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STUDY OF TRAIN DERAILMENT DUE TO SUSPENSION DAMAGE

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Liu et al. [1] analyzed train derailment data from the FRA rail equipment accident database for the period 2001 to 2010, and found that about 30% of the derailment events were caused by car problems. When trains travel on a railway with damaged suspension systems, such as damaged dampers or springs, this can cause safety problems. However, few studies of this topic have been carried out in the literature, and thus the related safety concerns are not well known. In this paper, a nonlinear dynamic finite element method is developed to investigate train derailments due to damage to suspension systems, where nonlinear moving wheel elements, spring-damper elements, and a lumped mass from the literature [2] were used to simulate the train. The relayed algorithm will be modified in this study to simulate a spring-damper that abruptly changes its properties. At the beginning of the simulation, the initial trainloads are gradually added into the mass center of each rigid body in the train model with large system damping, so that the initial fake vibration can be well reduced. Parametric studies using the finite element results then indicate the following: (1) The derailment coefficients of the wheel axis nearby the damage location increase significantly during the damage interval time, but for wheel axes far away from the damage location, the derailment coefficients are only slightly influenced by this. (2) Damage to the damper has only a minor influence on the train derailment coefficient, and most of the train derailment effect comes from damage to the spring. (3) The derailment coefficients rise with a decrease in the suspension damage ratio. Damage to the primary suspension is more serious than that to the secondary suspension, because it directly influences the contact force between the wheel and rail. (4) The train speed has little influence on the derailment coefficients due to damage to both the primary and secondary suspensions, because damage to the suspension system is not located at the wheel or rail, where are highly influenced by the train speed and can cause cyclic contact problems. (5) The train derailment coefficients rise with a decrease in the damage interval time, and the related increase rate is significantly higher for a small damage interval time, and thus abrupt damage to the suspension of moving trains should be avoided.

REFERENCES

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