Lincoln-Juarez Land Port of Entry Vehicle Processing Facility

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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.

**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.
Methodology for Testing
Boundry Layer Wind Tunnel & CFD Modeling

Examining the passive strategies needed to remove particulate from underneath the canopy and the wind conditions in the Laredo area, we were able to move forward by creating physical models that could be tested in the Boundary 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.

Computational Fluid Dynamics Testing
Examining the passive strategies needed to remove particulate from underneath the canopy and the wind conditions in the Laredo area, we were able to move forward by creating physical models that could be tested in the Boundary 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.
**Overall Model**
- Significant increase of velocity close to the exit wall.
- High turbulence intensity above the canopy.
- Flow Reversal stop canopies.
- Investigation downstream of canopies is required.

**Streamwise Mean Velocity**
- Straight roof: Flow not connected outward.
  - Flow passage unidirectional.
- Single slope roof: Flow component in streamwise direction due to single slope.
- Separation due to the perforations on roof occur although not remediated.

**Wall-normal Mean Velocity**
- Straight roof: Flow tracked in the eaves.
- Single slope roof: Strong component of wall-normal velocity outward.

**Streamwise Reynolds normal stress**
- Straight roof: No turbulence intensity in canopies due to low flow passage.
- Single slope roof: Strong component of turbulence which will create noise.
- Double slope roof: Mixing could be attenuated while still transferring the flow upwards from the canopy.
- Perforated slope roof: Not efficient.

**Vertical Reynolds Normal Stress**
- Straight roof: No turbulence intensity in canopies due to low flow passage.
- Single slope roof: Mixing in center of canopy.
- Double slope roof: Mixing attenuated in the vertical direction.
- Perforated slope roof: Not efficient.

**Reynolds Shear Stress**
- Straight roof: No turbulence intensity in canopies due to low flow passage.
- Single slope roof: Strong shear stress component, could be non-negligible if slopes are stationed in canopies.
- Perforated slope roof: Not efficient.

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**2D MODEL**
- Single slope/Double slope performance was not given due to lack of data.
- Further investigation is recommended.
- Backwall condition study was inconclusive due to low flowage.