

## Development of Restricted Formula SAE Intake Manifold Using 1D and Flow Simulations Based on Track Analysis

**Authors :** Sahil Kapahi

**Abstract :** A Formula SAE competition is characterized by typical track layouts having slaloms, tight corners and short straights, which favor a particular range of engine speed for a given set of gear ratios. Therefore, it is imperative that the power-train is optimized for the corresponding engine rpm band. This paper describes the process of designing, simulating and validating an air intake manifold for an inline four cylinder four-stroke internal combustion gasoline engine based on analysis of required vehicle performance. The requirements for the design of subject intake were set considering the rules of FSAE competitions and analysis of engine performance patterns for typical competition scenarios, carried out using OPTIMUMLAP software. Manifold geometry was optimized using results of air flow simulations performed on ANSYS CFX, and subsequent effect of this geometry on the engine was modeled using 1D simulation on Ricardo WAVE. A design was developed to meet the targeted performance standards in terms of engine torque output and volumetric efficiency. Finally, the intake manifold was manufactured and assembled onto the vehicle, and the engine output of the vehicle with the designed intake was studied using a dynamometer. The results of the dynamometer testing were then validated against predicted values derived from the Ricardo WAVE modeling and benefits to performance of the vehicle were established.

**Keywords :** 1 D Simulation, air flow simulation, ANSYS CFX, four-stroke engine, OPTIMUM LAP, Ricardo WAVE

**Conference Title :** ICICEE 2017 : International Conference on Internal Combustion Engines Engineering

**Conference Location :** Rome, Italy

**Conference Dates :** December 11-12, 2017