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It is important to determine experimentally and theoretically the dynamical behavior of a railway vehicle which derails or overturns due to natural disaster, in order to reduce its damage. The authors manufactured a model vehicle of 1 to 10 scale, and carried out tests on vibrating track on which the vehicle standing still or running might derail or overturn. Based on these experiments we have developed a numerical simulation program, which is able to calculate the dynamical behavior of a vehicle when it derails or overturns exceeding the numerical criterion of derailment. By using this program, we computed the vehicle motion and prepared the limit diagram of derailment or overturning, which coincided well with the test results.