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Aerodynamic Noise Reduction of Pantograph by Small Rods

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Extended Abstract

Aerodynamic noise is dominant on high-speed trains and one of the main sources of aerodynamic noise is the pantograph. The aerodynamic noise from the uppermost part of the pantograph, called the panhead, which is in contact with the overhead wires, is significant. Various studies have been conducted to reduce aerodynamic noise from the panhead, such as exploring the panhead shape using optimization methods and controlling the flow using plasma actuators and synthetic jets [1]-[3]. However, they were designed for one-way operation and did not take into account the bi-directional operation that is a feature of trains. In addition, complex shapes and mechanisms are unacceptable from a cost perspective for panheads that are frequently replaced. Therefore, as a way to reduce aerodynamic noise without changing the shape of the existing panhead itself and without using complex mechanisms, and also to accommodate the bi-directional operation of trains, the installation of small rods at the front and rear of the panhead was devised, and its effectiveness was confirmed in a wind tunnel test.

In the wind tunnel experiment, a square cylinder simulating a panhead was set between the end plates, and small rods were placed in front and behind the cylinder. The length of one side of the square cylinder was 70 mm. Four different rods were prepared. They were round rods with diameters of 10 mm and 20 mm, and square rods with sides of 10 mm and 20 mm. The square rods were installed at a 45-degree angle to the flow. The distance between the centre of the cylinder and the rod, L, was set to 70, 105, 140, and 175 mm. The wind speed was set to 35 m/s. The Reynolds number, based on the length of the square cylinder, is 1.6×10^5. The unsteady lift force of the square cylinder was measured and the noise was measured with a microphone placed below the square cylinder.

The results showed that the installation of the rods could significantly reduce the aerodynamic noise. The largest reduction in aerodynamic noise was observed when 20 mm square rods were installed at L=140 mm.

References

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