external fuel tanks.