



# Team 25 : Taller Wind Turbine for Low Wind Speed Regions

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## ABSTRACT

Wind power is a great way to generate clean, renewable energy. Wind turbines are very common in the West and Midwest, but current wind turbines are not effective to use in the Southeastern United States because the average wind speed is too low to provide adequate power. Team 25 has been tasked with developing a wind turbine that is cost-effective in these areas with lower average wind speeds.

## OBJECTIVES AND CONSTRAINTS

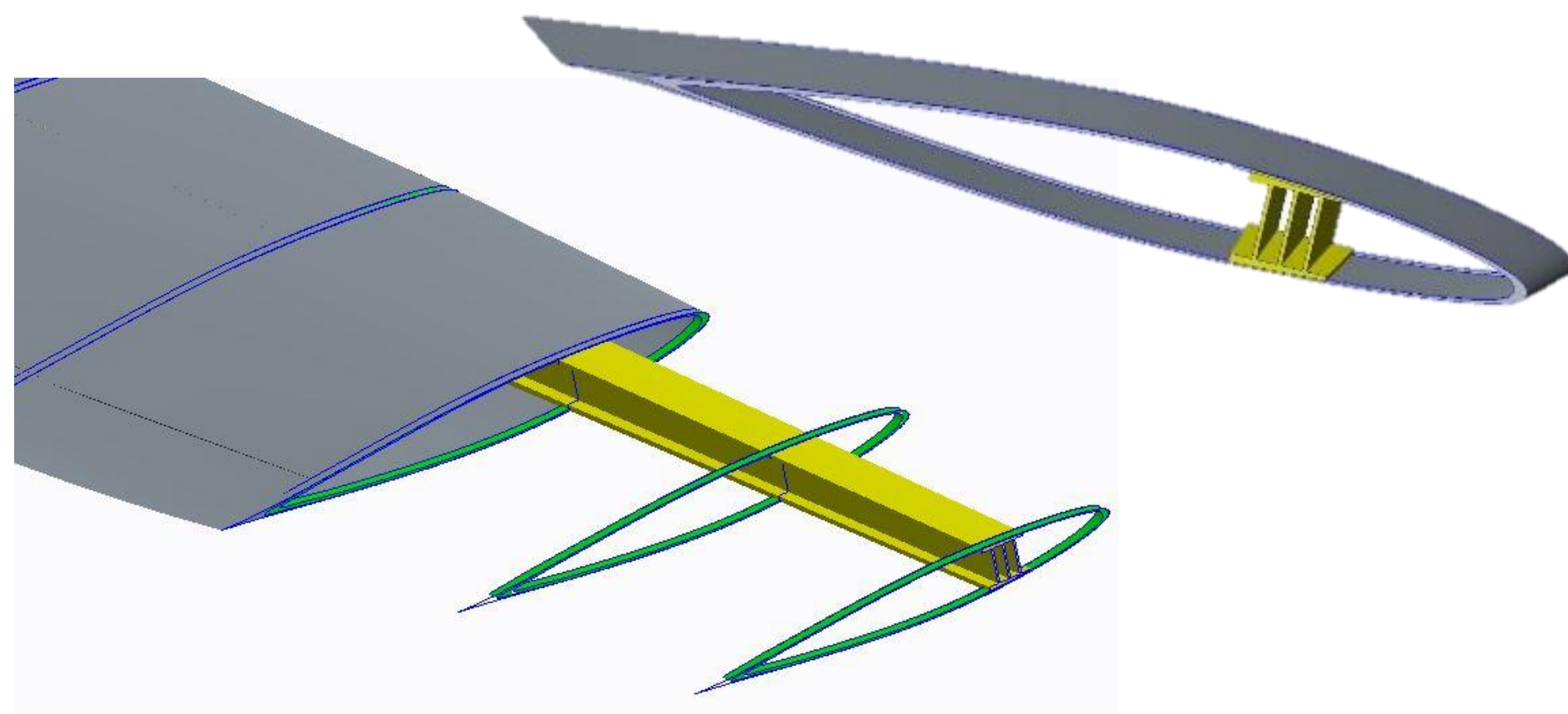
- Design a wind turbine 150-200% the height of current wind turbines
- Design lighter blades
- Use NREL 5MW generator in design
- Build scaled prototype using \$2,000 budget

## SELECTION OF BLADE DESIGN

Four initial blade designs were considered and the final design was selected based on weight, shape factor ( $\phi_B^e$ ), ease of manufacture, and risk of failure.

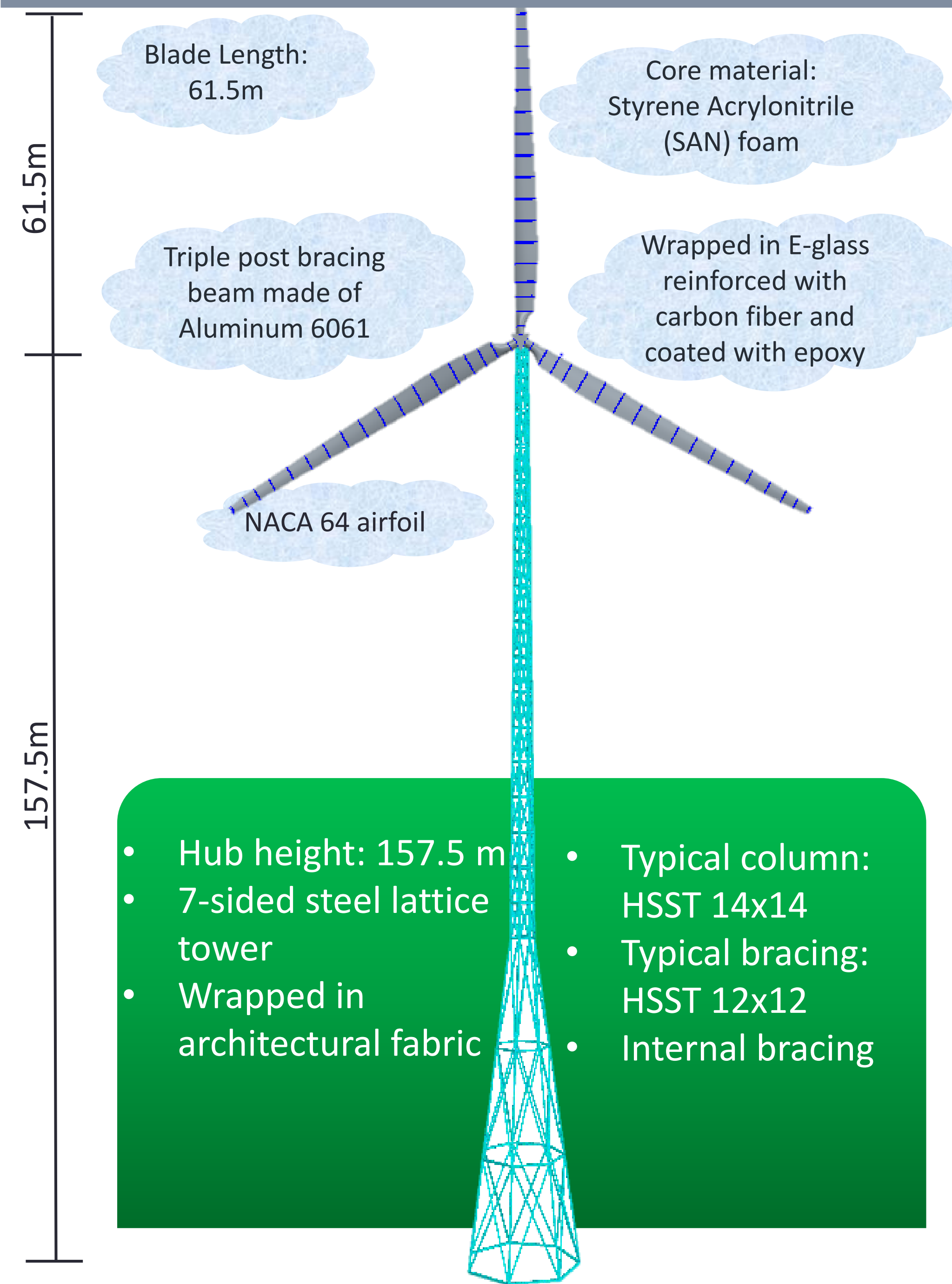
$$\phi_B^e = \frac{12I_{NS}}{A^2}$$

Triple I-beam design selected



Blade breakdown schematic

## FULL SCALE DESIGN



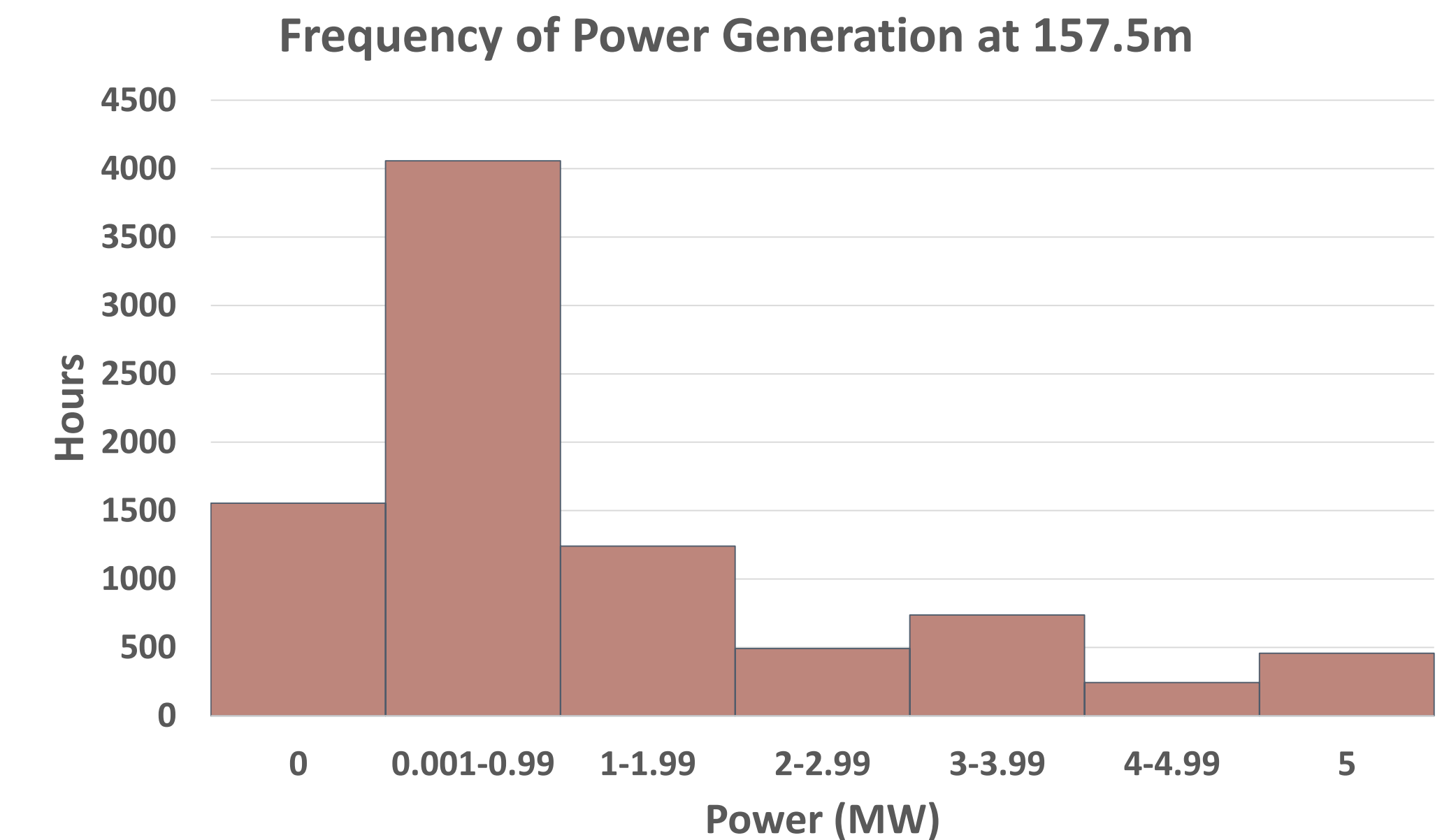
- Hub height: 157.5 m
- 7-sided steel lattice tower
- Wrapped in architectural fabric
- Typical column: HSST 14x14
- Typical bracing: HSST 12x12
- Internal bracing

## WIND SPEED CALCULATIONS

- Target site: South of Lake Okeechobee, FL
- Avg. hourly wind speed of 2014
- Interpolated data from 10m to 157.5m using:

$$v(h) = v_{10} * \left(\frac{h}{h_{10}}\right)^{\frac{1}{\alpha}}$$

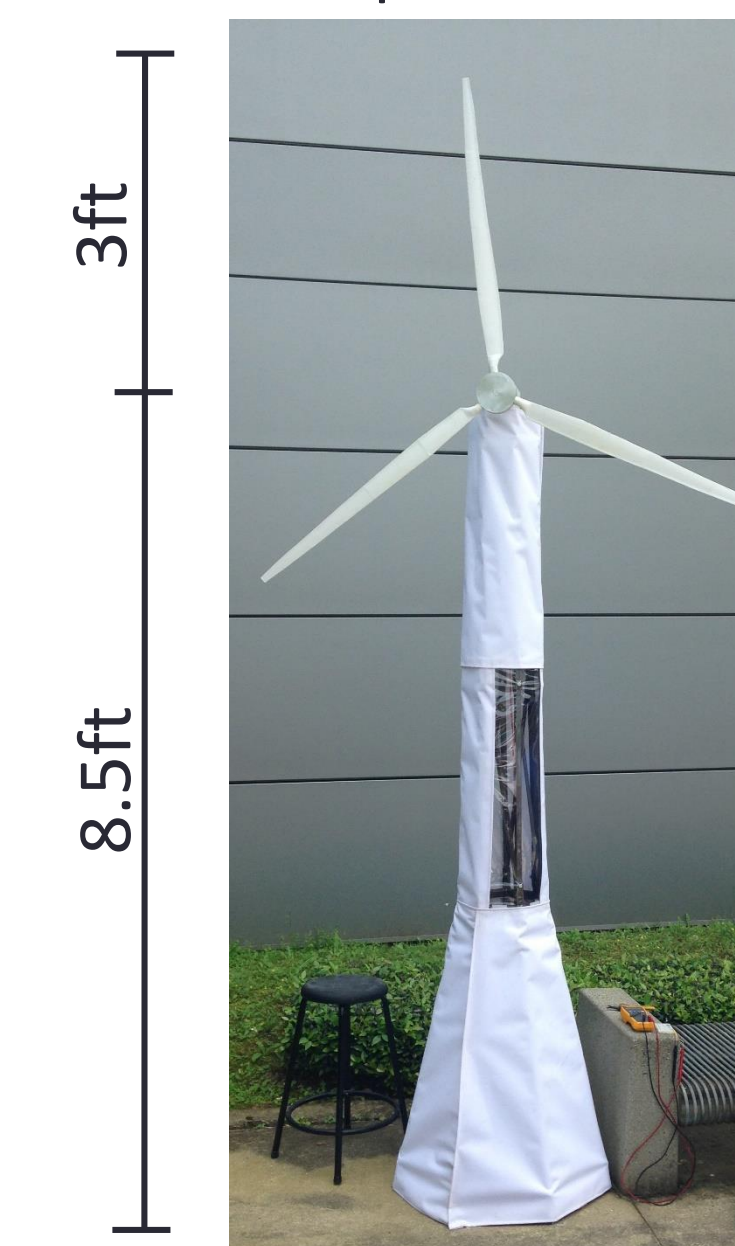
## FREQUENCY OF POWER GENERATION



- Power generated in target site
- Generates useable power 82.3% during 1 year
- Power Generated per year: 10,570MWh (970 Houses powered)

## PROTOTYPE

Due to the fact that a full scale prototype for this project is unrealistic and an accurately sized smaller prototype would result in many dimensions being infinitesimally small the team constructed a small scale representation of the full design.



### Blades

- 3D printed
- 3-ft long
- Wrapped in fiberglass

### Tower

- 8.5-ft steel lattice tower
- 3 typical sections
- Main geometry properly scaled
- Heptagonal rings between sections
- Wrapped in fabric