Experimental Reproduction of Wheel Thermal Cracks

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Thermal cracks initiating in the wheels of vehicles equipped with tread brakes cause an increase in rolling noise and a deterioration in ride comfort. Not only that, but they reduce the service life of the wheel because of the larger cutting depth needed when reprofiling the wheel. However, the crack initiation process and mechanism are complicated, and a fundamental solution has therefore not yet been found.
In addition, cracks equivalent to the thermal cracks found on the actual vehicle wheel had until now not been recreated in a stationary bench test, so we had no testing methodology to examine the phenomenon. In the present study wheel tread thermal cracks have been experimentally reproduced using full-scale brake test apparatus. Factors affecting the initiation of thermal cracks as well as the wear of the wheel tread are specified by the observational analyses. We estimate that thermal cracks in the wheel initiate under conditions of both repeated heat input from the brake shoe and from rolling contact with the rail. Judging from the area of crack initiation and growth, load cycles caused by rolling contact with the rail as well as the heat input cycle generated by the brake shoes greatly affect the growth of thermal cracks in the wheel.
We have also shown the probability that the nature of the wear of the wheel tread is not simple wear caused by friction with the brake shoe but plastic deformation of the wheel material whose temperature has risen as a result of the friction caused by the brake shoes. The knowledge obtained in the present study will be of considerable importance in reducing maintenance costs and in optimizing the friction brake system designs.

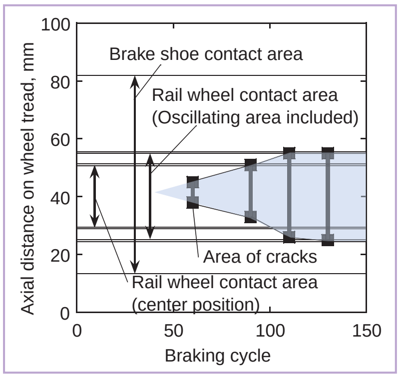

Fig. 1 The condition of crack initiation and growth

Study of Under-Floor Air Flow to Reduce the Phenomenon of Flying Ballast

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Complex air flows arise between the underside of trains and the track caused by the interaction between them. The flow is one of the main causes of the phenomena of flying ballast and of snow building up on the underside of the cars. Snow adheres to the underside of the train and drops in lumps on to the track, also causing ballast to fly up.
To study the under-floor air flows, we measured it in field tests on the track (Fig. 1, Fig. 2) and confirmed that smoothing the underside of the cars reduced the velocity of the air flow (Fig. 3).
To investigate the possibility of reducing the impact of the flow by modifying the shape of the underside of the cars, we carried out tests in a wind tunnel.
By comparing the air flow measured in the on-track tests with that in the wind tunnel tests, we were able to verify that the flow in the on-track tests was reproduced in the wind tunnel tests. We measured the velocity profiles of the air flow beneath the cars.
We understood that the velocity of the flow decreased as we smoothed the shape of the under-floor area. Furthermore, we developed a model running facility that enabled us to estimate the velocity of the flow above the ground as the train passes over it.
Next, we carried out a study on a new measure (passive control of the air flow using deflectors fitted to the car bodies to reduce the build-up of snow on the underside of trains. Using wind tunnel tests, we confirmed that the deflectors reduced the velocity of the flow and that the velocity reduction effect was related to the angle of the deflectors. To verify the effect of the deflectors in reducing the build-up of snow we carried out the wind tunnel tests using artificial snow particles. We found out that the snow particle flux decreased near the bogies thanks to the deflectors and that the effect of reducing the snow particle flux extended over a large area near the bogies.

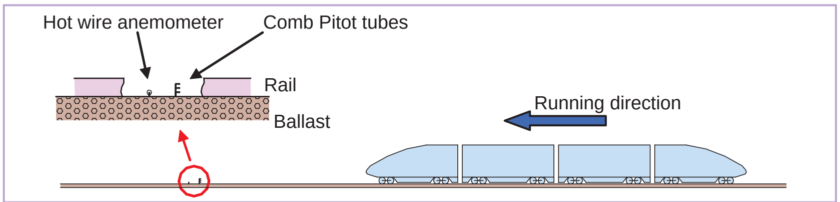

Fig. 1 Measurement of air flow above the ballast

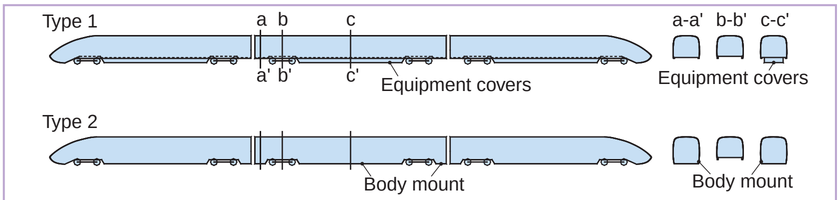

Fig. 2 Under-floor shape of the car

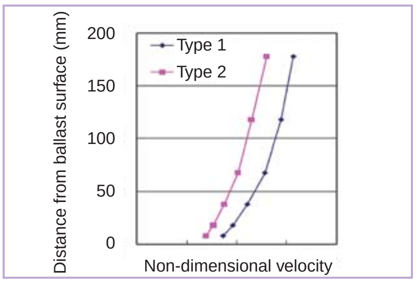

Fig. 3 Velocity profiles of the air flow above the ballast