WOW! Challenge
Miami Coral Park Senior High School

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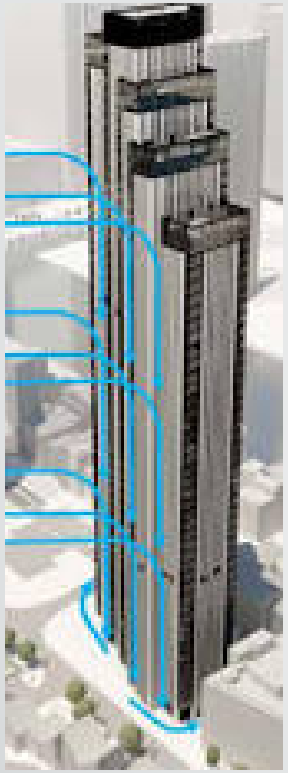
Problem Statement of Competition

The objective for the *2018 FIU Wall of Wind (WOW) Mitigation Challenge* is to reduce the wind-induced force on a building's foundation, by optimizing its overall shape.

- 32 inches tall (on base provided)
- Minimum 8 inches wide
- 40 Lbs. Maximum
- Center gravity must be within +-1 inch of center.
- Wind Test will be done from 2 sides at 90 degrees.

Hurricane Wind Mitigation

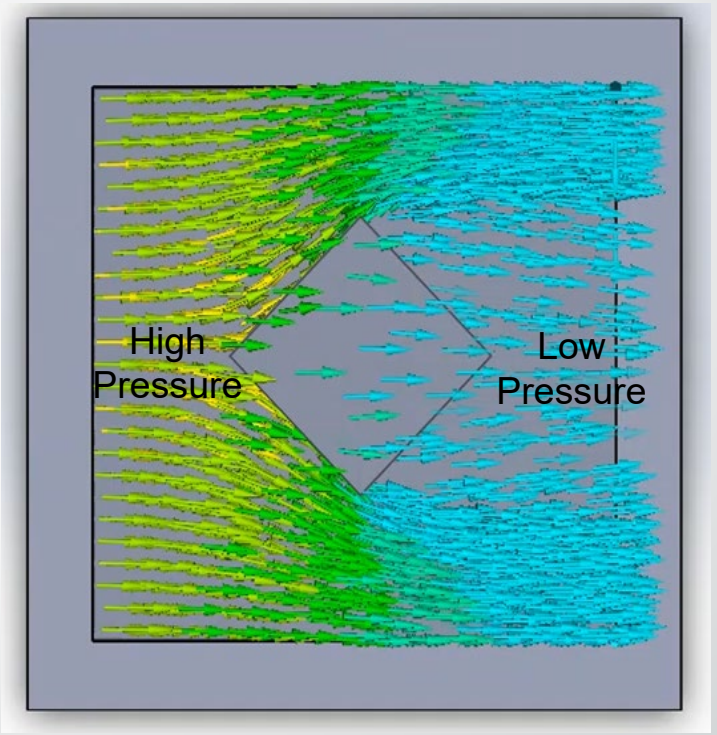


- The process of equipping a building to increase its resistance to high speed winds.
- Significantly improves the safety of the building.

- Hurricane Wind Mitigation will lower Insurance premium.
- Extremely important in hurricane-prone areas.

Possible designs

- Square
  - Good for low windspeeds
  - Little to none wind mitigation
- Diamond
  - Great mitigation at the front
  - Creates vacuum at the back

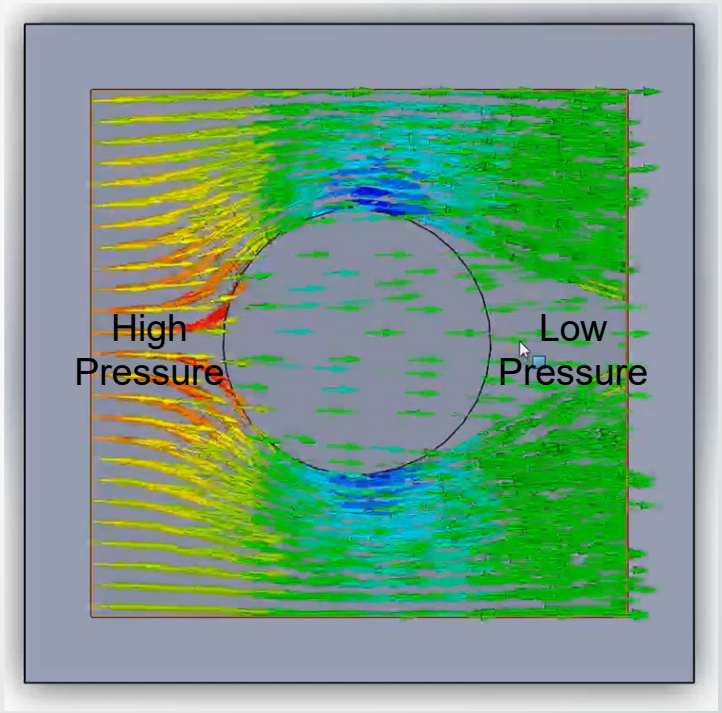


Summary

Goal Name	Unit	Value	Averaged Value	Minimum Value	Maximum Value	Progress [%]	Use In Convergence	Delta	Criteria
GG Av Turbulent Viscosity 1	[Pa*s]	0.0129	0.0137	0.0129	0.0149	100	Yes	0.0020	0.0021
GG Av Turbulent Time 1	[s]	0.014	0.014	0.014	0.014	100	Yes	1.115e-004	0.020
GG Av Turbulence Length 1	[m]	0.005	0.005	0.005	0.005	100	Yes	1.987e-004	3.693e-004
GG Av Turbulence Intensity 1	[%]	15.67	16.30	15.67	17.08	100	Yes	1.41	2.43
GG Av Turbulent Energy 1	[J/kg]	22.826	24.263	22.826	26.410	100	Yes	3.584	3.648
GG Av Turbulent Dissipation 1	[W/kg]	5317.61	5613.49	5317.61	6075.33	100	Yes	757.72	816.95

Possible designs

- Circle
  - Reduces flow viscosity significantly
  - Center of mass is easy to determine
  - More expensive to build

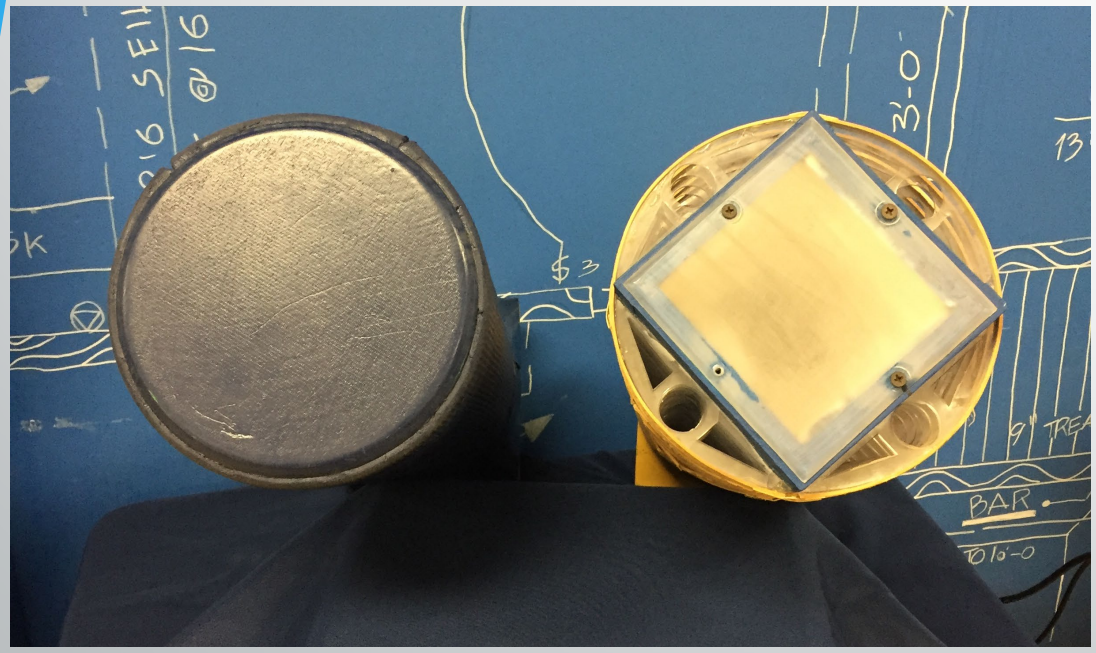


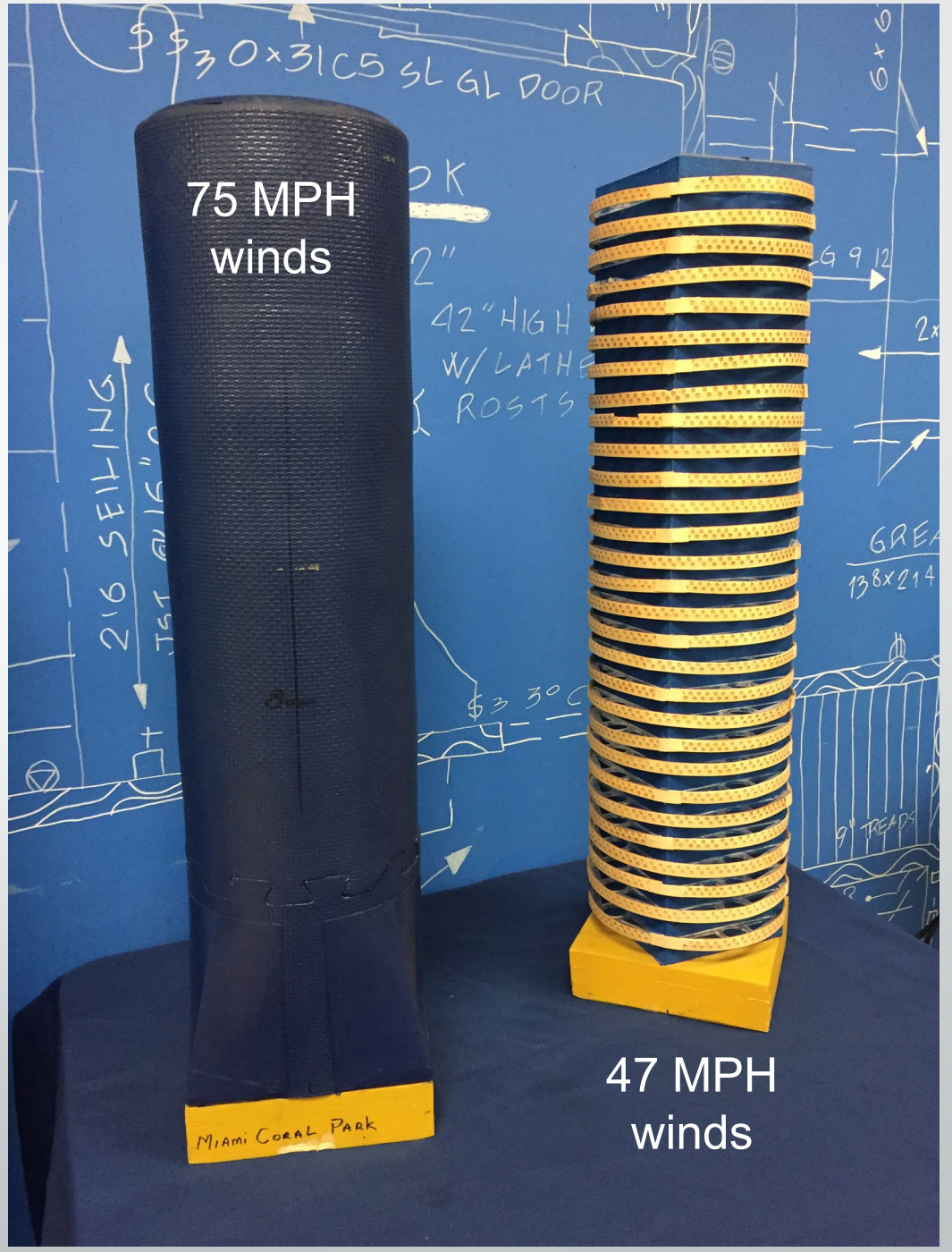
Summary

Goal Name	Unit	Value	Averaged Value	Minimum Value	Maximum Value	Progress [%]	Use In Convergence	Delta	Criteria
GG Av Turbulent Viscosity 1	[Pa*s]	0.0065	0.0069	0.0065	0.0074	100	Yes	0.0009	0.0016
GG Av Turbulent Time 1	[s]	0.012	0.012	0.012	0.012	100	Yes	1.263e-005	0.021
GG Av Turbulence Length 1	[m]	0.004	0.004	0.004	0.004	100	Yes	1.041e-004	2.714e-004
GG Av Turbulence Intensity 1	[%]	10.12	10.87	10.11	12.05	100	Yes	1.95	2.24
GG Av Turbulent Energy 1	[J/kg]	10.441	10.968	10.441	11.740	100	Yes	1.299	2.158
GG Av Turbulent Dissipation 1	[W/kg]	2289.99	2375.75	2289.99	2495.64	100	Yes	205.65	423.07

Circle Building Design

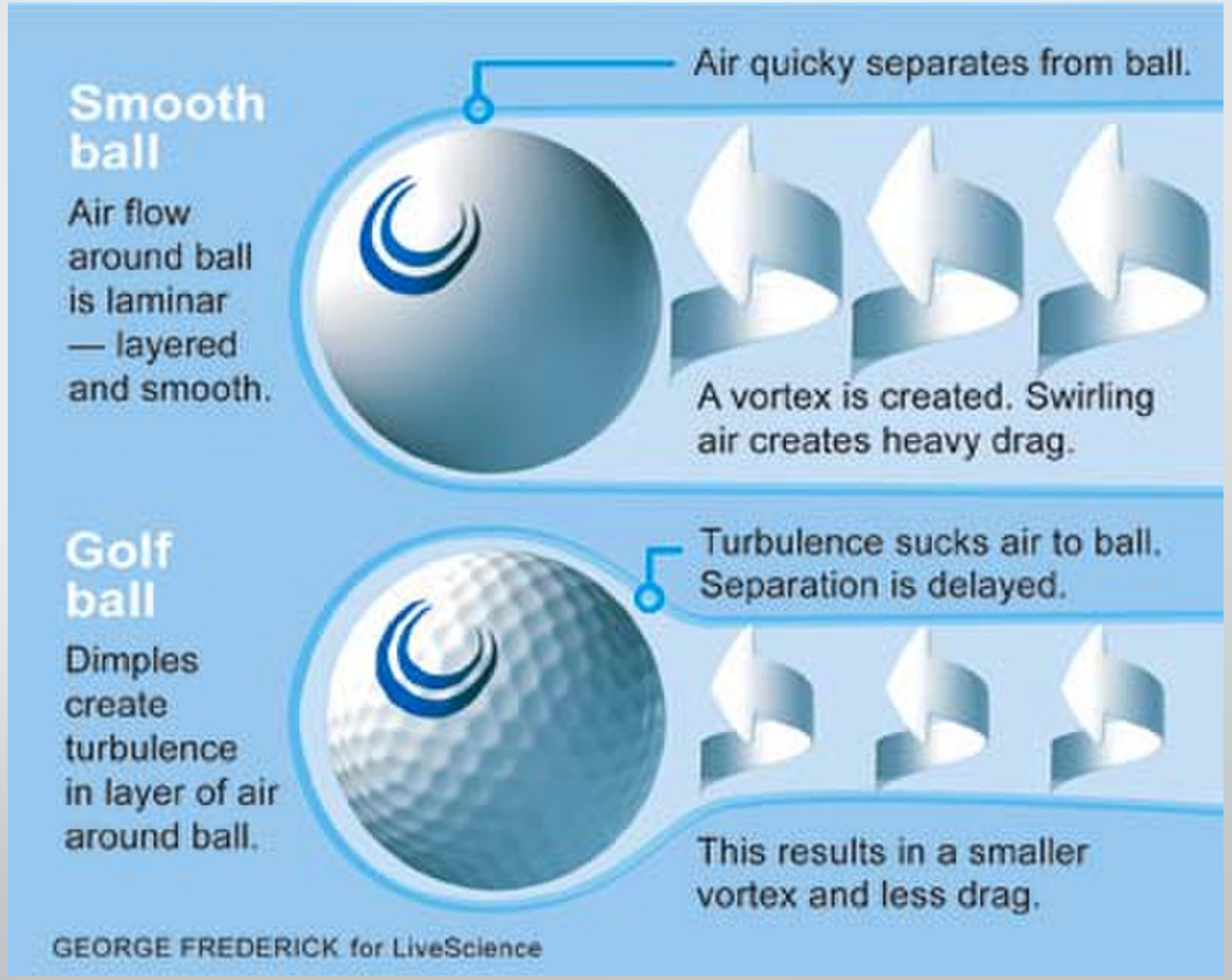
Diamond Building Design With Circular Balconies





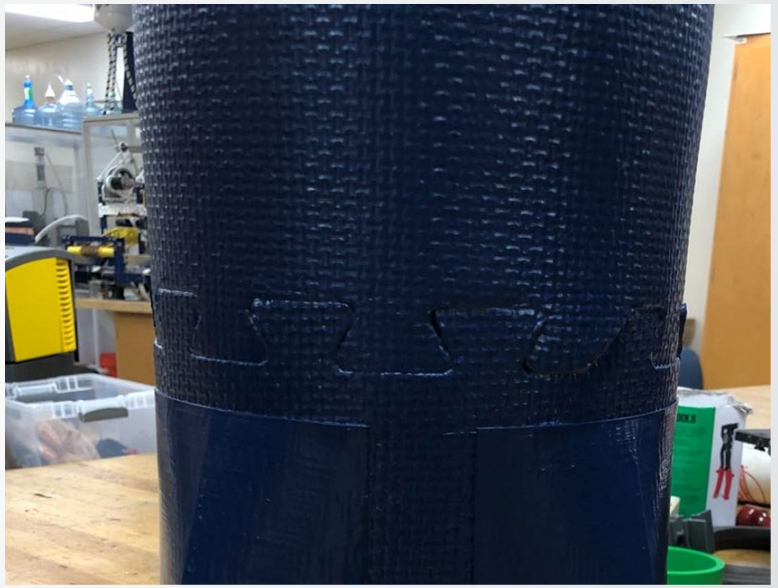
Golf Ball Effect

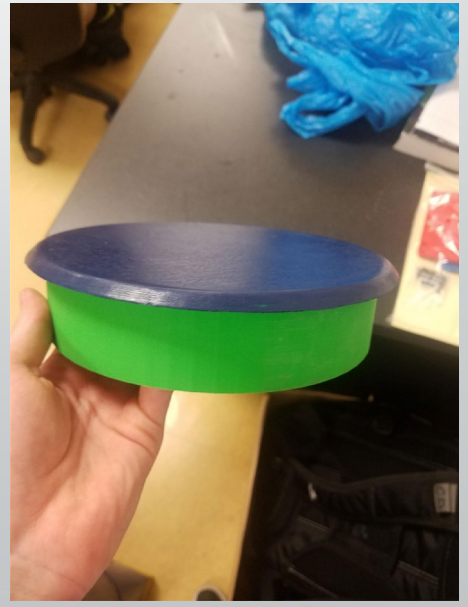
Dimpled Surface



Our Materials

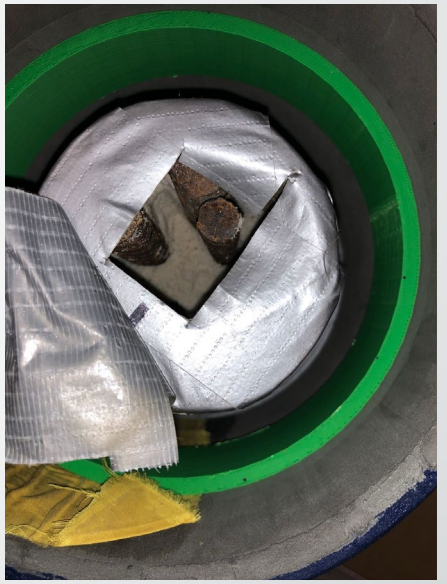
- A foam structure (VEX Field Tiles)
  - Flexible
  - Easy to shape
  - Dimpled surface
- 3D-printed dome
  - Facilitates wind flow at the top





Our Materials

- Circular rings along the structure in rib pattern
  - Maintain shape
  - Increase structural strength
- Sand and Rebar
  - Add weight to the structure
  - Easy to add/remove
  - Help keep center of mass in desired location



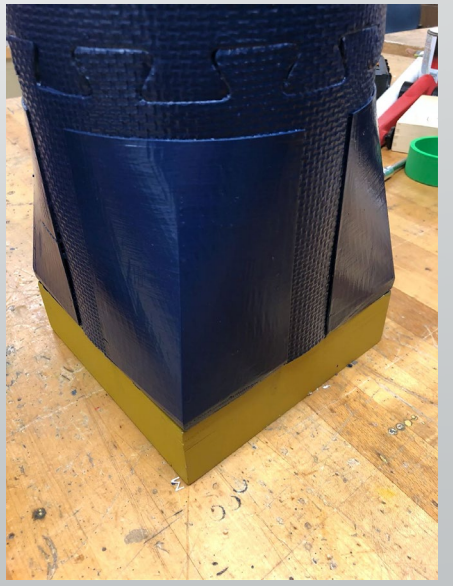
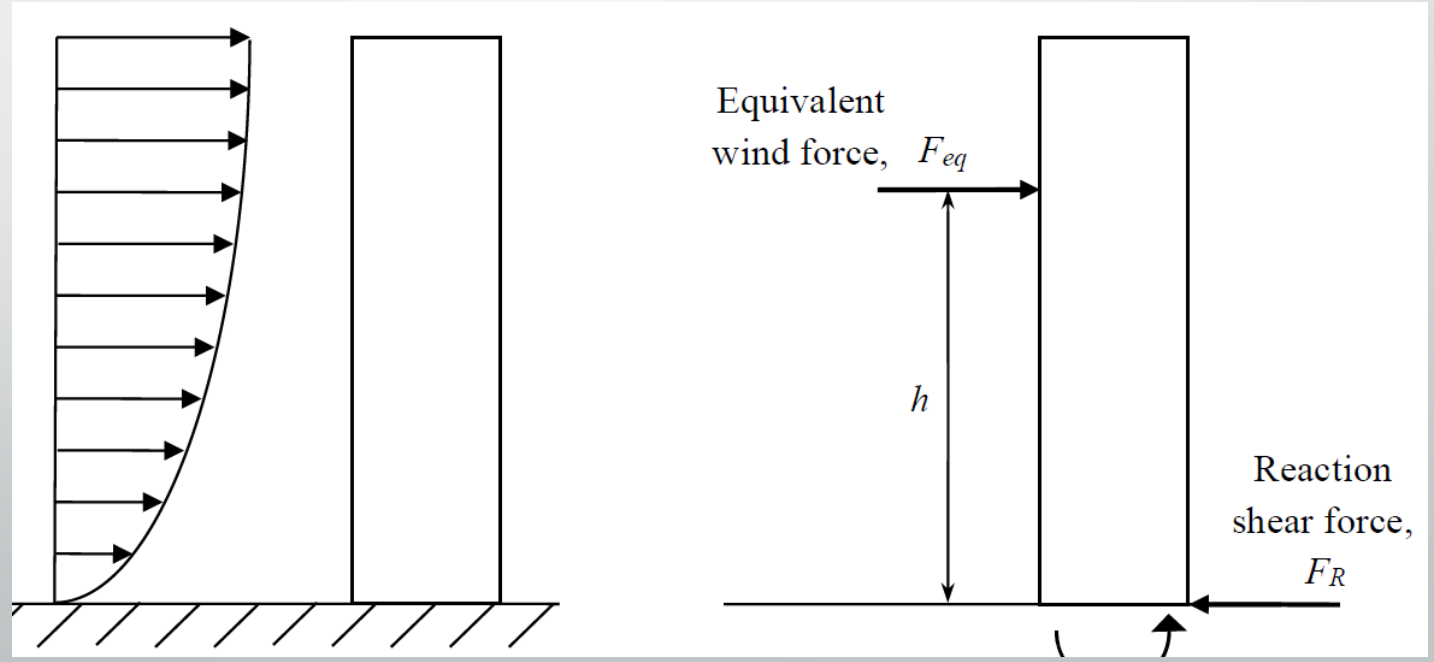


Diagram of downward force on bottom of building

3D-printed corners

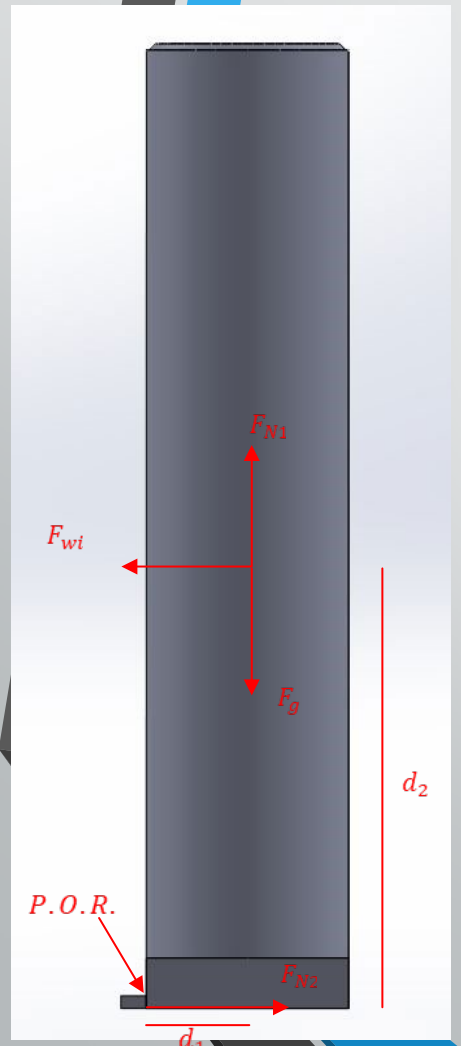
- Increase downward force by manipulating wind

- Increase the upward normal force experienced



Calculations

Force Exerted by Wind



$$\sum \tau_x = 0$$

$$\tau_1 + \tau_2 = 0$$

$$F_g d_1 - F_{wind}\, d_2 = 0$$

$$F_{wind} = \frac{F_g d_1}{d_2}$$

Center of Mass

Cylinder C.O.M.: (4 , 17) in
Block C.O.M.: (4 , 1) in

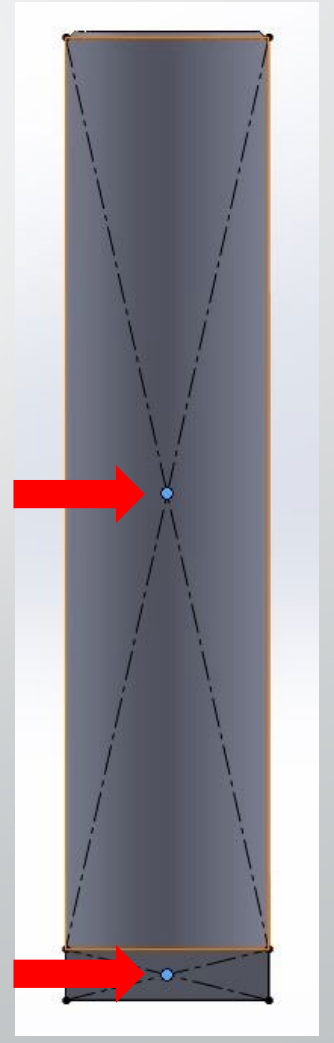
$$y_{com} = \frac{1}{m_T}\sum_{i=1}^{\infty} m_i y_i$$

$$y_{com} = \frac{m_{cylinder} y_{cylinder} + m_{block} y_{block}}{m_T}$$

$$y_{com} = \frac{(16.3kg)(0.432m) + (2.1kg)(0.025m)}{18.4kg}$$

$$y_{com} = 0.385\ m$$

$$y_{com} \cong 15.25\ in$$



Video of test in wall of wind


Wall of Wind Challenge
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