**The Summer Undergraduate Research Fellowship (SURF) Symposium**
**3 August 2017**
**Purdue University, West Lafayette, Indiana, USA**

# Laboratory Characterization of Unsteady Boundary Layers

Umair Sarwar[1], Dr. Cary Troy[1]
[1]Lyles School of Civil Engineering,Purdue University

## ABSTRACT

The study of waves and their effects on mean flow and turbulence in natural water bodies is an important issue for applications in aquatic biology, coastal engineering, sediment transport and hydrodynamic of the lake. These waves result in the generation of an oscillatory (Stokes) boundary layer near the bottom of the water column. The goal of this study was to conduct various experiments that will be used to characterize the turbulence in unsteady boundary layers and help understand the relation between various flow variables (e.g. wave amplitude, frequency, water depth, turbulent kinetic energy, etc.). Using the research facilities provided, three different types of waves were generated. Turbulence characteristics of purely oscillatory waves from a large wave basin are analyzed for unsteadiness time scales. In a smaller water flume, data was obtained for mean currents alone as well as waves plus currents combined. For the latter scenario, the flow was decomposed into vectorial components and characterized for turbulent features. The results are compared to theoretical profiles derived by simplifying the Navier Stokes equation in each of the three experimental conditions and plotted using MATLAB. The obtained models have been applied to model turbulence enhancement for mussel clearance models in Great Lakes, with the potential for further modelling of natural environments. Moreover, there is vast scope of research in this area to understand how the surface roughness affects the effects of surface roughness on apparent roughness and boundary layer height in unsteady boundary layers.

## KEYWORDS

Boundary layer. turbulent, oscillatory, Stokes