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Lincoln-Juarez Land Port of Entry Vehicle Processing Facility

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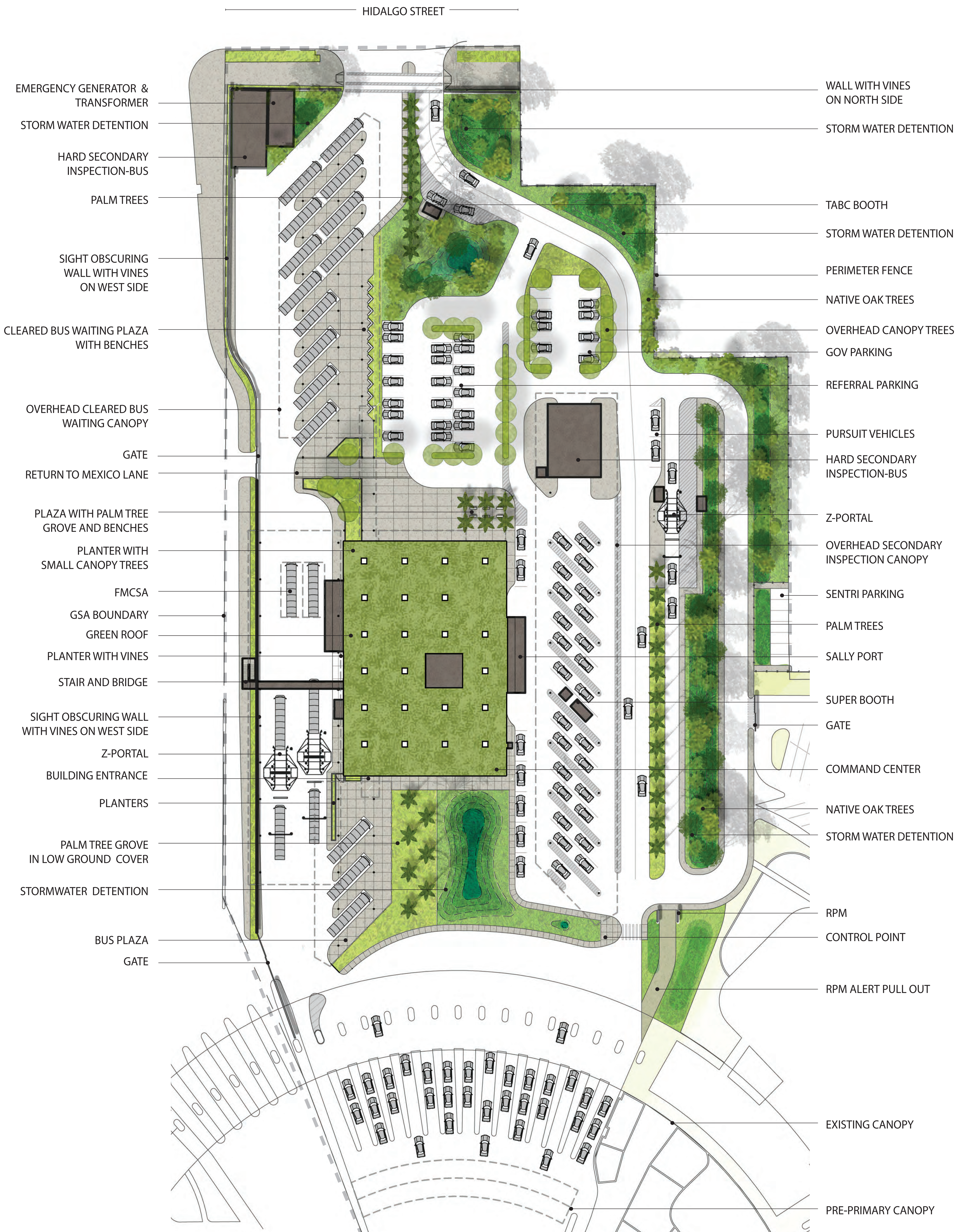
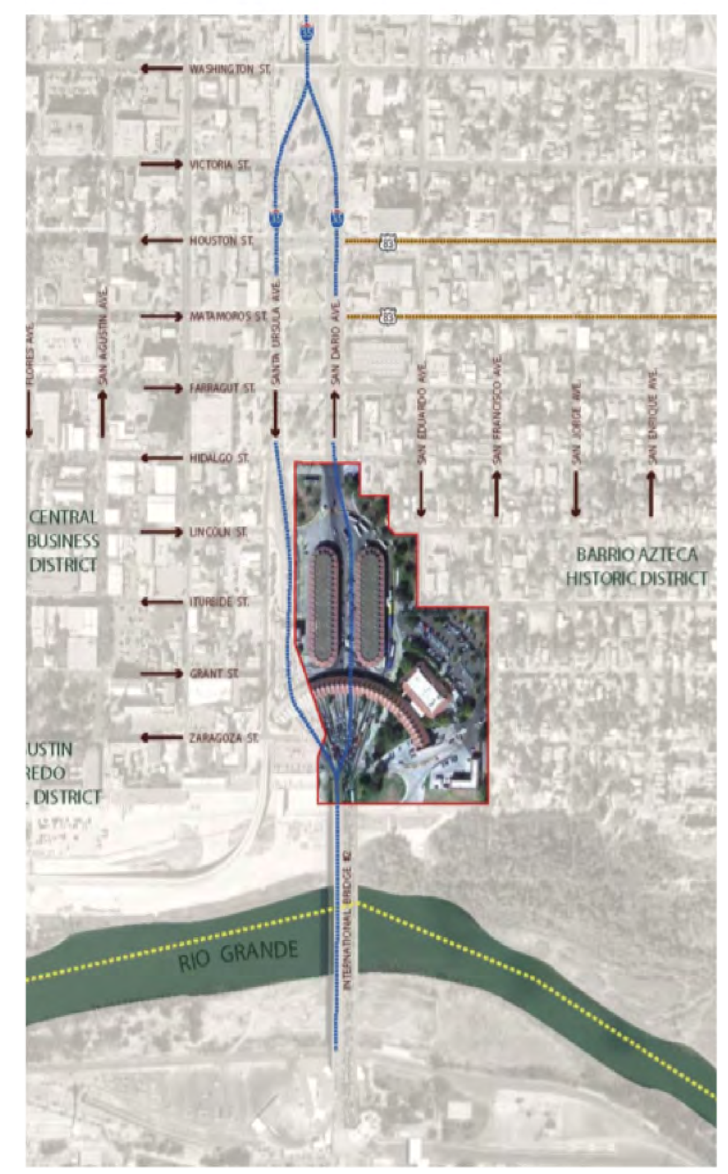
Lincoln-Juarez Land Port of Entry
Vehicle Processing Facility



Site Plan (by THA)

Aerial View and Perspectives (by THA)

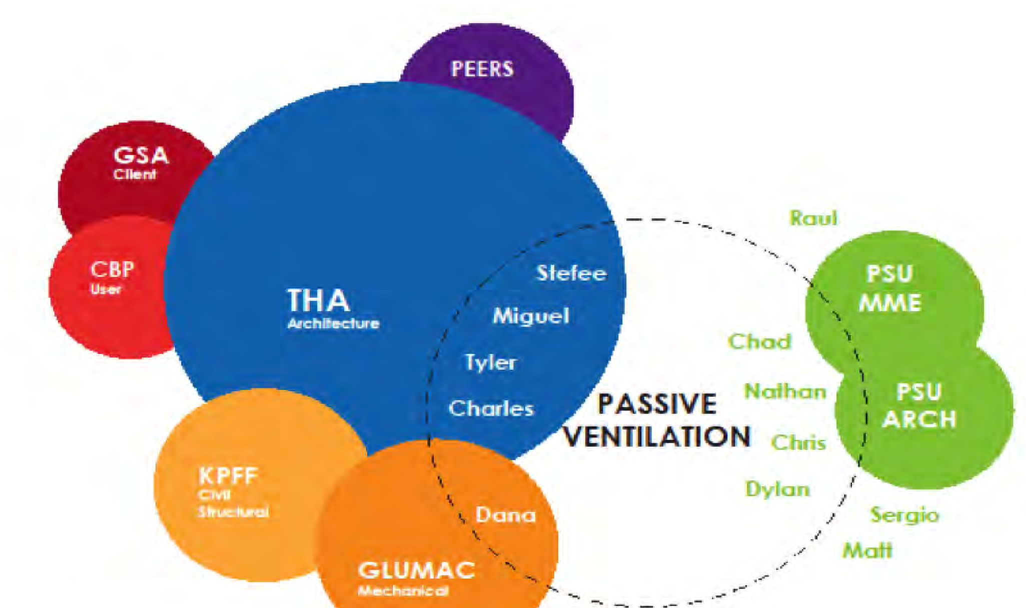


SITE OVERVIEW

The Lincoln-Juarez Land Port of Entry (LPOE) in Laredo is a unique and complex operation. Today, this port is one of the busiest in the nation. It is one of the few surrounded by an urban context, adjacent to a historic downtown commercial center and a historic barrio. The Lincoln-Juarez LPOE was built in 1976. Since then, the operations of the Port and the organizations that operate it have changed significantly.

PROJECT OVERVIEW

The indoor environmental quality of a building has a significant impact on occupant health, comfort, and productivity. Exposure to the exhaust fumes of idling vehicles is a dangerous but avoidable toxic hazard. Proper ventilation of vehicle inspection areas is essential, and to the maximum possible means, should be accomplished by natural ventilation. We intend to research the extent to which it is possible to use passive ventilation strategies to alleviate the auto exhaust exposure of officers and travelers using the Port of Laredo entry.



Project Diagram

Project Timeline

PROJECT TEAM

THA Architecture

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Stefee Knudson
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Amanda Petretti
Tyler Nishitani

PSU Graduate Students

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Dylan Morgan
Chad Norvell
Chris Kline

Collaborators

Raul Bayoan Cal
Matt Melius
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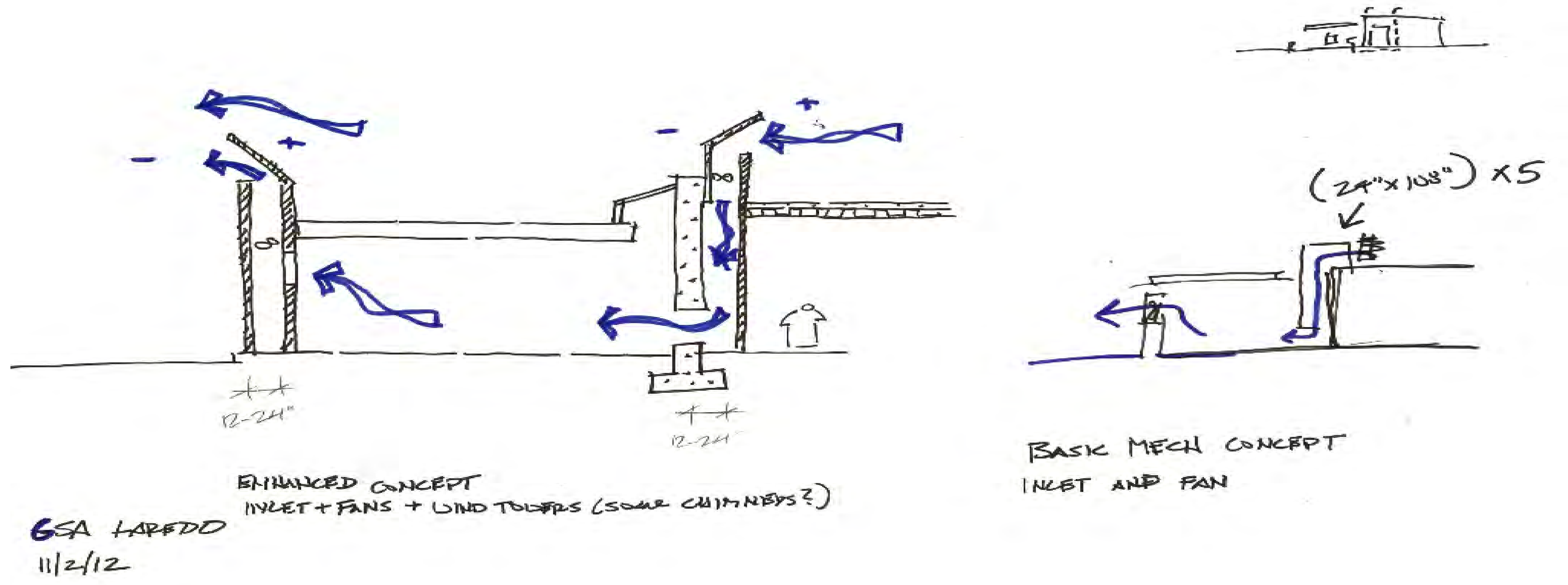
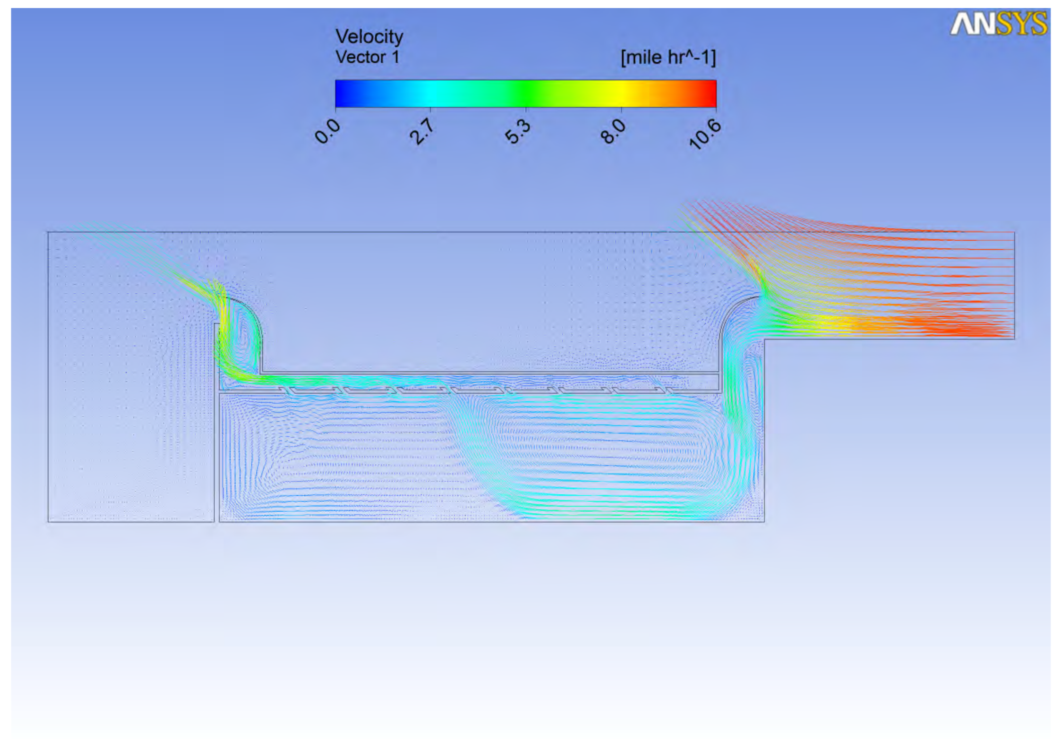
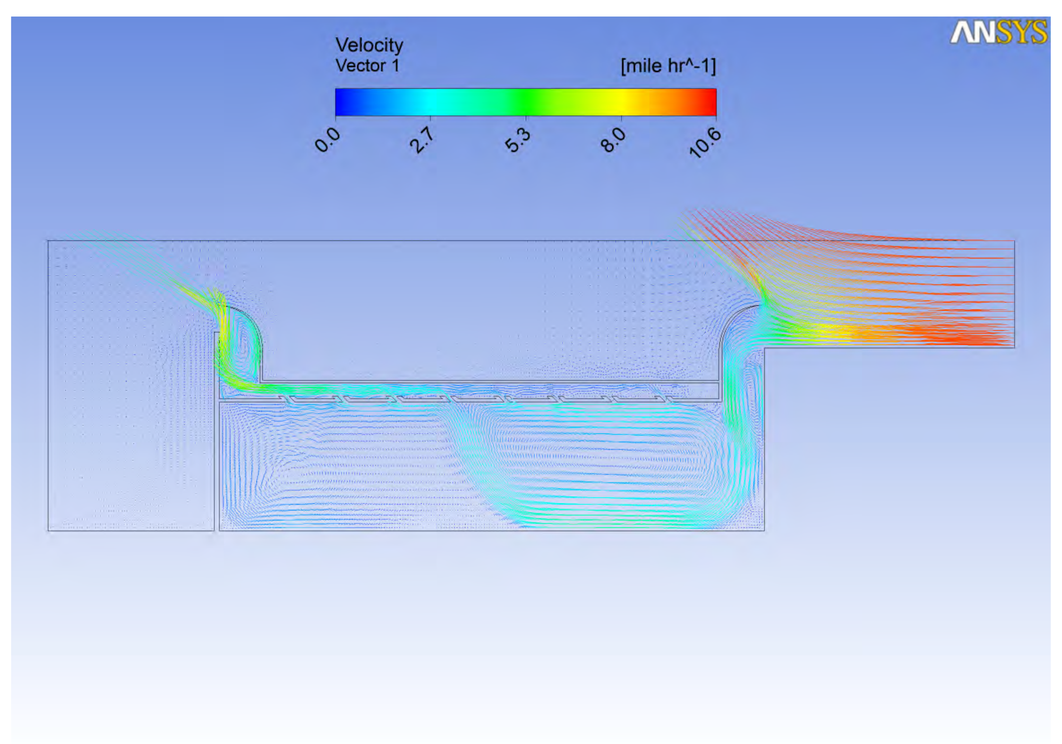
Methodology for Testing
Boundry Layer Wind Tunnel & CFD Modeling

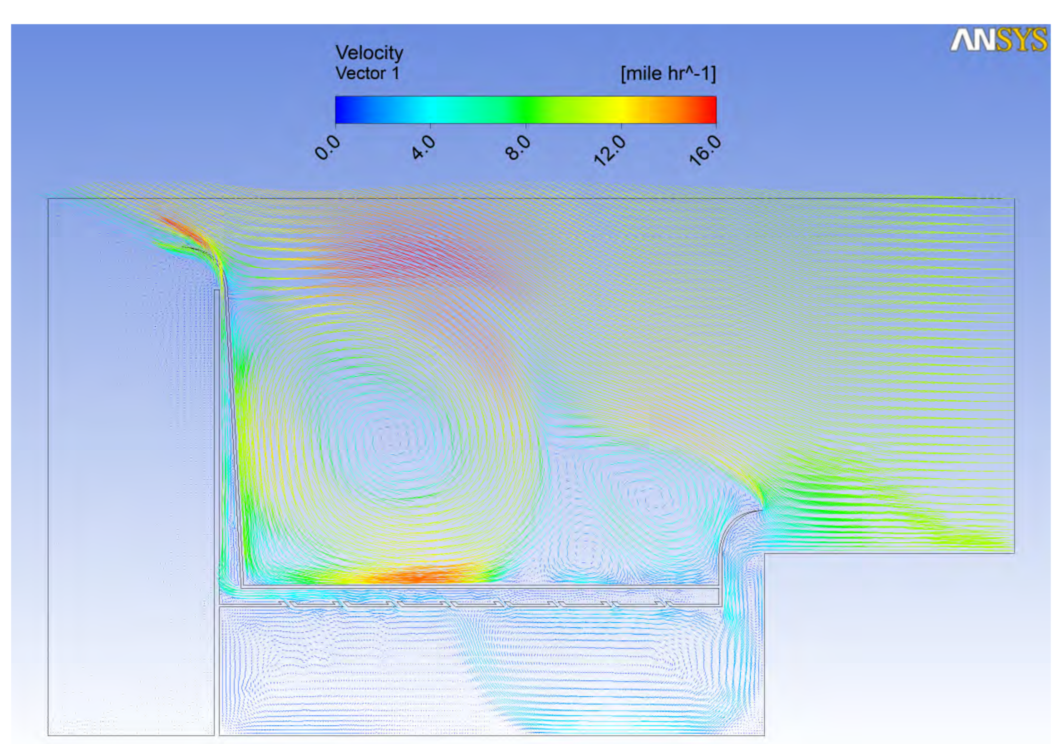


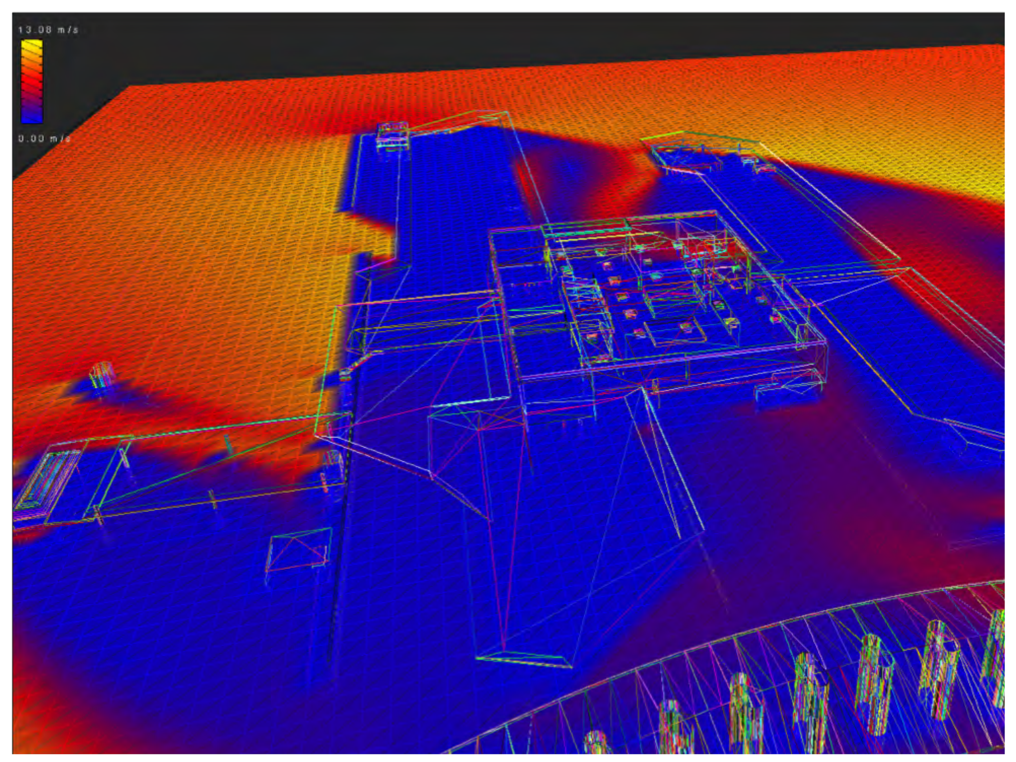
Computational Fluid Dynamics Testing

Examining the passive stratigies needed to remove particulate from underneath the canopy and the wind conditions in the Laredo area, we were able to start with a concept sketch and import these sections into Ansys, a CFD modeler. Using these studies we could start to get an idea about what geometries started to give us the vectors that would become the best strategies for the space. These East-West sections looked directly at a 2D set of variables, in which one of our larger scale model is base off of. We were able to look at the whole site and a 3D model using Vasari, but finding more success in the physical wind tunnel testing.

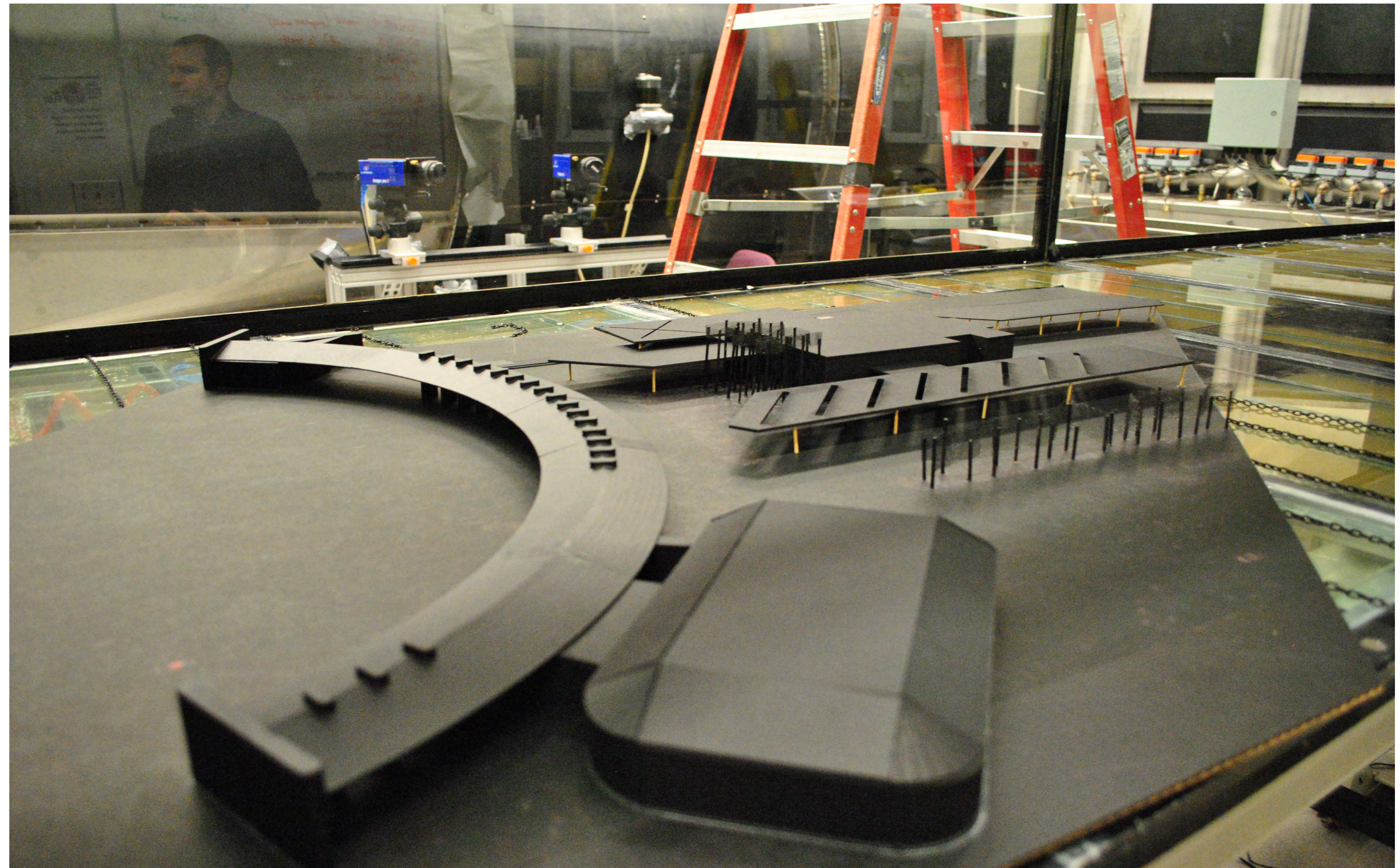




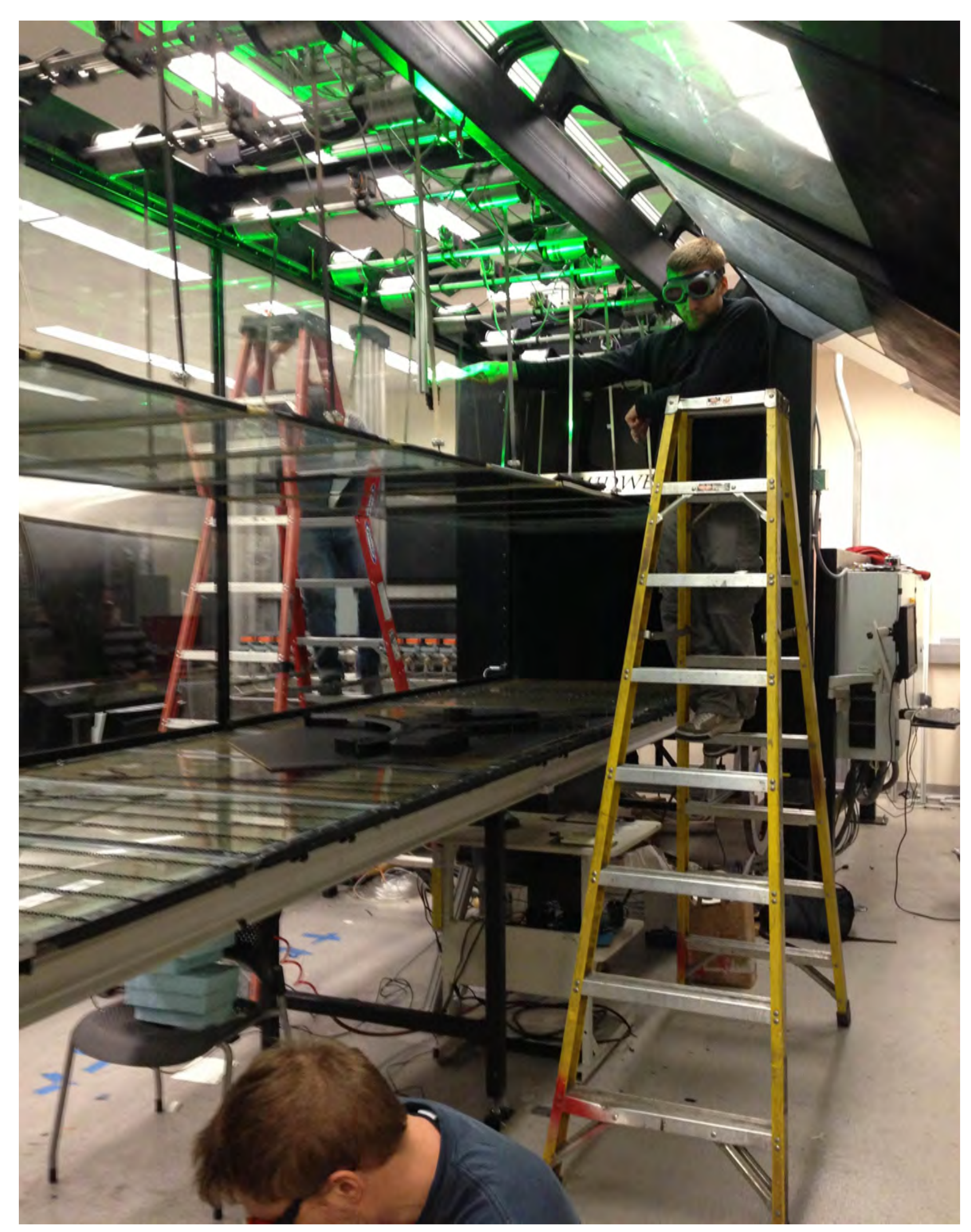


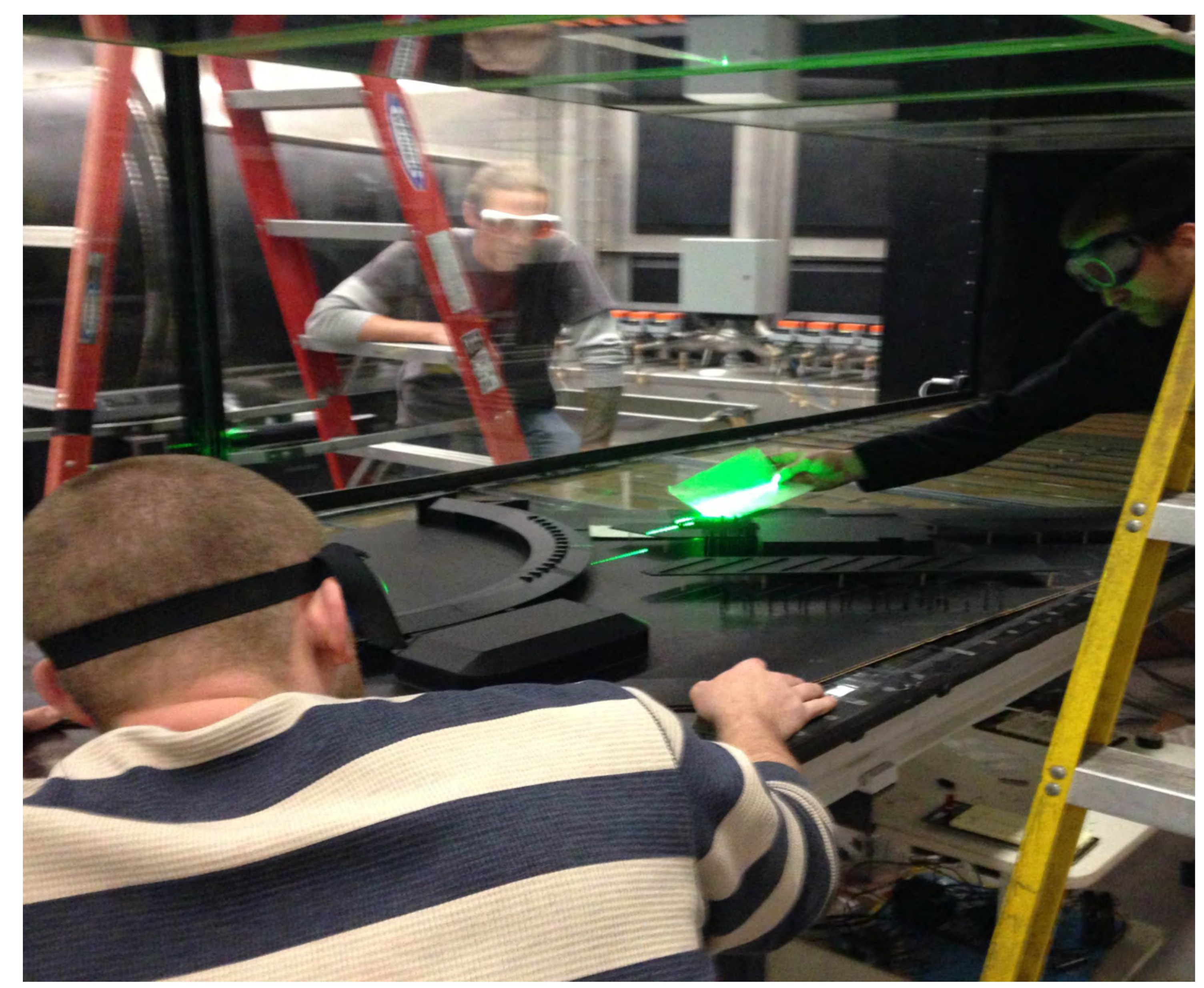


Vasari Site Model CFD (above)



Site Model in Wind Tunnel (above)





Boundry Layer Wind Tunnel

Building off of our East-West section studies and site modeling, we were able to move forward by creating physical models that could be tested in the Boundry Layer Wind Tunnel in the Engineering Building, headed up by Assistant Professor Raul Bayoan Cal. The wind tunnel uses a laser sheet as a backdrop in the area to be tested, particles travel along the wind passage and are photographed by specific camera equipment. These photographs then are processed through the computer and produce valuable and highly accurate wind data.

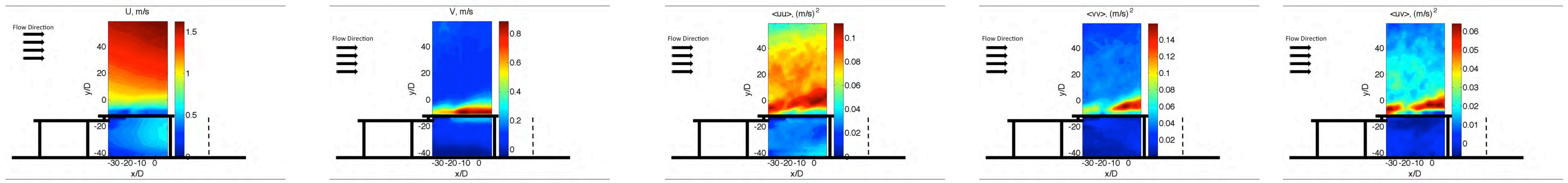
Data Matrix

First Results from the Wind Tunnel

3D MODEL

Overall Model

- Significant increase of velocity close to the exit wall.
- High turbulence intensity above the canopy.
- Flow ejected atop canopy.
- Investigation downstream of canopy is required.



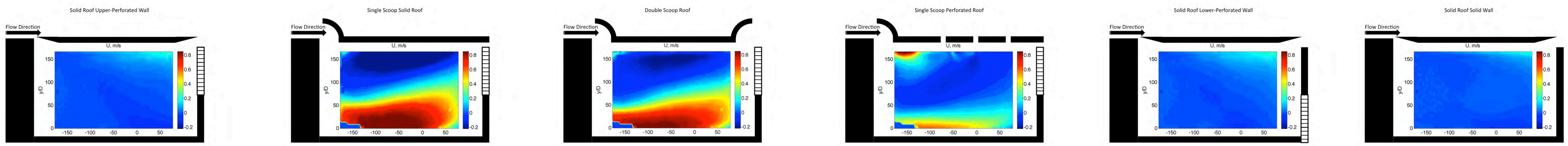
2D model

- Straight roof not conducive to removing fluid out.
- Single/Double Scoop performance was best given the back wall conditions. Further conclusions from detailed discussion.
- Back wall condition study was inconclusive due to height of roof.
- Height of roof and shape of scoop to be further researched.
- Area within canopy modified for more efficient flow passage.

2D MODEL

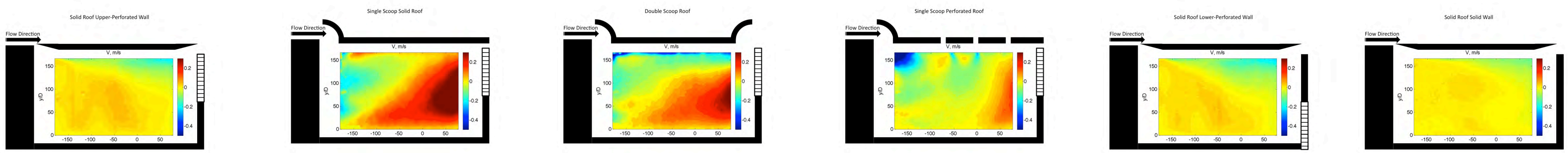
Streamwise Mean Velocity

- Straight wall: Flow not convected outward. Flow passage minimal.
- Strong component of flow in streamwise direction due to single scoop.
- Injections due to the perforations on roof occur although not remediated.



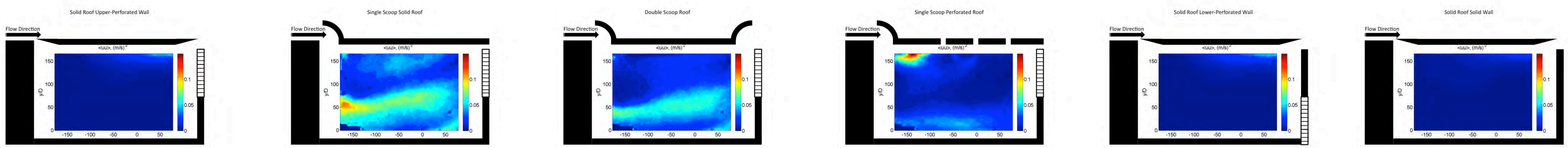
Wall-normal Mean Velocity

- Straight roof: Flow trapped in the enclosure.
- Single scoop roof: Strong component of wall-normal velocity outwards.



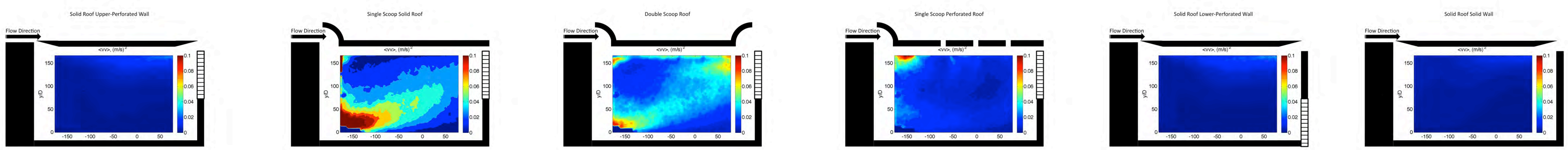
Streamwise Reynolds normal stress

- Straight roof: No turbulence intensity in canopy due to low flow passage.
- Single scoop roof: strong component of turbulence which will create mixing.
- Double scoop roof: Mixing could be attenuated while still transporting the flow outwards from the canopy.
- Perforated scoop roof: Not efficient.



Vertical Reynolds Normal Stress

- Straight roof: No turbulence intensity in canopy due to low flow passage.
- Single Scoop roof: Mixing in center of canopy.
- Double Scoop roof: Mixing attenuated in the vertical direction.
- Perforated scoop roof: Not efficient.



Reynolds Shear Stress

- Straight roof: No turbulence intensity in canopy due to low flow passage.
- Single/Double Scoop roof: Strong shear stress component. Could be non-negligible if buses are stationed in canopy.
- Perforated scoop roof: Not efficient.