W W! VIRTUAL CHALLENGE 2022

Virtual Competition at the NSF-NHERI Wall of Wind FIU's Engineering & Computing Center
Week of March 28th, 2022

Physical Guidelines

Updated: 03-09-22

1. Design Objective

1.1: The objective for the *2022 FIU Wall of Wind (WOW) Mitigation Challenge* is to reduce the wind-induced force on a building's foundation, by optimizing its overall shape. A schematic diagram of this interaction is shown in Figure 1. Mitigation solutions will demonstrate a sound comprehension of aerodynamic principles. Teams are tasked with developing a mitigation solution that will improve a building's aerodynamic performance in order to reduce the reaction forces and moments on a scale model of the building. The building models will be tested by the NSF-NHERI Wall of Wind at FIU to evaluate the effectiveness of the mitigation solution. The mitigation solution may be created by re-shaping an allowable portion of the building model.

1.2 ***Teams must develop and construct their building design in compliance with the requirements and restrictions described in this document below. READ ALL THE RULES CAREFULLY!***

1.3 : A PowerPoint will become available on the PowerPoint section of the Challenge web page: https://www.ihrc.fiu.edu/outreach-education/wall-of-wind-challenge/
Please also review any new technical questions covered in a FAQ Document in the Documents section of the web page.

2. Scale Building Model Requirements and Restrictions

2.1: Each team will construct a building model and have it tested by the NSF-NHERI Wall of Wind.

2.2: The goal is to construct a building model that will remain upright, not blown over, to as high a wind speed as possible.

2.3: The building model will be a minimum of 32 inches high (i.e. total height), which includes a gold painted wooden base (8 inches x8 inches x1.5 inches) which will be provided for each team; see Figure 2.

2.4: Above the lowest 1.5 inches of the building model, which is the provided wooden base, and up to at least 30.5 inches above the base, the building model must have a minimum **solid** (i.e. not porous; no air can pass through) width of 8 inches, or wider; see Figure 2.

2.5: The weight of the building model must be no greater than 40 lbs., including the provided square base. The center of gravity must be directly above the center of the 8 inch square base (+/- 0.5 inches) and must be within +/- 1 inch of the mid-height of the model building, measured from the bottom of the provided base to the top of the highest element on the building model. See Figure 2.

2.6: Any shape above the lowest 1.5 inches of the provided base can be used as long as it always has a minimum **solid** width of 8 inches when viewed from any and all directions; see Figure 3 for shape examples.

2.7: All building models will be tested for two wind directions at 90 degrees to each other; see Figure 3 for example wind directions on various shapes. The building model will be prevented from sliding during the Wall of Wind tests by a small 0.75-inch-high stop that will be placed at the back and side edges of the gold base.

2.8: The goal is to have a building model shape that has the least tendency to be blown over by the wind when tested for the two directions at 90 degrees to each other. The wind speed for each of the two directions will be gradually increased until the model blows over. The higher the wind speed at which this happens will result in a higher score for the team.

Other remarks:

- Any type of non-hazardous material shall be allowed and considered acceptable for designing the mitigation solution, given that the solution complies with the construction guidelines described in sections 2.1-2.8. Some common examples of acceptable materials include (but are not limited to) wood, foam, plastic, metal, white glue, super glue, and epoxy.

- Wind speeds will be measured by the FIU Wall of Wind team.

- Each student team with be provided with $50 for buying materials and supplies. Students are permitted to spend more than the provided $50, but these additional costs shall be the responsibility of the student team.

3. Physical Test Requirements and Restrictions

3.1 : High school teams will deliver their building models to FIU no later than March 30th or make arrangements for pick-up. During the competition, each Team's building model will be tested by the NSF-NHERI Wall of Wind, which will generate incremental wind speeds; see Figure 4.

3.2 : Only one building model will be accepted from each high school team for wind testing.

3.3: Safety is paramount during the competition and wind testing. The FIU Wall of Wind team will be responsible for preparing and securing the building models for the wind testing. Everyone is required to wear a FIU safety hard hat in the Wall of Wind Building before and after the wind tests.

3.4: Prior to wind testing, Judges will inspect the building models to verify that the design and mitigation solution is in compliance with the requirements and restrictions listed in Section 2; the Judges reserve the right to deduct points or disqualify from competition any design and or mitigation solution that is found to be in violation of the rules and regulations listed in Section 2.

4. Scoring

4.1 : The score for each high school team for the wind tests will be calculated as follows: Two "blow-over" speeds will be recorded for each building model; one for wind direction 1 and one for wind direction 2 at 90 degrees from the first direction. The Judges will pick the two sides and angles to be tested. The score will be the lower of these two speeds plus 0.9 x the higher of the two speeds.

4.2 : Building Height Bonus: the score of the physical testing for any building model over 32 inches will be multiplied by a ratio of total height divided by 32. All other rules still apply. The center of gravity must be located at half of the total height +/- 1 inch and the minimum width must always be 8 inches from any direction. The weight of the building model must be no greater than 40 lbs.

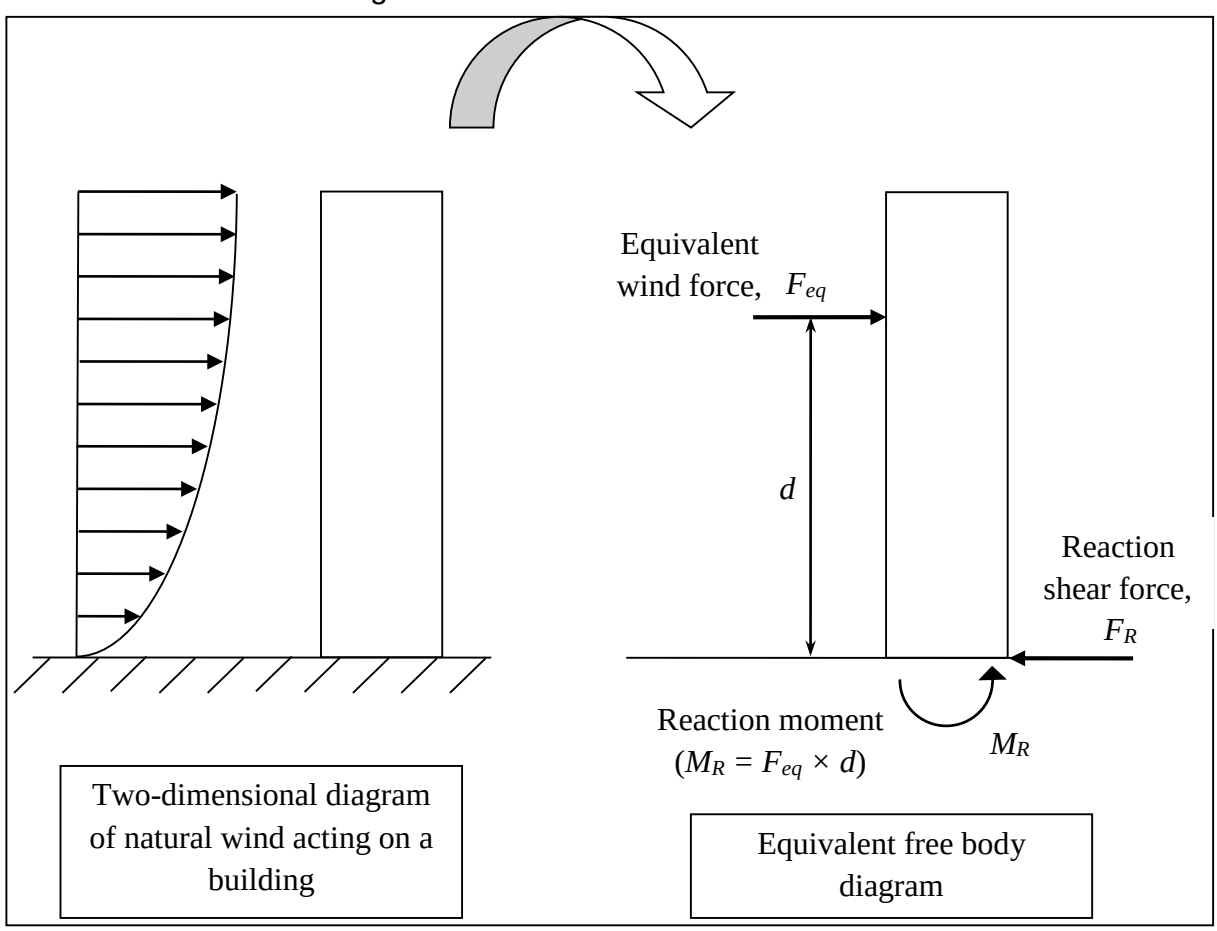

Figure 1: Simplified two-dimensional schematic diagram of wind acting on a tall building, and the equivalent free body diagram. Note: across wind forces and moments may also exist, and will act into or out of the building.

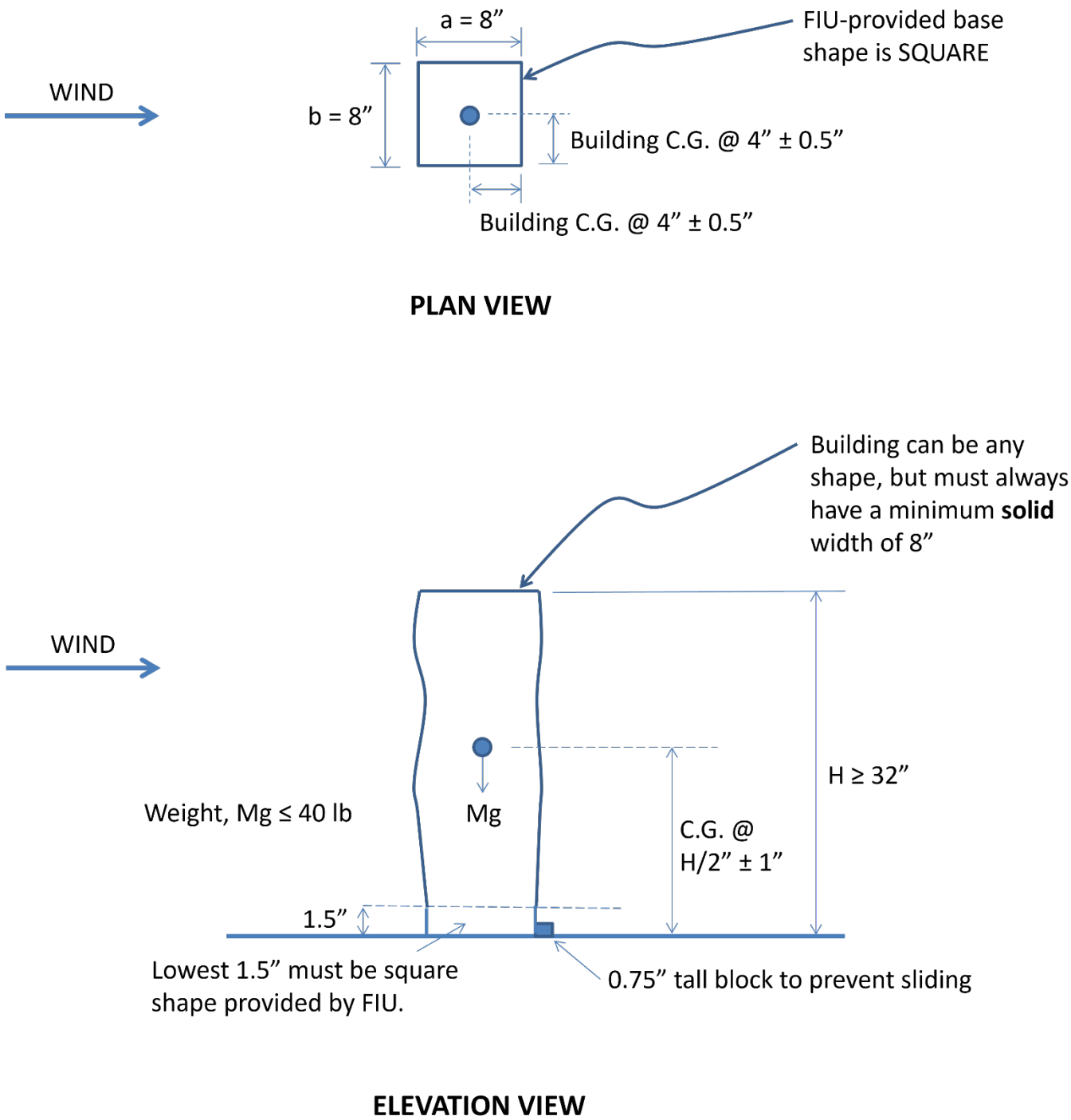

Figure 2: Schematic diagram of the building model, showing variable shape above the provided square base.

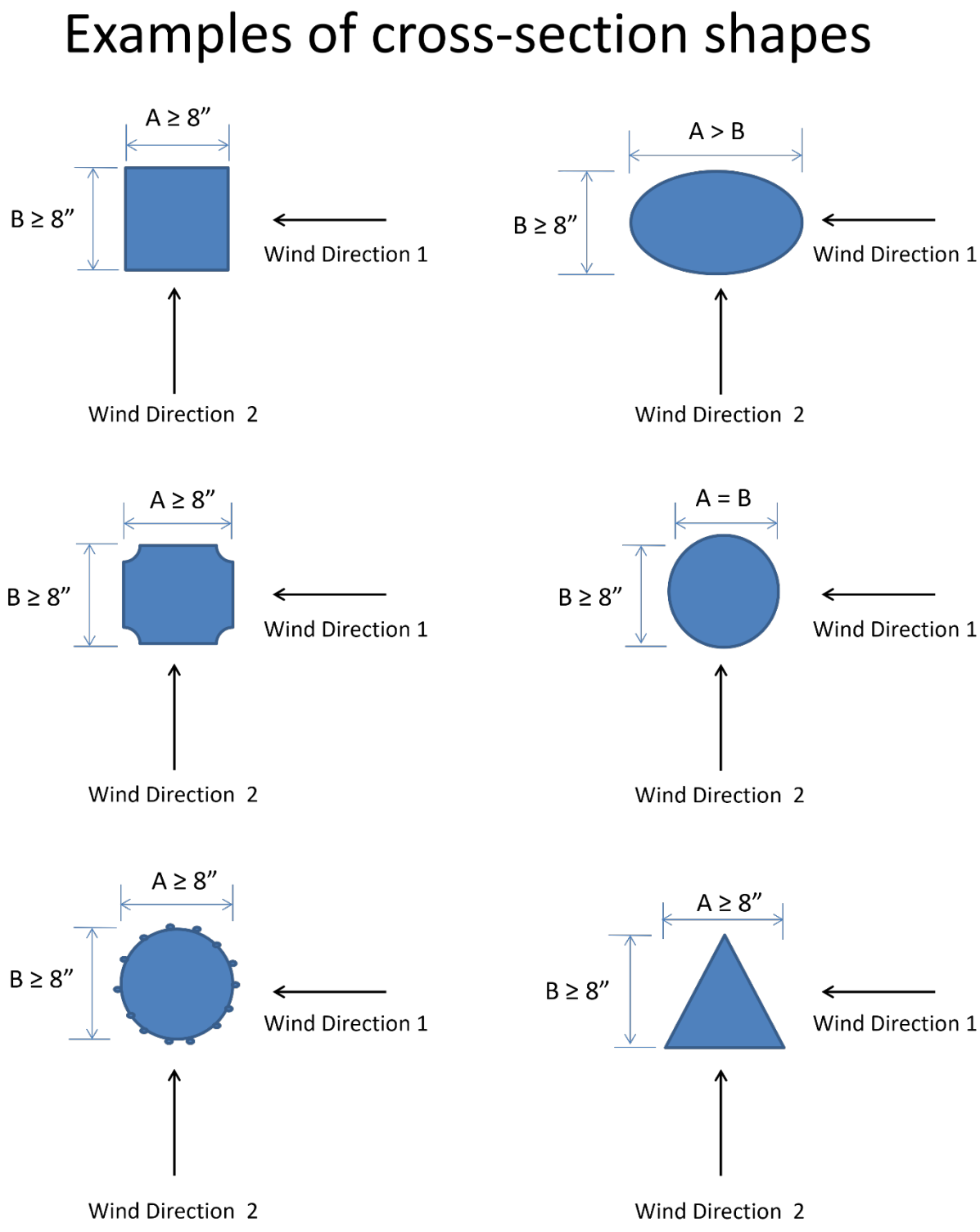

Figure 3: Examples of allowable cross-section shapes and wind directions that will be tested at the NSF-NHERI Wall of Wind at FIU.

Figure 4: The NSF-NHERI Wall of Wind will test the building models for the 2022 Wall of Wind Mitigation Challenge; the NSF-NHERI Wall of Wind can generate sustained wind speeds up to the highest classification in the Saffir–Simpson Hurricane Scale, a Category 5 hurricane.