The Department of Mechanical Engineering presents:

The Master's Dissertation Defense of:

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Near Field Modeling of the Effects of
Sound Barriers on Flow and Dispersion

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Dr. Marko Princevac, Chairperson

MECHANICAL ENGINEERING

Previous research of air quality in the vicinity of roadways has used either field measurements, where results are site specific, or modeling, which can be computationally expensive or too simplified and misleading. The presented research consists of a systematical laboratory and numerical investigation of the influence of different sound barrier (SB) configurations on the dispersion from roadways. Sound Barriers can be seen along the sides of freeways, especially in Southern California. The primary purpose of SBs is to dampen roadway noise; however this research focuses on their influence on the dispersion of pollutants from roadways. Vehicular emissions have been shown to be a major source of pollution in urban areas and that long term exposure can lead to adverse health effects. There is a need for reliable models to predict the effectiveness of SBs. These models need to be validated and the best way to accomplish that is through laboratory experiments. The laboratory experiments are being conducted at the Laboratory for Environmental Flow Modeling (LEFM) at the University of California, Riverside, which has a custom made water channel with the capability of performing Particle Image Velocimetry (PIV) and Fiber Optic Assisted Laser Induced Fluorescence (FOALIF) measurements. This water channel is commonly used to investigate the flow and dispersion within complex urban geometries. The water channel is also being used for qualitative flow visualizations by releasing fluorescence tracer dye. The presented measurements have been made with a neutrally buoyant dye (mixture of dye with water). The laboratory experiments are accompanied with numerical modeling using Quick Urban and Industrial Complex (QUIC) model, which consists of a wind and a dispersion module. The wind module has two options: 1) parametric flow description (QUIC-URB) or 2) flow results from Reynolds Averaged Navier-Stokes equations (QUIC-CFD). The dispersion module deploys Lagrangian particle tracking method. It was found that in both the water channel and QUIC simulations, the presence of SBs increases the vertical spread of the plume relative to that of no SBs. The presence of SBs has been shown to decrease the downwind concentrations due to the enhanced vertical mixing, however in certain situations, such as during conditions of low wind speeds, the SBs tend to trap the pollutants on the roadway.