Dynamic Heliostat Testing and Analyses

Sandia National Laboratories

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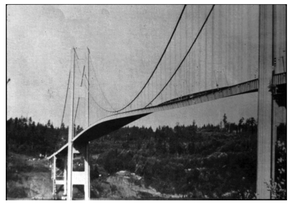
CONCENTRATING SOLAR POWER: COLLECTORS

Problem Statement

- Dynamic wind loads can cause structural fatigue and degrade optical performance
- Previous studies have focused on the impact of static wind loads (mean, peak) using scaled models in wind tunnels (Peterka, 1992)
- Need better characterization and understanding of the impact of dynamic wind loads on full-scale heliostats



Tacoma Narrows Bridge collapsing under 40 mph winds (1940)

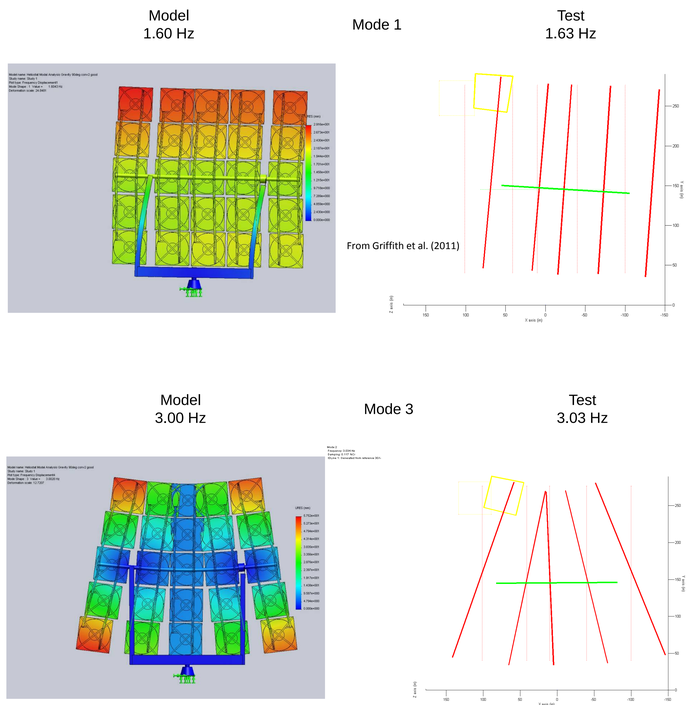
Objectives and Approach

- Perform modal testing and analyses on full-scale heliostats at Sandia's National Solar Thermal Test Facility (NSTTF) in Albuquerque, New Mexico
- Identify modal frequencies and shapes excited by wind loads
- Evaluate impacts of spatial positioning and blocking in a field of heliostats
- Use validated models to improve structural reliability and optical performance of new "low-cost heliostat" designs for SunShot

National Solar Thermal Test Facility at Sandia National Laboratories, Albuquerque, NM, with 200+ heliostats (~6 MW_{th})

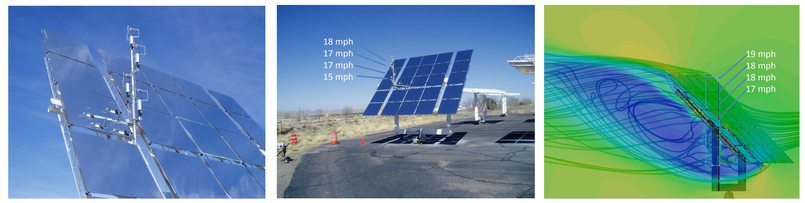
Modal Testing & Analyses

Installation of accelerometers and strain gauges on a heliostat at the NSTTF



Predicted (left) and measured (right) modal shapes and frequencies

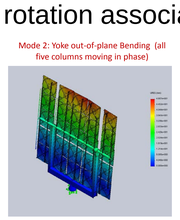
Wind Testing & Analyses

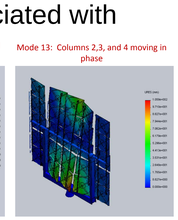


Evaluation of velocity profiles near a heliostat with 3D ultrasonic anemometers and computational fluid dynamics modeling (upstream velocity was 20 mph)

Findings and Next Steps

- Predicted and observed modal frequencies and shapes matched well for most modes
- Need to evaluate rigid body modes of rotation associated with azimuth and elevation drives
- Modes 2 (yoke out-of-plane bending ~2 Hz) and 13 (columns 2, 3, and 4 moving out-of-plane ~5 Hz) were strongly excited by wind





- Remote data acquisition and analysis system is being developed
- Peterka (1992) wind load models are being evaluated
- Additional heliostats are being instrumented and modeled to evaluate impacts of wind on structural fatigue and optics

Participants

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References

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SunShot U.S. Department of Energy

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