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Improving Train Aerodynamics

Fuel efficiency is important to trains. The purpose of my project was to determine the most aerodynamic design for bullet-trains. I tested several bullet-train locomotive nose angles in a carefully-controlled wind tunnel, and also treatments for the gap between cars to determine which would most improve aerodynamic and fuel efficiency. I designed and built a wind tunnel using a leaf blower as a wind source. Then I carved and tested a control nose angle of 90° and test angles of 40°, 25° and my own design. I also tested four HO-scale boxcars with a control of standard couplings, and tests of wedge-shaped wind deflectors on the top of the cars, and covering between cars. I measured their aerodynamic drag in the wind tunnel with a spring scale which displayed in Newtons and grams. I did five trials for each test, recorded the number of Newtons of aerodynamic drag, and averaged the results. The 25° nose angle was better than the 90° and 40° angle, but my design was the most aerodynamic with a 15.4% improvement over the 25° angle and a 62% improvement over the control. Additionally, covered cars were 11.5% more aerodynamic than their control. The total engineering improvement comparing my nose design and covered cars against the controls was 32.4% at 50 mph and 36.5% at 75 mph wind speeds. Most bullet trains have close to a 40° nose angle, which can be improved upon. I hope my experiments can help trains become more aerodynamic and fuel efficient.