



# Tornado Simulator

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## PROJECT DESCRIPTION

The Mechanical Engineering Department has commissioned the design and fabrication of a small-scale tornado simulator. The Tornado Simulator will enable vortex wind research at the University of Wyoming. The simulator consists of the following subassemblies: the inner and outer shell, fan, vane, and frame. The project features variable fan speeds, vane angles, and test platform heights, allowing researchers to study a range of vortex effects on scale models.

## DESIGN REQUIREMENTS

Flow Rate:	5 m <sup>3</sup> /s (11,000 cfm)
Vane Movement:	10° to 60° minimum
Fan Motor Speeds:	0 to 1,800 rpm
Individual Component Dimensions:	80" by 36" (Standard doorway)
Individual Component Weight:	100 lbs maximum
Test Platform Movement:	Z axis movement

## SUBASSEMBLIES

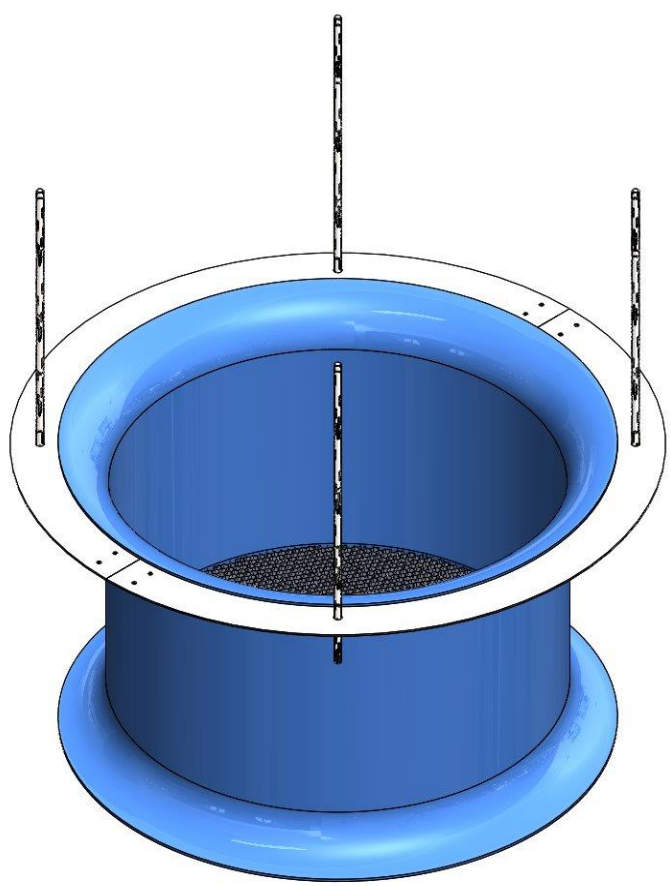


Figure 1. Fan Subassembly

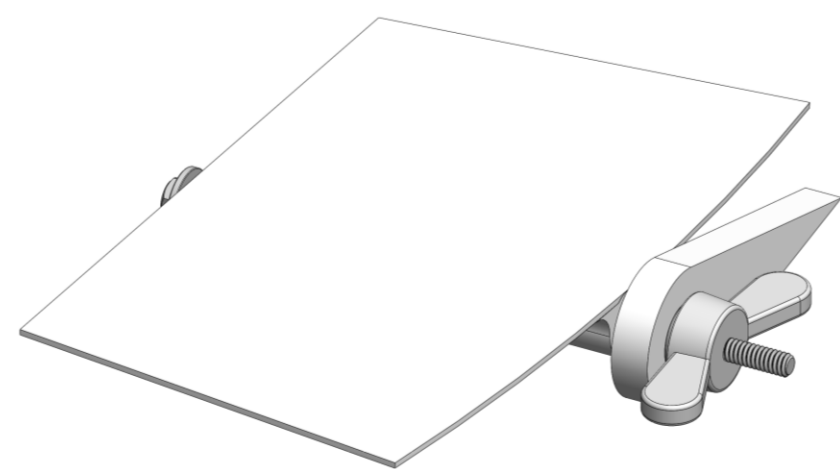


Figure 2. Vane Subassembly

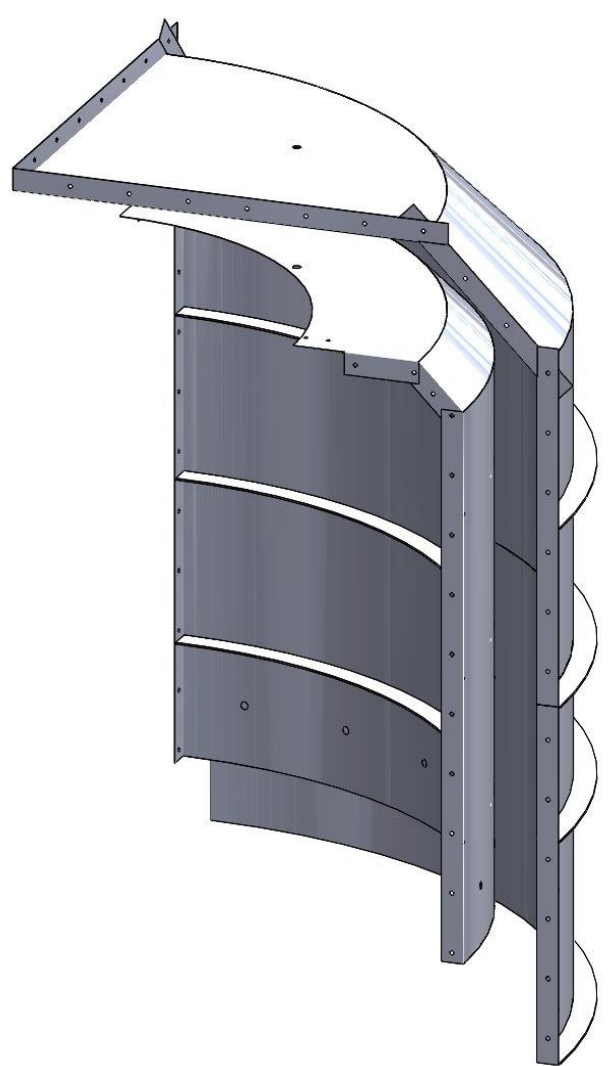


Figure 3. Inner and Outer Shell Subassembly

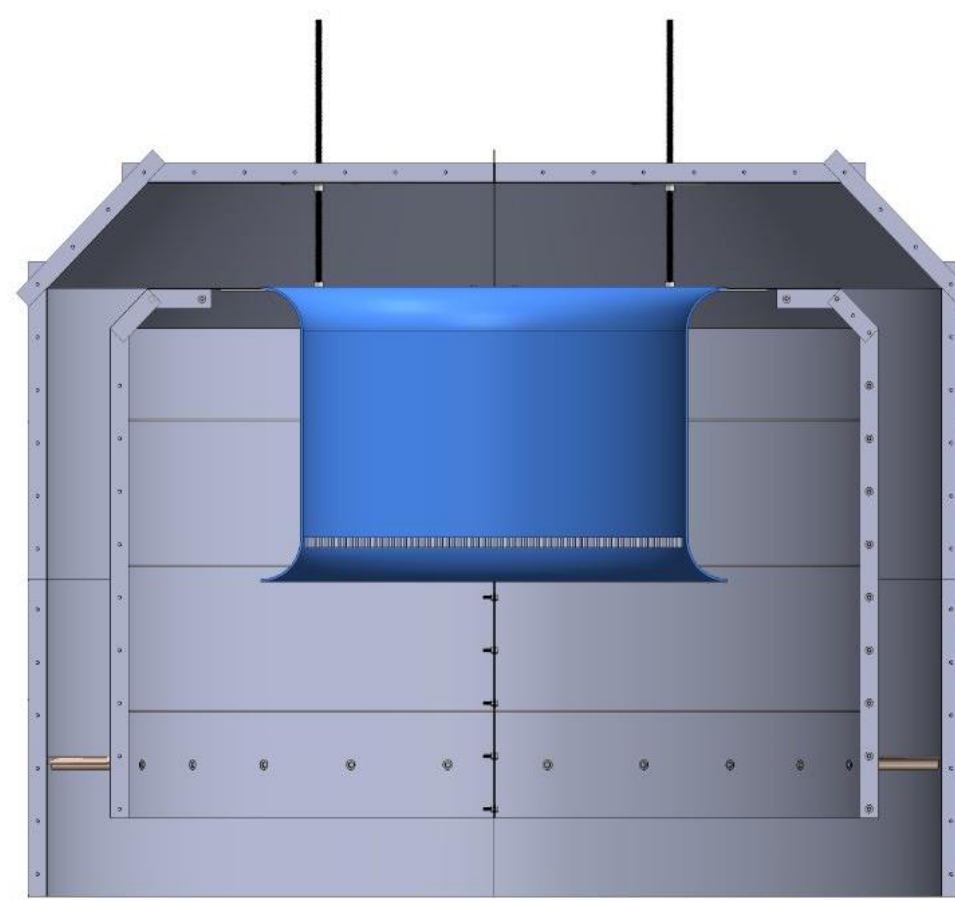


Figure 4. Cross-Sectional View of Simulator

## COMPLETE ASSEMBLY

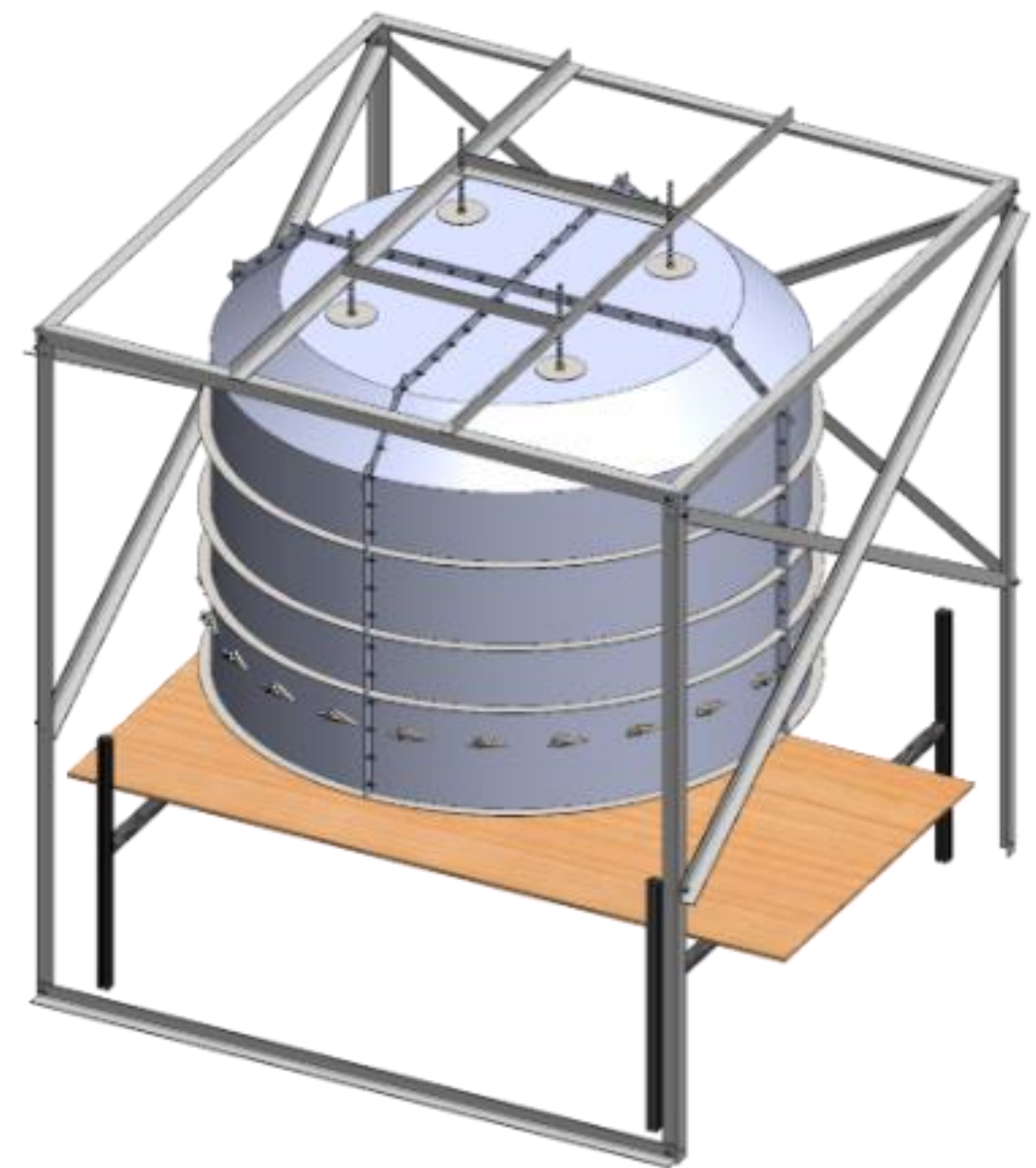


Figure 5. Complete Tornado Simulator Assembly

## DESIGN PROCESS

This simulator was designed referencing the Tornado Simulator at Iowa State that was fabricated in 2005. After preliminary designs, the computational fluid dynamics of the small-scale tornado simulator were validated using ANSYS by our collaborator Utsav Purkait.

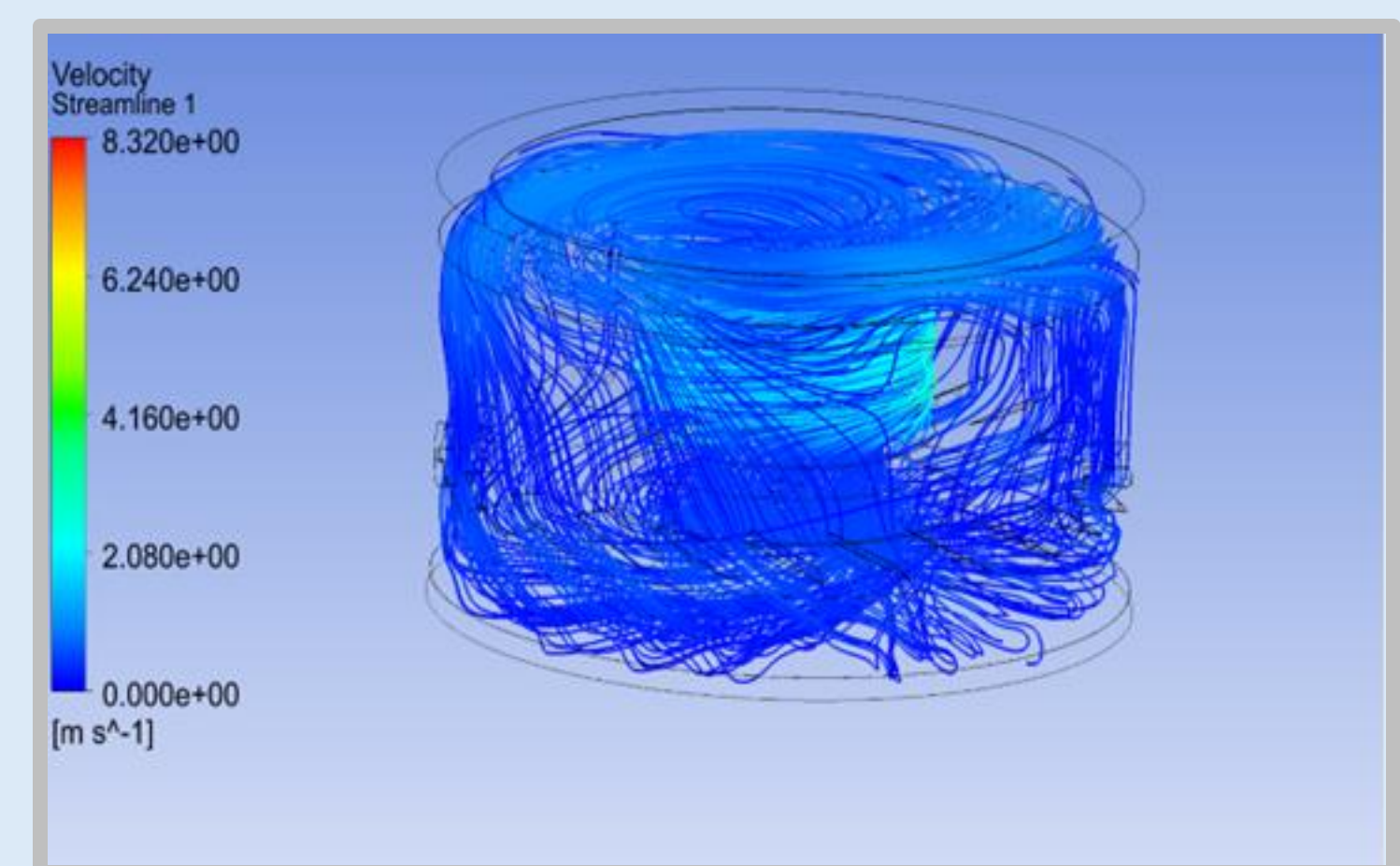


Figure 6. Model Simulated Vortex Validation of Final Design

## FABRICATION

- Sheet metal pieces of each shell and all fan bracing components were water jetted.
- Shell pieces were welded into quarters by the machine shop.
- Frame pieces were cut to length by team.
- Holes were milled into frame pieces by team for bolts and all thread.
- All shell pieces and fan bracing pieces were conditioned to help prevent rust and wear.
- Vanes will be 3D printed using PLA.
- Team will assemble frame and simulator shells using bolts.

## TESTING

- Structural testing and calculations of frame before simulator is hung
- Circuit analysis and system set up validation for electrical
- Use of fog machine for visual representation of vortices
- Operation Manual written for use of Simulator
- Manual written for assembly of simulator
- Data taken for vortex diameter and height at differing fan speeds.