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Abstract
 The project consists of a current medical facility located in Gresham, Oregon. This site is subjected to fierce winds pushing west out of the Columbia River Gorge. These winds have the ability to reach hurricane wind speeds which will ultimately guide the shape of the building footprint and overall orientation/ building envelope. ZGF is looking for a qualitative study between multiple massing models in relationship with wind turbulence. These models are desired to reveal not only the effects of the wind on the massing models, but the existing buildings surrounding the new building. The goal behind this series of wind tunnel tests is to decide whether or not the building itself can be designed around the forces of wind or if there needs to be another intervening source, i.e. landscaping.

The primary design elements to be informed by these wind tunnel tests are overall shape of the building between two proposed designs, a tall rectangular building or an "L" shape. These buildings also vary in height from their designs, 18 feet to 54 feet. The comfort of the vehicle turn around corridor just east of the main entrance i.e. wind concentration (eddy affect), high and low pressures, and wind noise. The area that is affected the most is the entry itself, therefore our secondary focus will be to find a way to make this entry safe from the winds as the current condition allows wind to essentially flood into the building once the doors open. Depending on how effective the wind tunnel is they are also interested in learning about the wind effects on a second entry door facing the parking lot to the east.

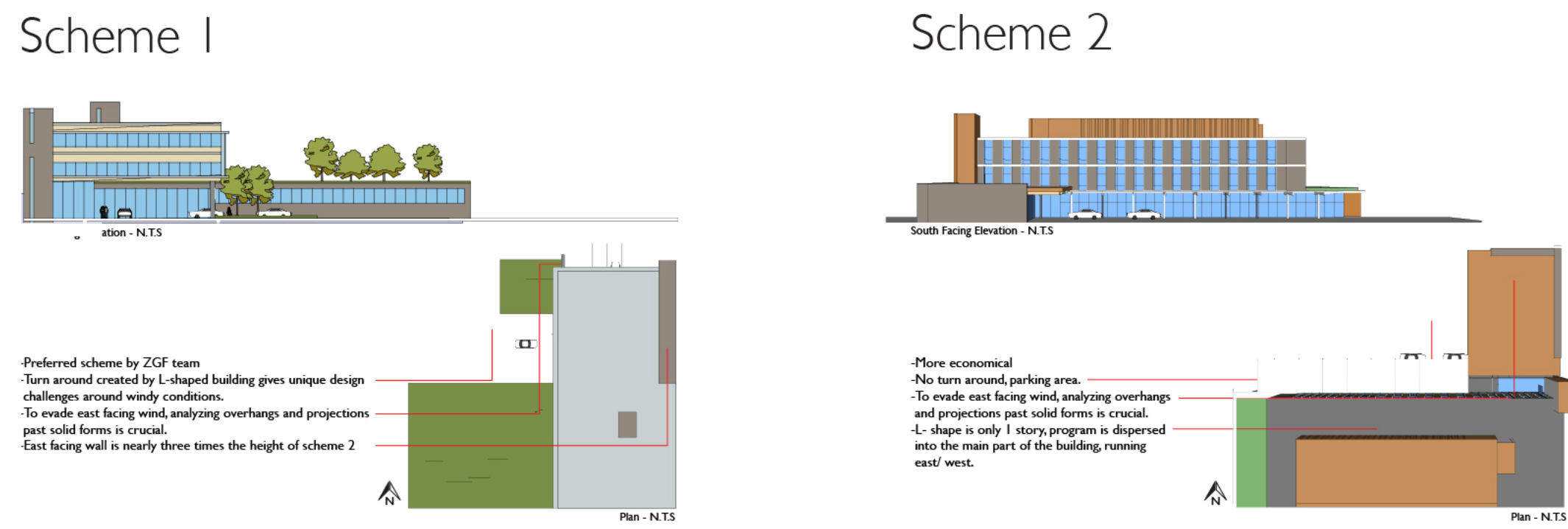


Figure 1. Scheme 1 and 2 Plan and Elevation
 Scheme 1 consists of a large 54 foot wall facing the east and behind it the entrance to the facility. The mass covers the turn around for cars. One load bearing wall is exposed on the west end of the overhang. This is the area of concern, Scheme 2 is more simple in respect to its design, with the majority of the building in a long linear rectangle facing east to west. This design has a smaller rectangle protruding to the north as its entrance/ reception area. This is again the area of concern for habitation. The lower roof allows for more wind to pass over the turn around, whereas scheme 1 blocked the winds initial gusts. We then learned through the testing that the blocking of the wind just increased the pressure as it builds, eventually releasing the wind in large abrupt gusts that were effecting the habitable area. This eddy effect that was being introduced was producing wind speeds much greater than the wind itself, therefore this option would have needed some additional design considerations in order to be comfortable in all conditions. Scheme 2 allowed for the wind to flow more evenly. This would create a more consistent wind speed, but would also eliminate the uncomfortable slam of the compounding winds after they've been blocked.

Figure 5. Wind Tunnel Detail Models/ Supporting Diagrams

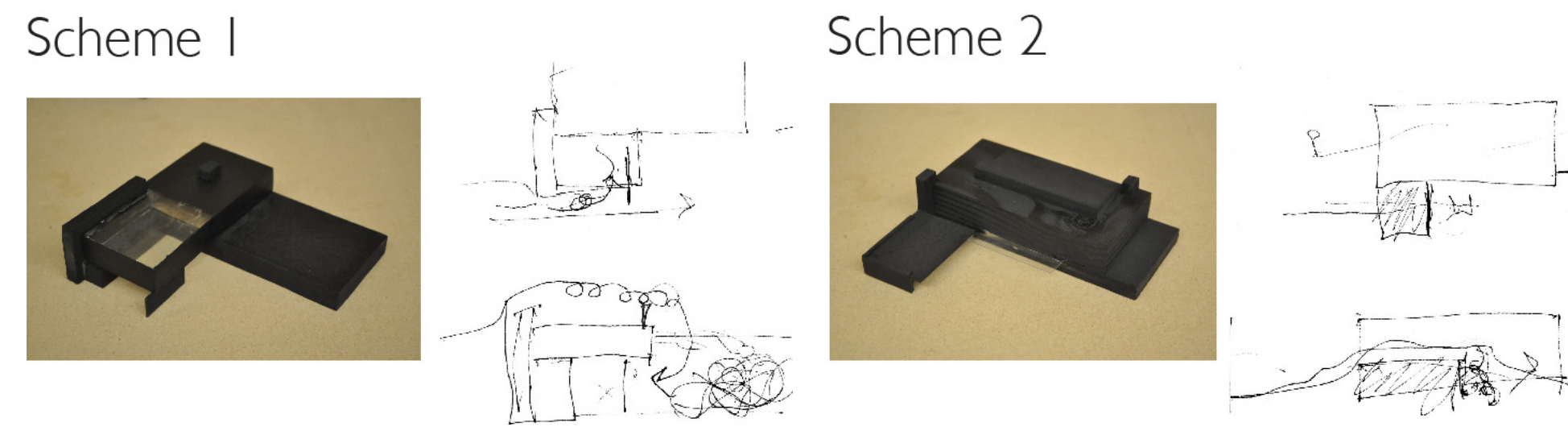


Figure 2. Scheme 1 and 2 Wind Tunnel Models
 Due largely in part to the scale of the models, the initial tests were inconclusive as the wind was subject to gravity and therefore traveled at a higher elevation than the building model in the wind tunnel. In order to resolve this problem we significantly adjusted the scale of the model by focusing on specific areas of the building and enlarging the scale of that building section. This decision allowed us to work within the parameters of the wind tunnel dimensions and study the areas most important to the buildings design.

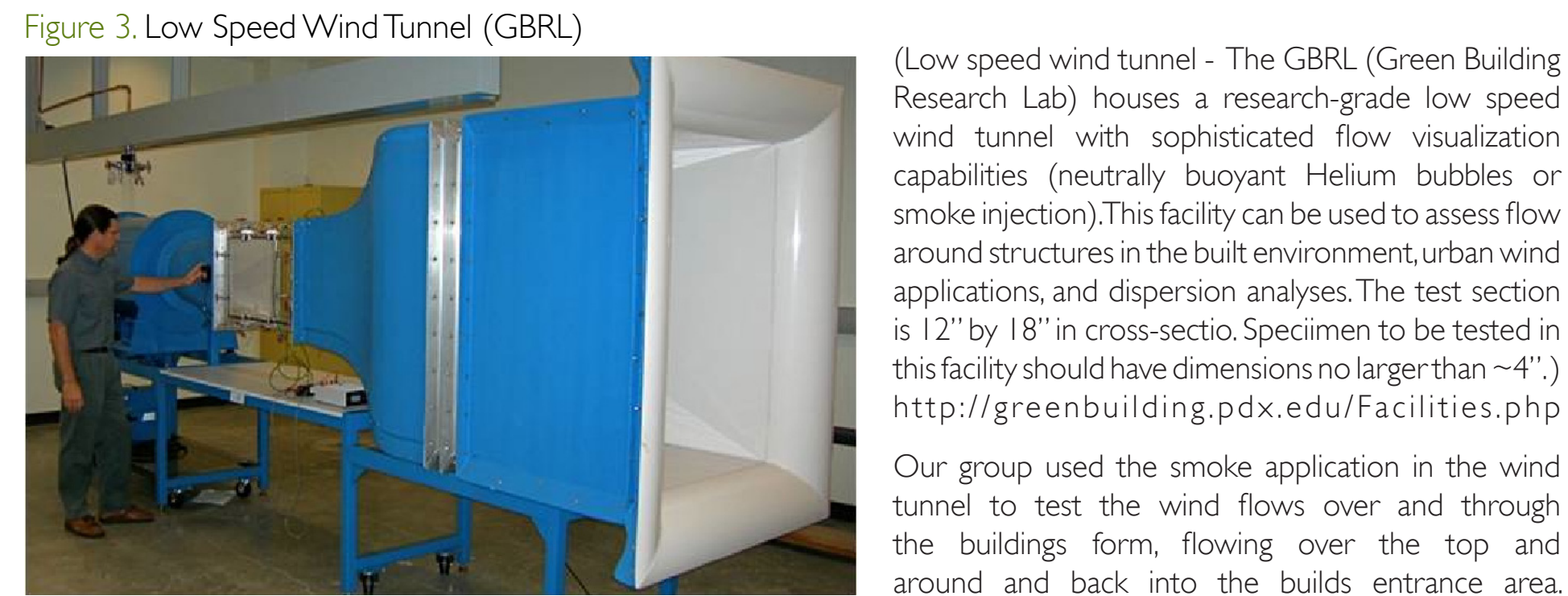
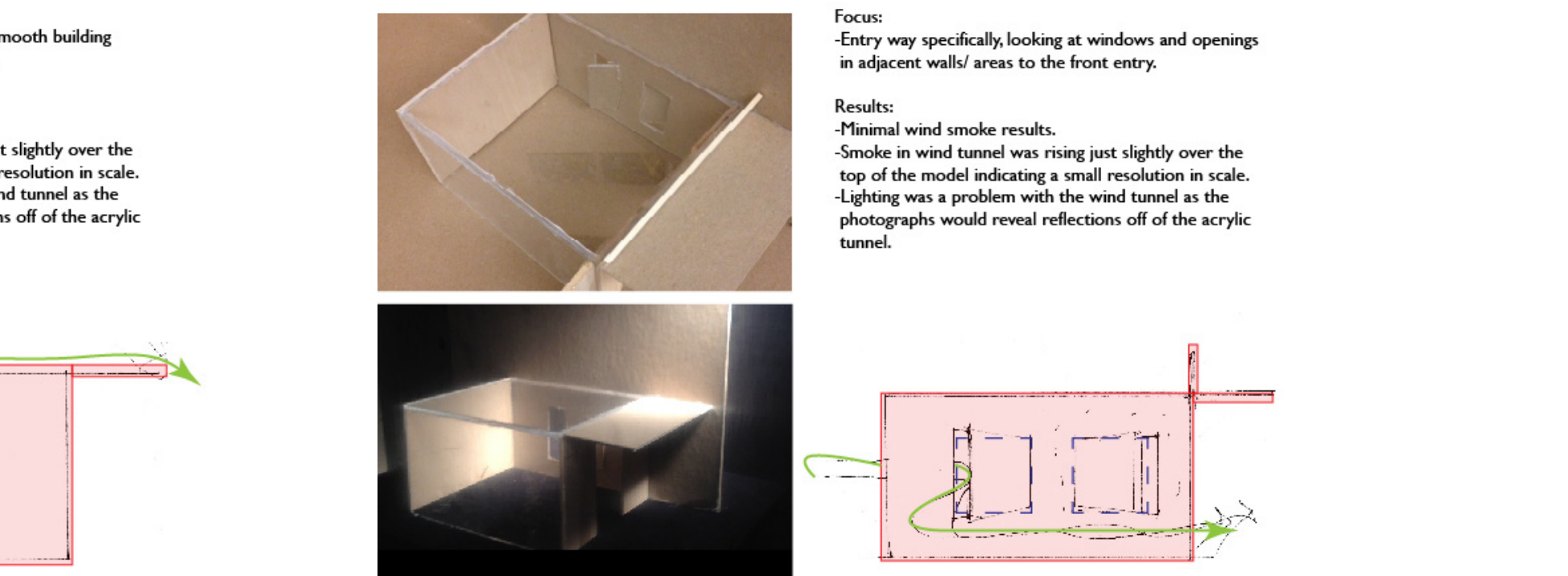


Figure 3. Low Speed Wind Tunnel (GBRL)
 (Low speed wind tunnel - The GBRL (Green Building Research Lab) houses a research-grade low speed wind tunnel with sophisticated flow visualization capabilities (neutrally buoyant Helium bubbles or smoke injection). This facility can be used to assess flow around structures in the built environment, urban wind applications, and dispersion analyses. The test section is 12" by 18" in cross-section. Specimen to be tested in this facility should have dimensions no larger than ~4")
<http://greenbuilding.pdx.edu/Facilities.php>
 Our group used the smoke application in the wind tunnel to test the wind flows over and through the buildings form, flowing over the top and around and back into the builds entrance area.

Figure 4. Methodology Diagram



Conclusion
 In conclusion, the building design could benefit from a design stance that responds to and helps the aerodynamics of the building and the environment it creates. The incorporation of a buffer or a tapered edge along the parapet as well as the northeast corner of the building would help it to react to the wind. The wind will be present on the building no matter how large the exposed facade. Working with the wind should be the approach as opposed to building a shear wall against it. As with skyscrapers which are exposed to high winds, the design reaction to the wind can help to make the building stronger.

Taking queues from skyscrapers, our methods for how to combat the wind turbulence are to design techniques applied at much larger scales. First would be to taper the corners of the building envelope. We would move forward by trying different variations to the corner itself and see what kind of turbulence is created or lessened compared to the typical 90 degree corner condition, or add a channel or some other way of controlling and harnessing the wind and allowing it to travel through part of the structure to see if it proves effective. By working with the wind the building would have a better chance at reacting to the different conditions that will be subjected to its location.

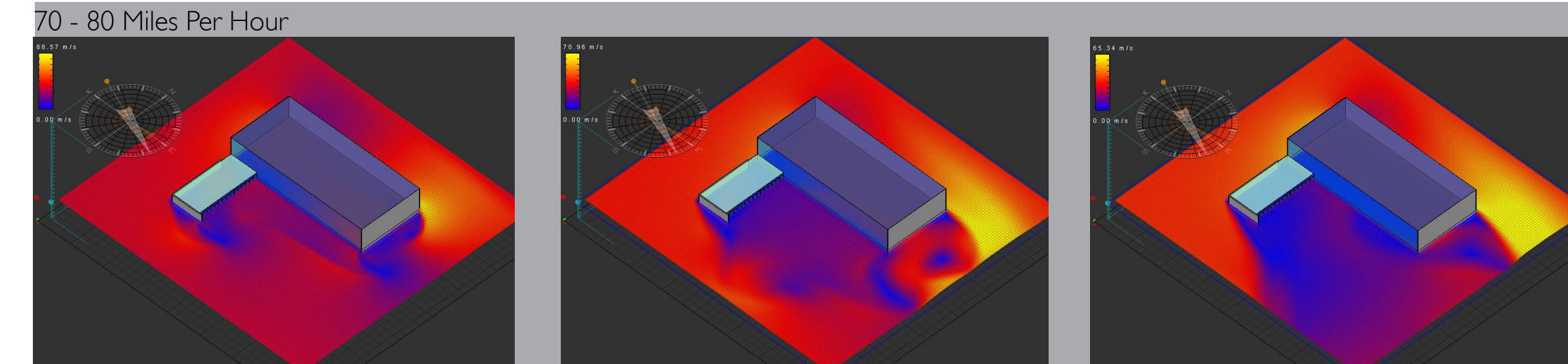
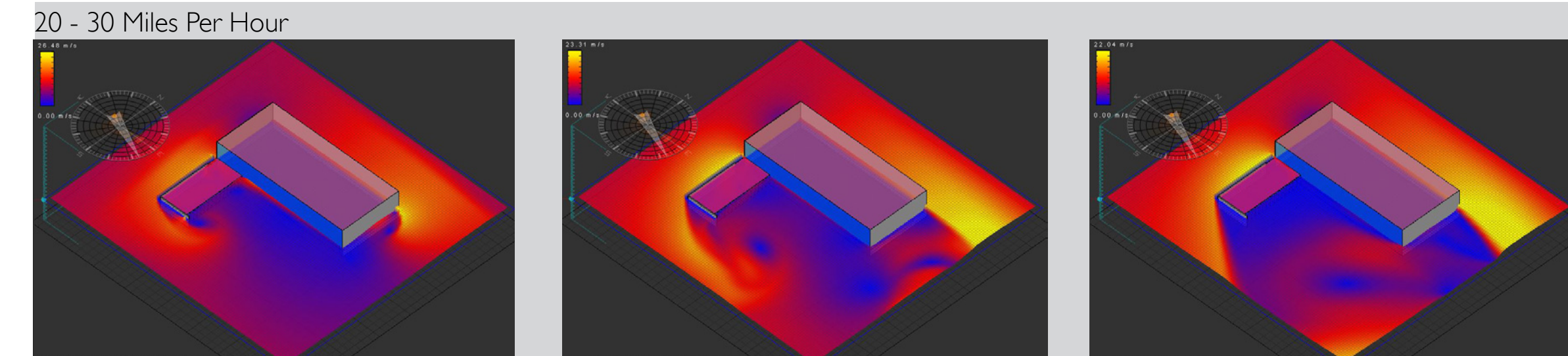


Figure 6. Axonometric View Illustrating Wind Movement Through the Building Entrance/ Courtyard

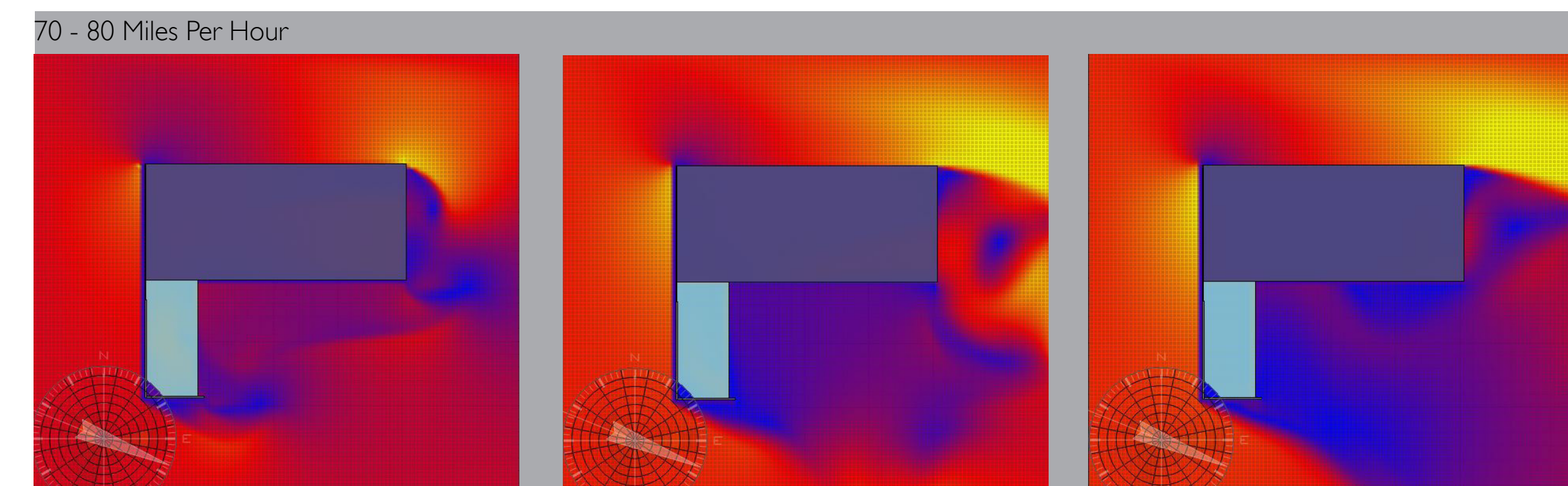
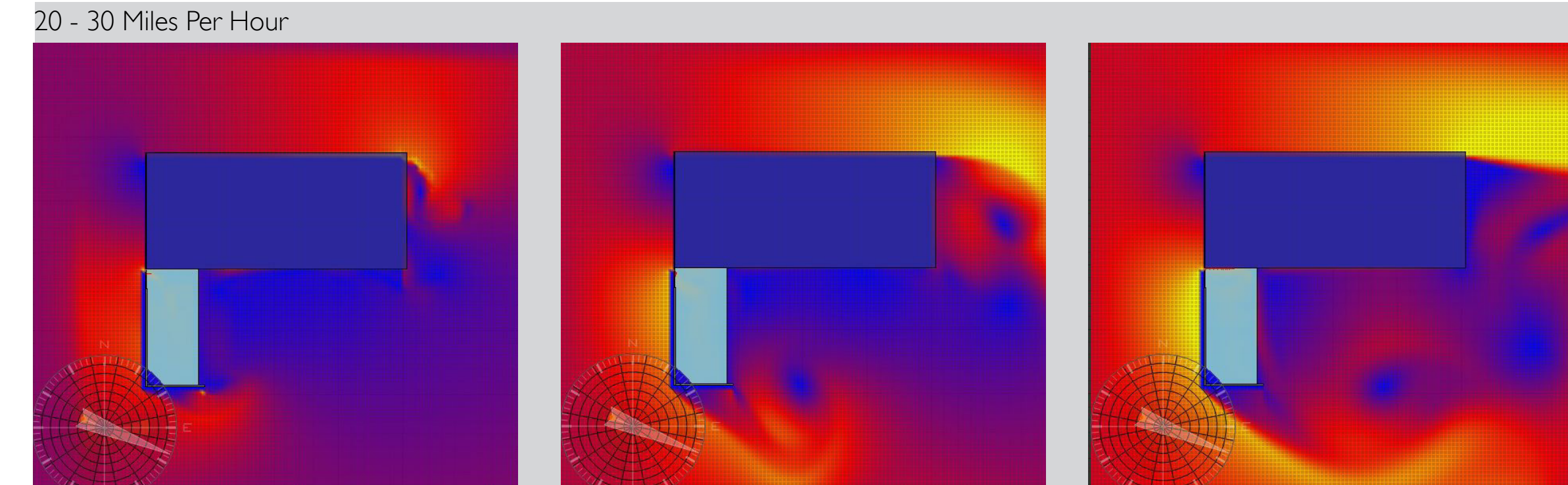


Figure 7. Plan View Illustrating Wind Movement Through the Building Entrance/ Courtyard

The tests run with Vasari helped to make more conclusive the information gained from the wind tunnel testing. Test information documents the wind in a gradient from yellow to blue with red as the medium set wind speed, blue as decreased wind speeds, and yellow as increased wind speeds.

At lower speeds the angle at which the wind begins to refract downward is greater, creating large waves that run across the surface of the adjacent parking lot. At speeds of 20-30 miles per hour the winds come over the top the east entryway building extension without a good deal of turbulence near the entryway door though it does have some turbulence in the parking area.

At greater speeds you can see an eddy effect developing closer to the entryway doors. Between 70-80 miles per hour the wind starts to refract downward on the west side of the building extension at a more acute angle bringing the turbulence closer to the building. These results help to clarify the wind pushed into the model during our large scale model testing in the wind tunnel.

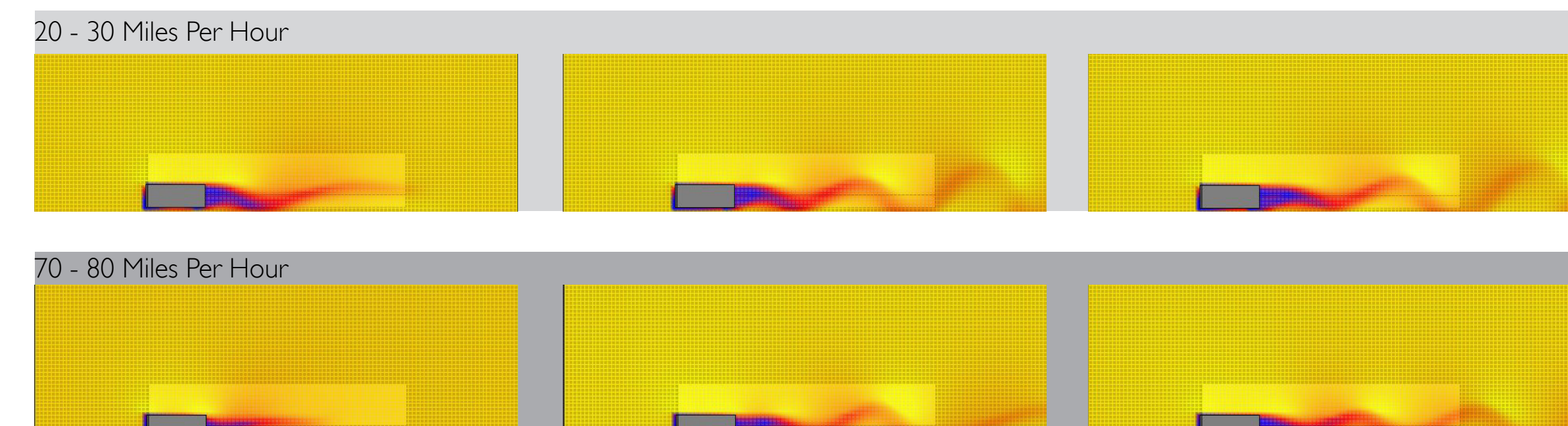


Figure 8. Elevation View Illustrating Wind Movement Through the Building Entrance/ Courtyard