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Peak Wind Effects on Low-Rise Building Roofs and Rooftop PV Arrays

Presented By:

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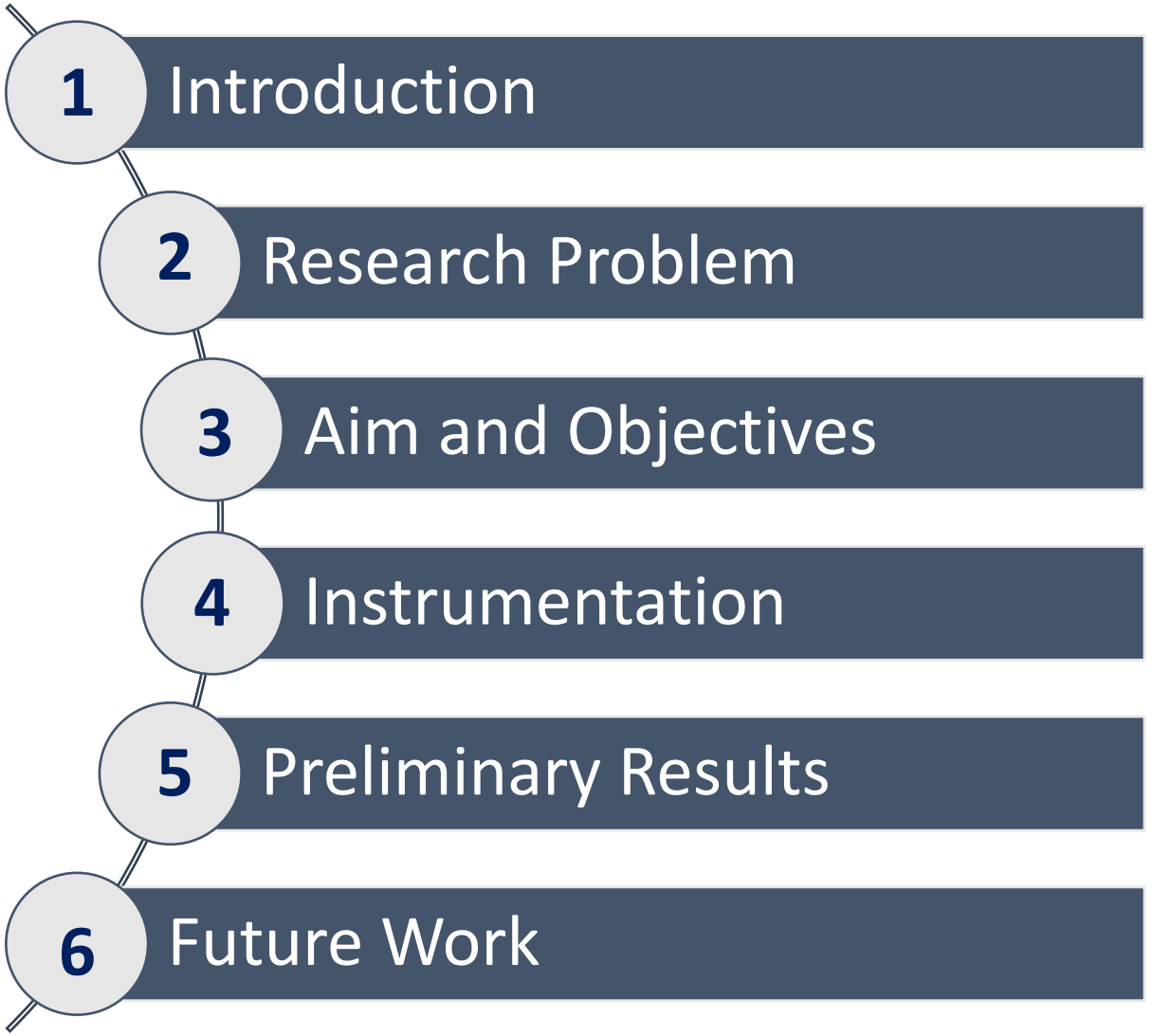
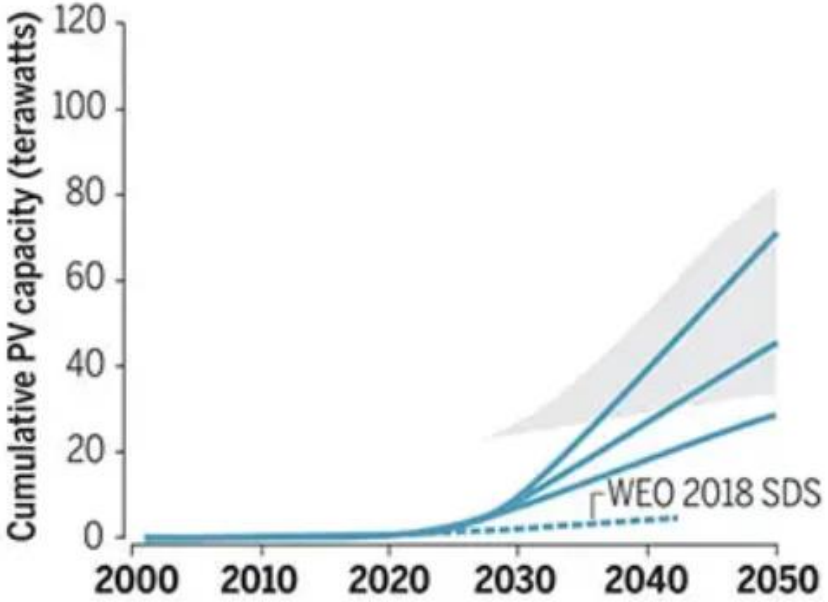
Outline



Introduction

- More than 2 million photovoltaic (PV) systems are mounted on rooftops of low-rise buildings in the U.S.

- Twenty-fold increase of solar PV power is expected by 2030.



Source: Solar Magazine

Research Problem

Rooftop equipment (including PV systems) are extremely susceptible to wind damage.

Failure of PV components can lead to severe consequences:

- Water intrusion and damage to the building's interior.
- Creation of wind-borne debris.

Aim and Objectives

Aim:

- Improve the estimation of peak wind effects on buildings and appurtenances.

Objectives:

- Conduct field measurements on the roof and rooftop PV array of Hogue Hall at CWU.
- Calibrate and validate wind tunnel measurements on large- and small-scale models at WOW.

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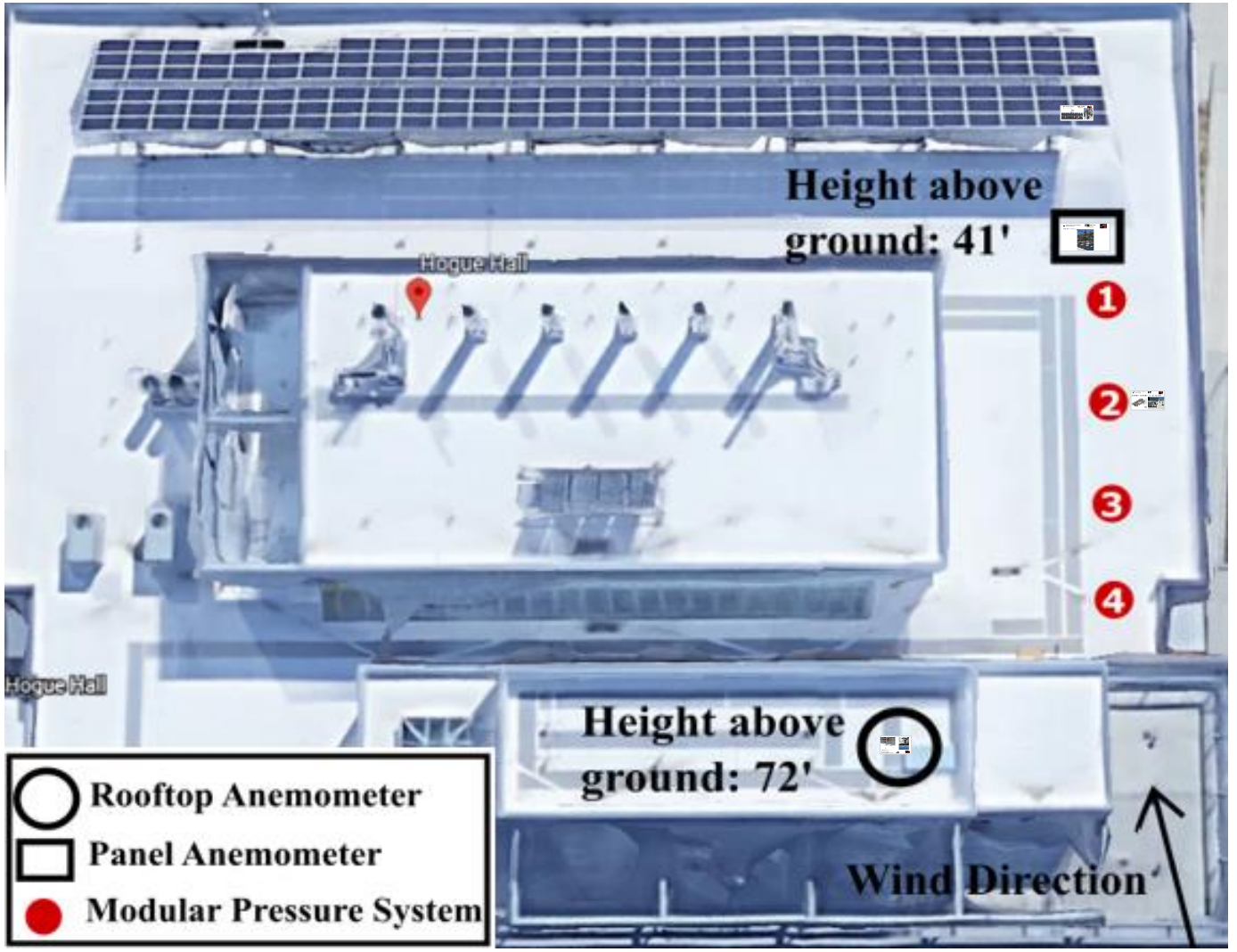
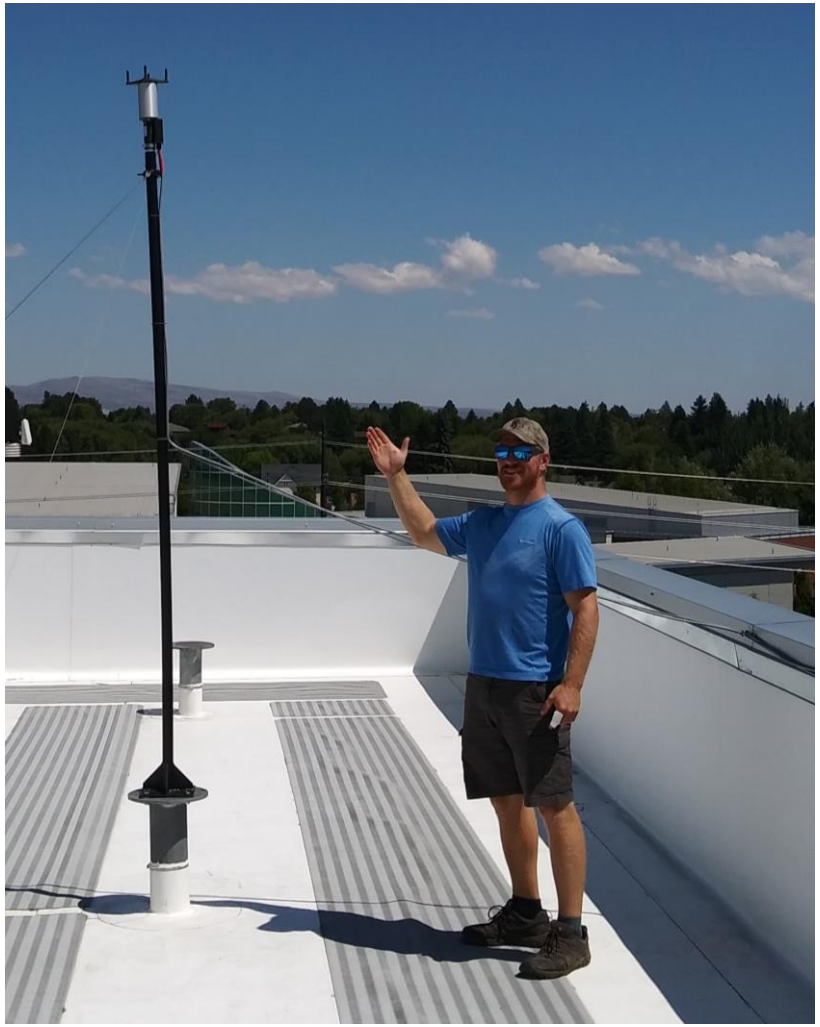
In-situ Measurements



Rooftop Anemometer



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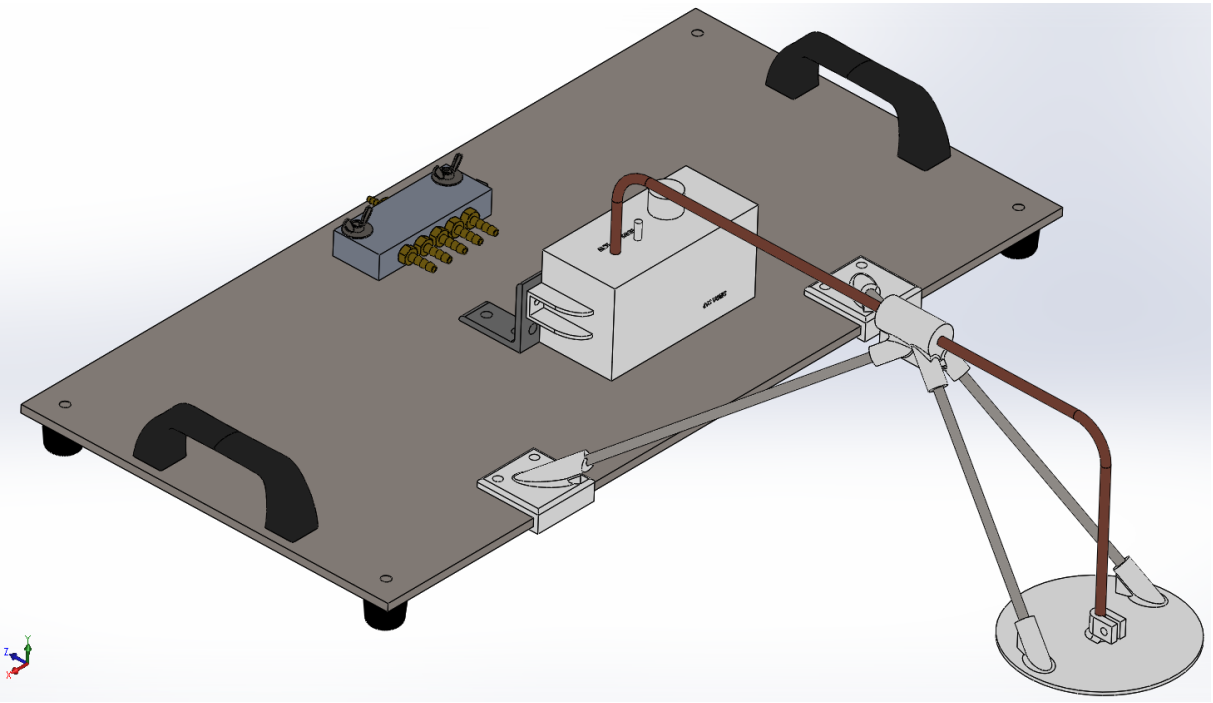
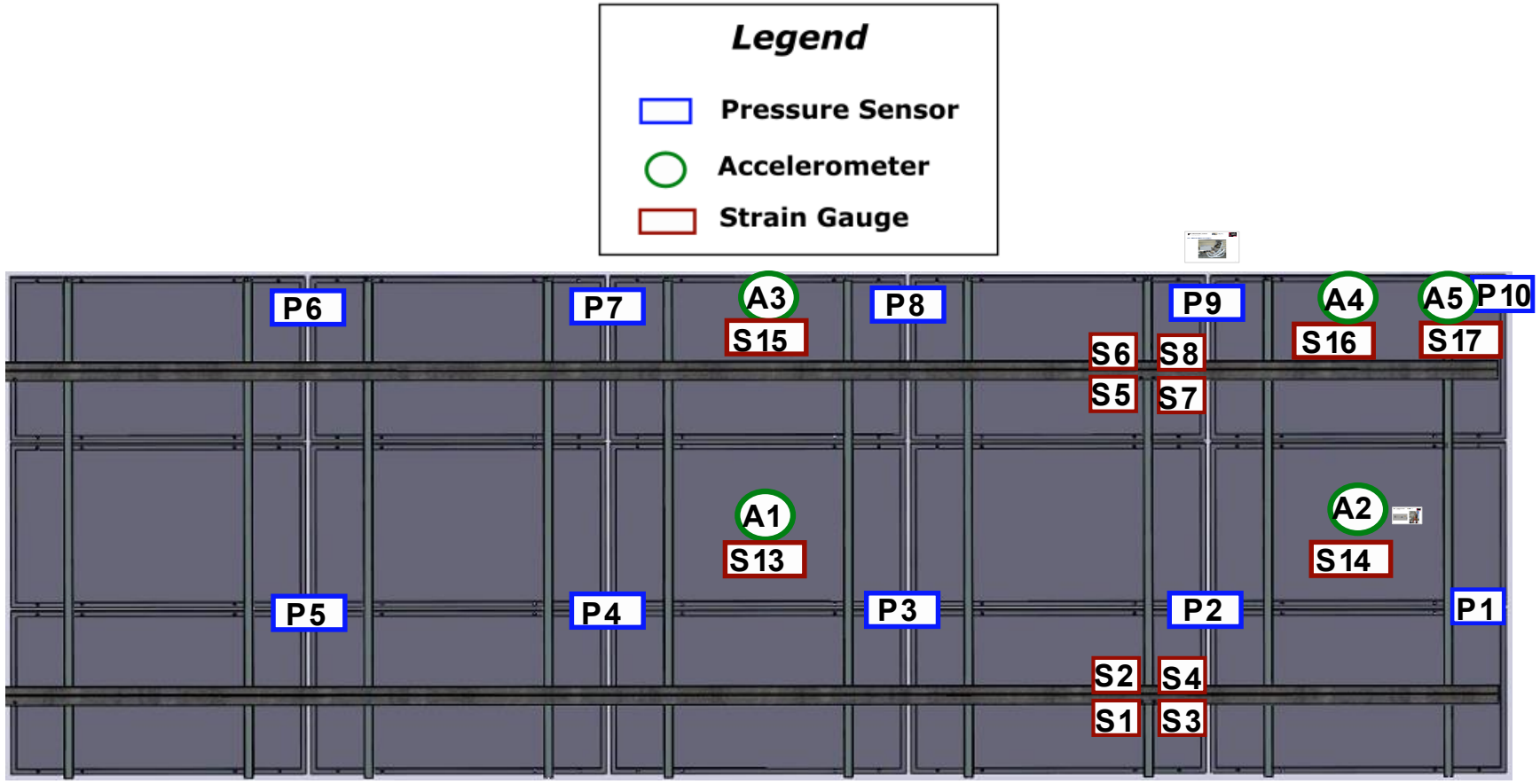
Panel Anemometer

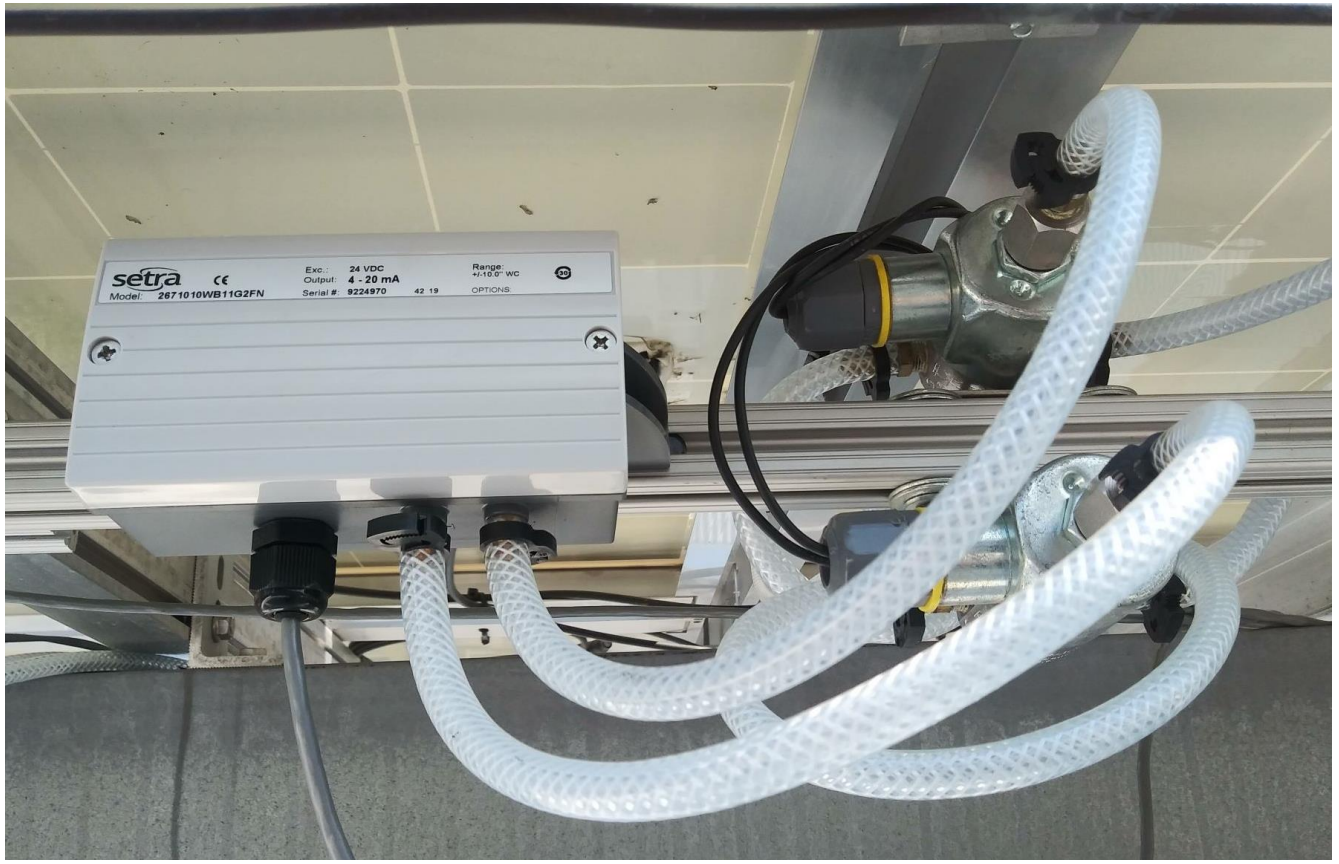
Modular Pressure System (Designed and constructed by the CWU team)



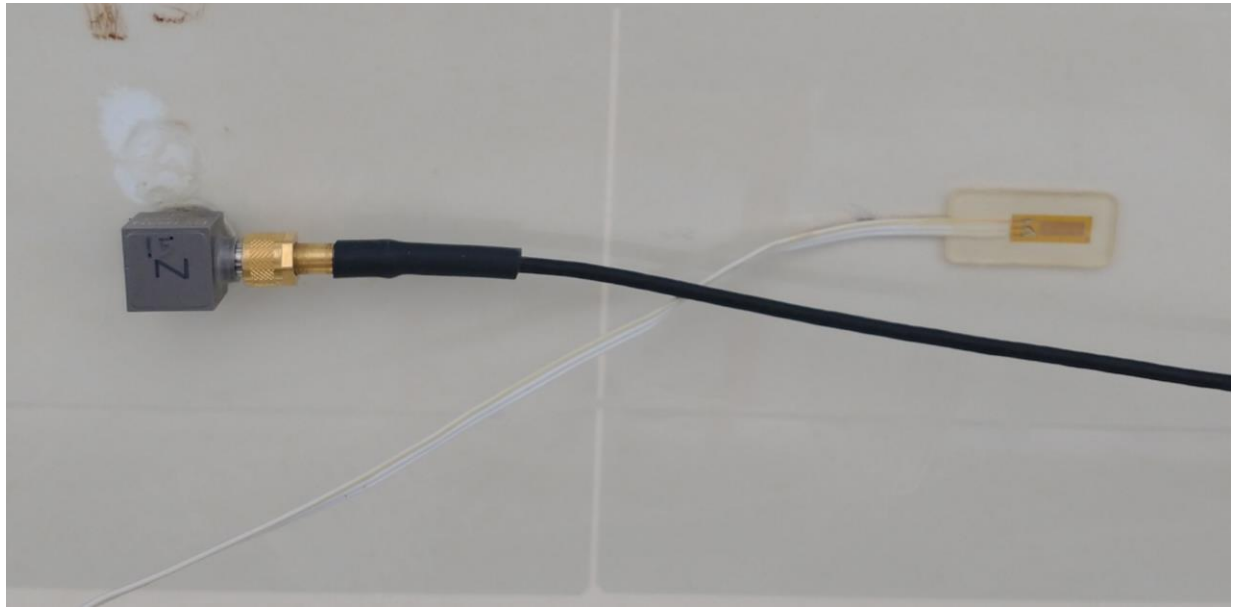
PV Array Instrumentation

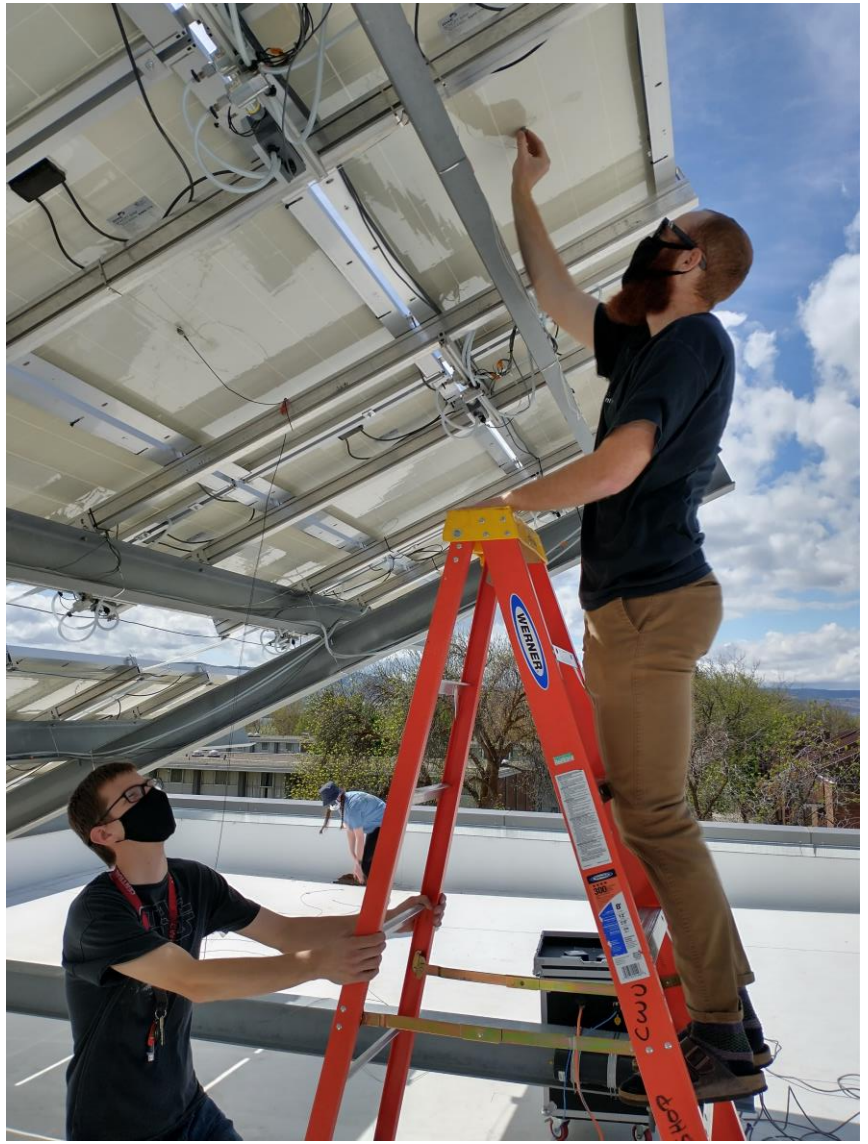


Setra Differential Pressure Transducer



Accelerometers and Strain Gauges





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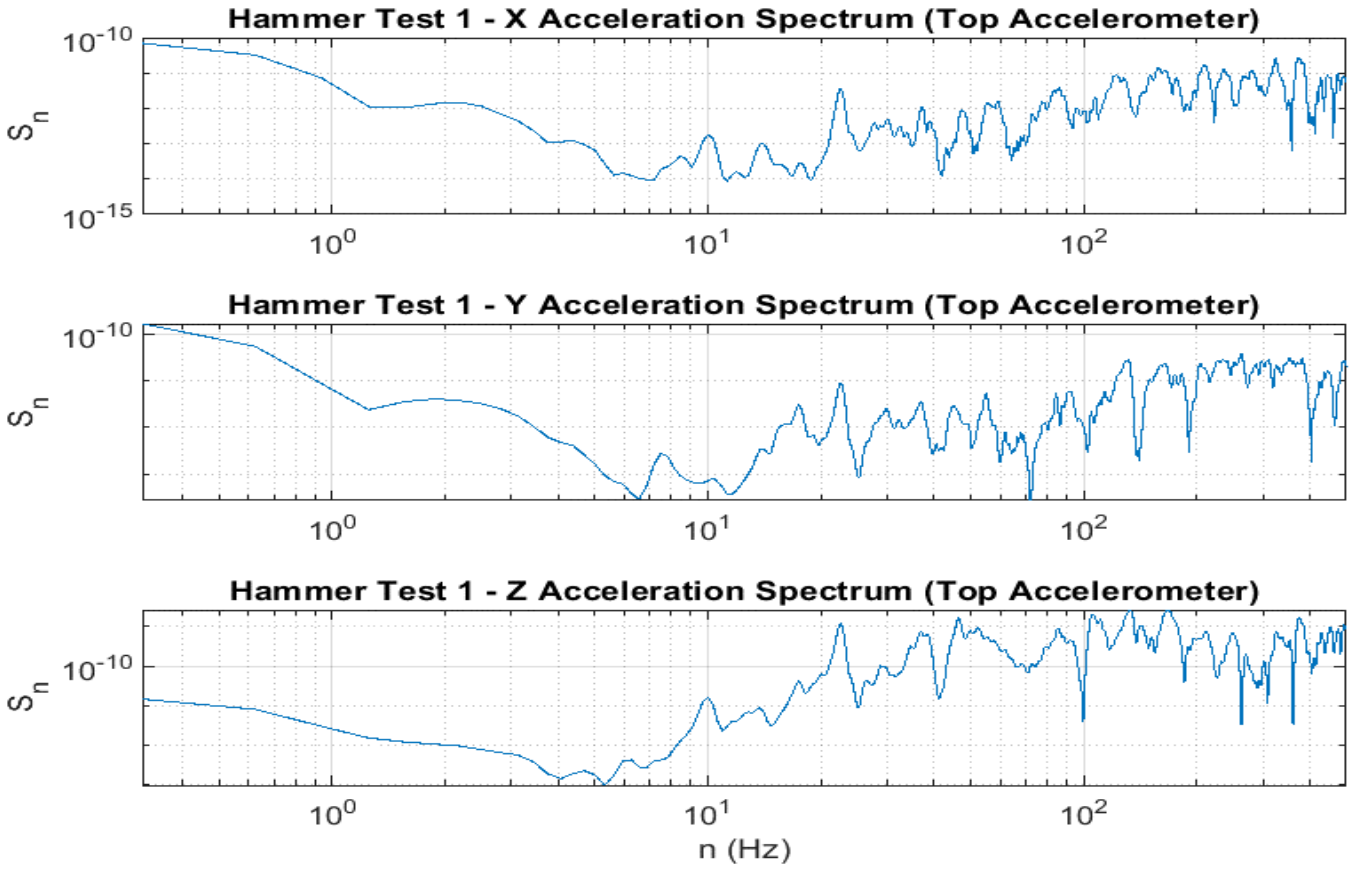
Preliminary Results

Hammer Testing

Mode #	Frequency (Hz)
1	10.0
2	14.0
3	22.0



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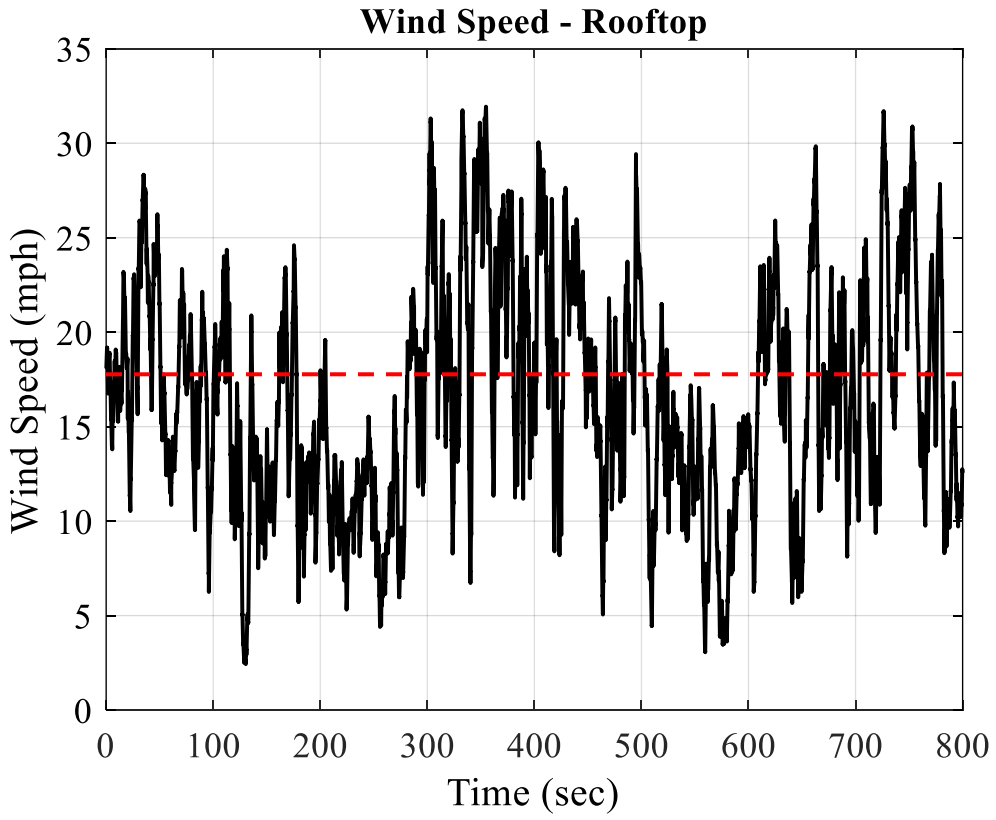
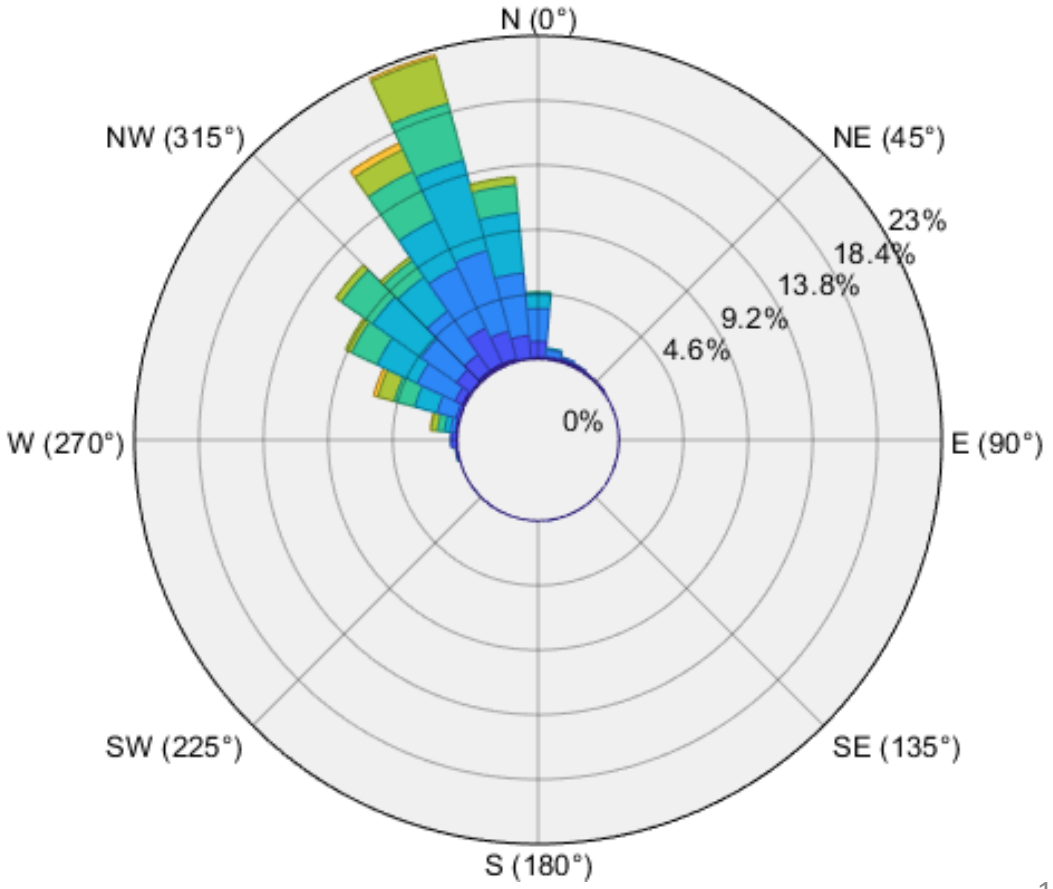
Preliminary Results

Wind Speed and Direction





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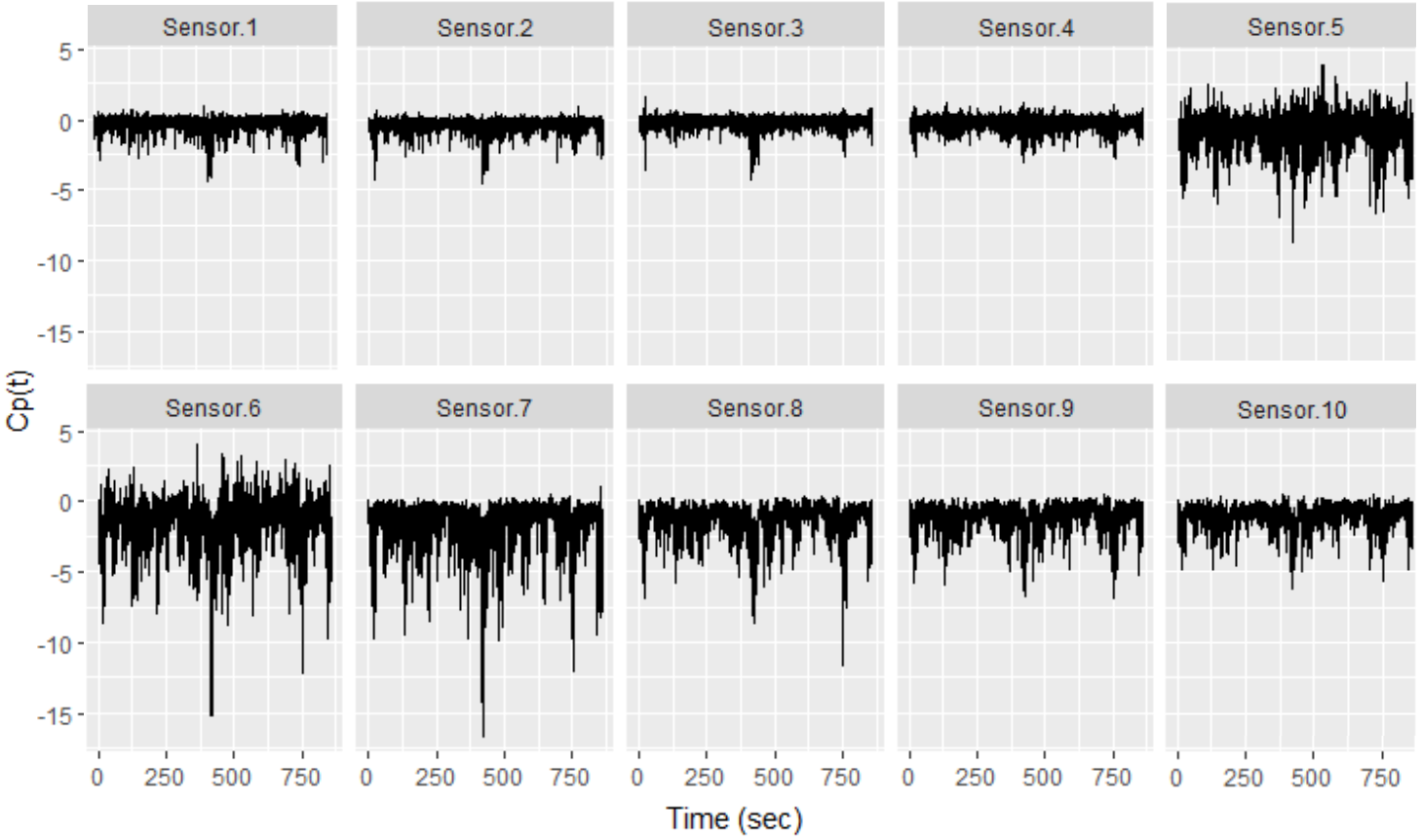
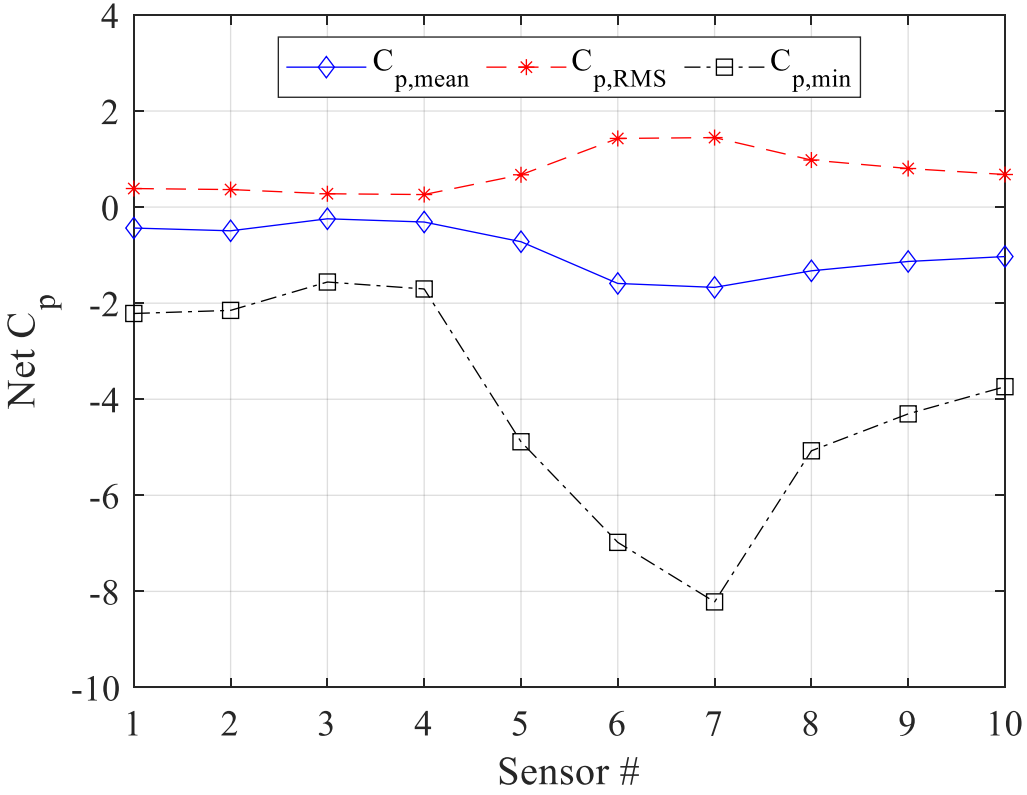
Preliminary Results

Net PV Panel Pressure Coefficient C_p





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Preliminary Results

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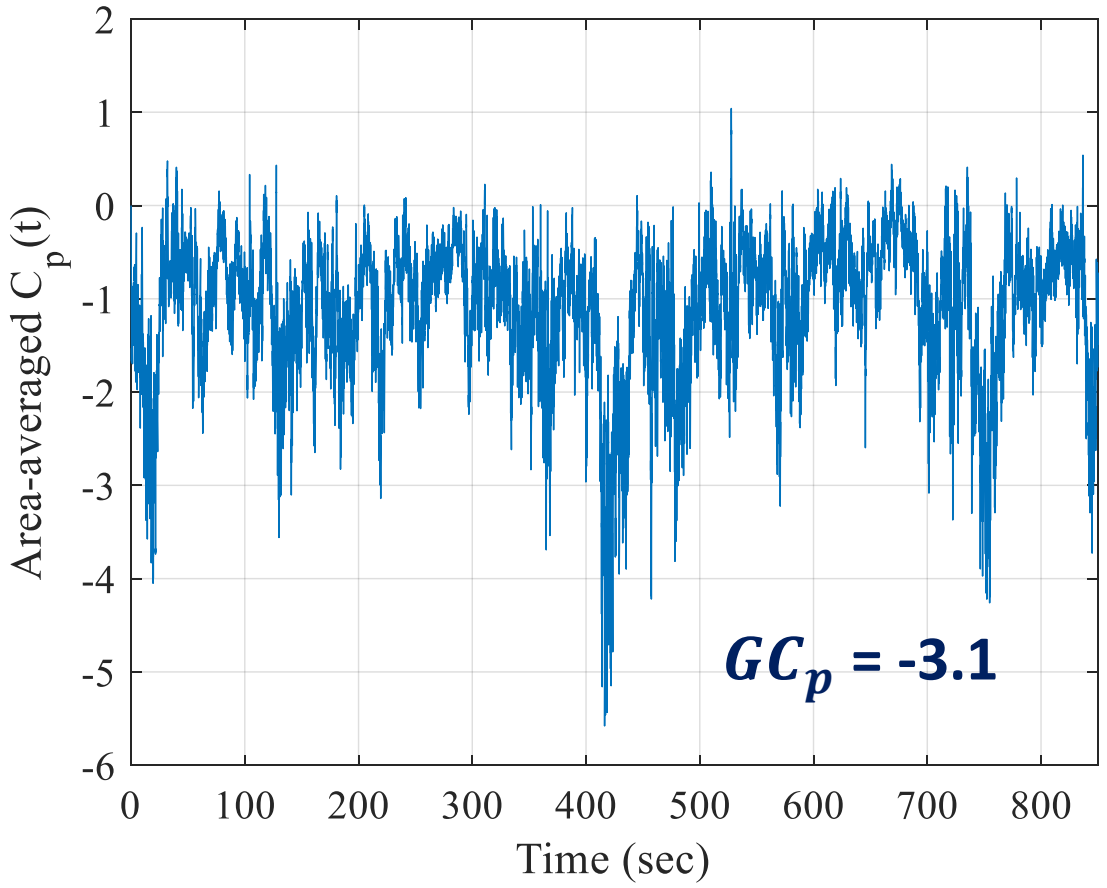
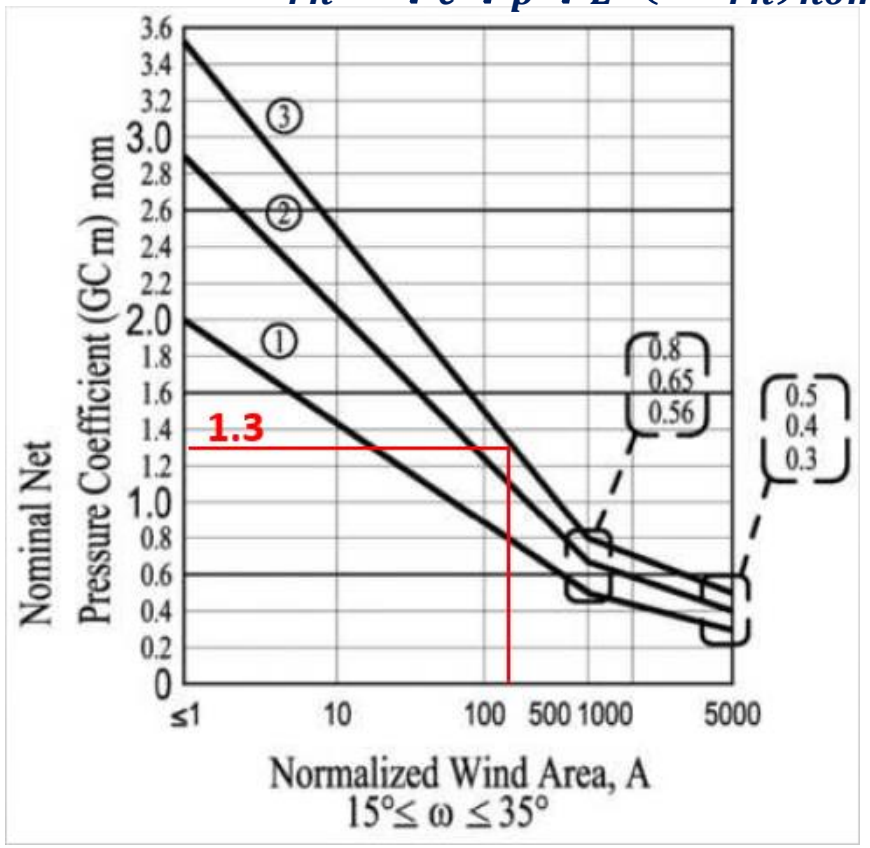


ASCE7-16: $GC_{rn} = \gamma_c . \gamma_p . \gamma_E . (GC_{rn})_{nom}$



GC_{rn} = -1.9 (Zone 3)

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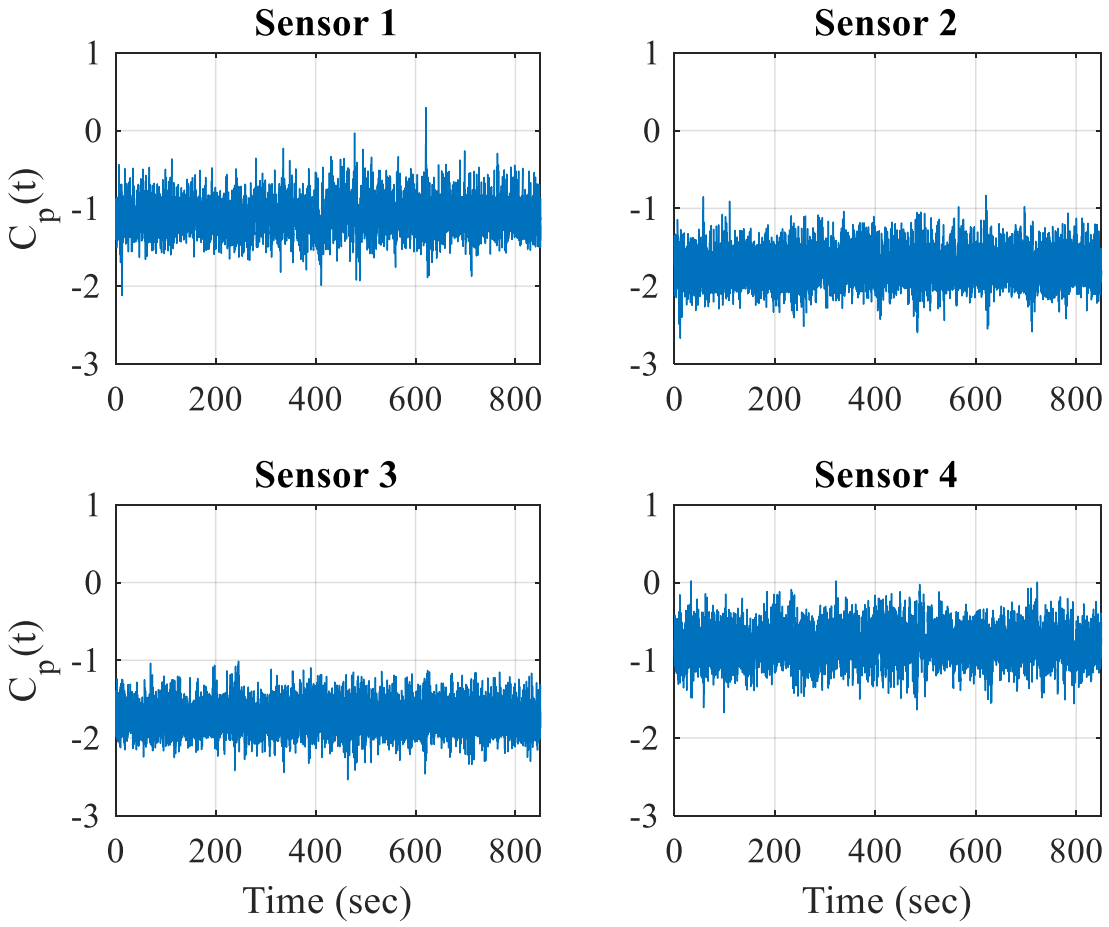
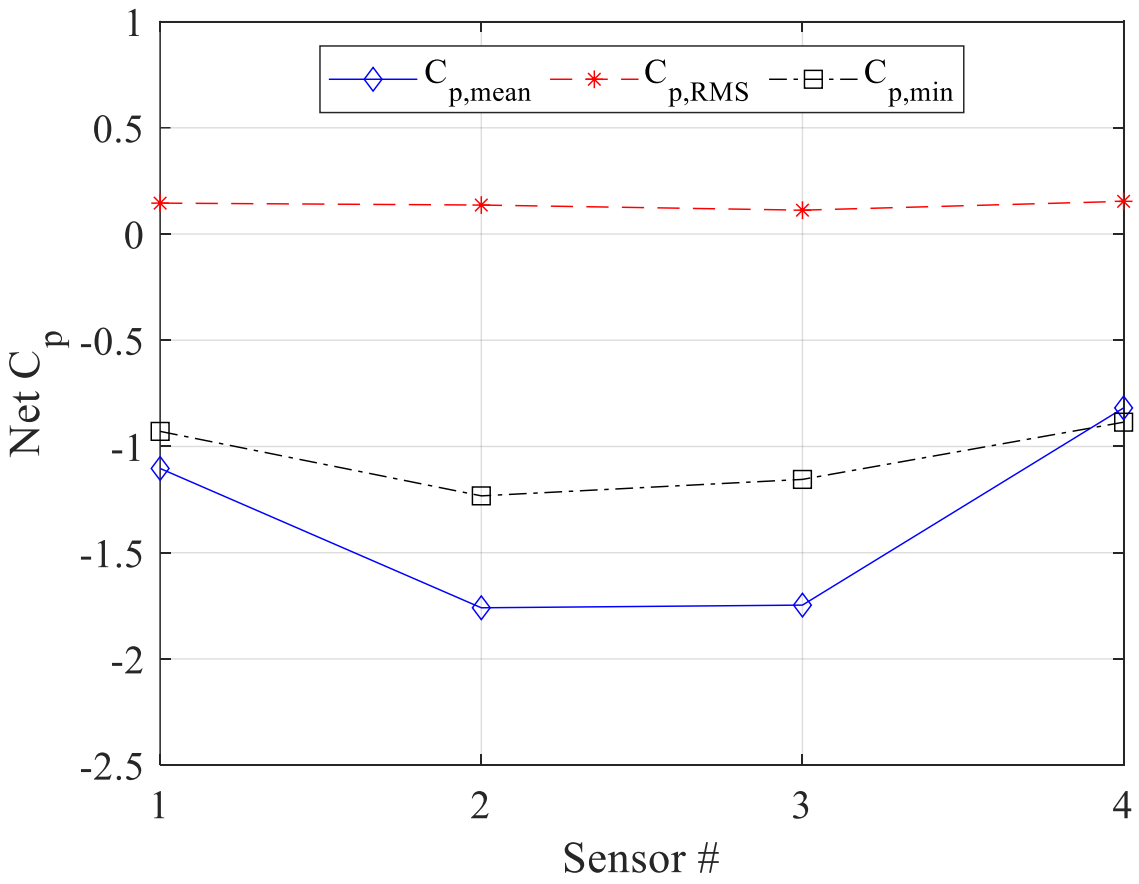
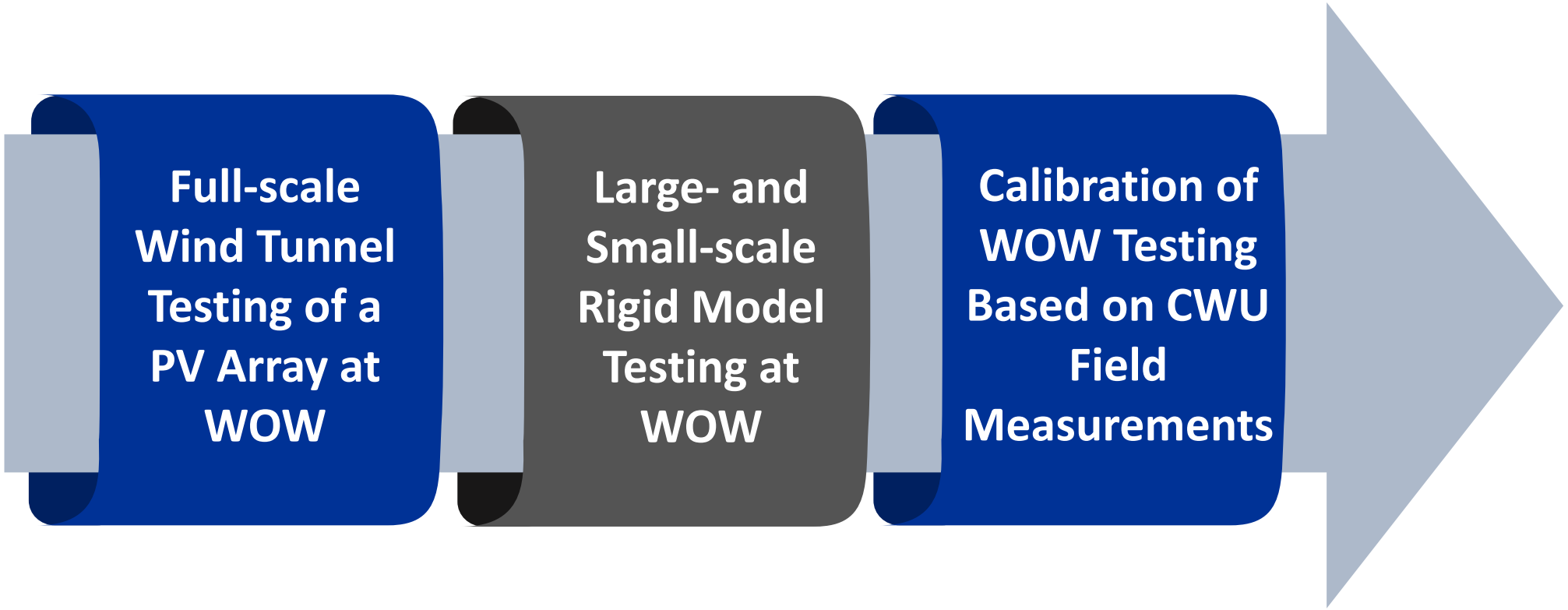
Preliminary Results

Net Roof Pressure Coefficient C_p





Future Work


Full-scale Wind Tunnel Testing of a PV Array at WOW
Large- and Small-scale Rigid Model Testing at WOW
Calibration of WOW Testing Based on CWU Field Measurements

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Thank you!

Questions?

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