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DYNAMIC INVESTIGATIONS ON FREIGHT WAGON SUSPENSIONS

VYŠETŘOVÁNÍ DYNAMICKÉHO CHOVÁNÍ VYPRUŽENÍ NÁKLADNÍCH VAGÓNŮ

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Method for testing the suspension of freight railway vehicles on the laboratory shaker rig was designed and verified. The tests have been performed with three types of leaf suspensions, installed in HAA coal wagon, using vertical excitation off all wagon wheels.

Byla navržena a ověřena metoda pro zkoušky vypružení železničního vagónu na zkušebním stendu. Zkoušky byly následně realizovány na třech typech listového vypružení, instalovaných v uhelném vagónu HAA při buzení všech čtyř kol vagónu ve vertikálním směru.

Keywords *suspension, freight wagon, dynamics, shaker rig*

Klíčová slova *vypružení, nákladní vagón, dynamika, zkušební stend.*

Background

Steel leaf spring suspensions have evolved over the last 150 years of which the most advanced designs are based on parabolic sloped leaves. A typical suspension is shown in Fig.1, which comprises 4 leaves active at tare load and a bottom (helper) leaf, which is active above tare.

The advantage of testing vehicle in the laboratory is that each parameter such as track quality, vehicle speed and load can be independently varied. This requires testing a complete wagon in order to characterize the way in which the suspension responds to various track inputs.

The shaker rig was built using clamping and supporting system Schenck 4000, all four wagon wheels were excited with hydropuls actuators PL 400 and 630 kN with internal displacement sensors and added load cells driven via S59 Schenck control unit (Fig.2). The wagon was instrumented with displacement sensors and accelerometers; in addition the noise level was measured with two microphones and strains at spring leaves.

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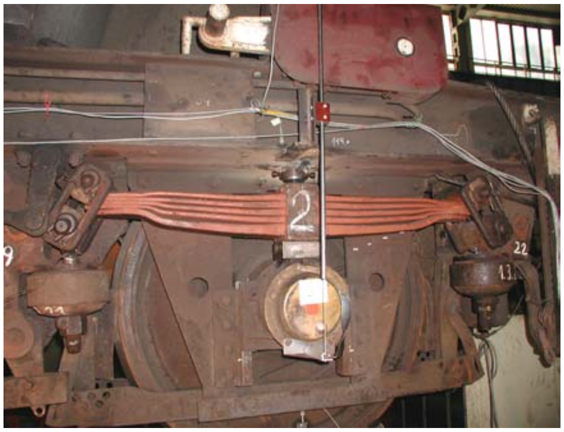

Fig.1 Tested parabolic spring

Fig. 2 Wagon shaker rig

2 Test overview

The significant resonance peaks and body modes were identified during **sweep tests** with constant amplitude 0.5 and 1 mm in frequency interval 0 to 30 Hz. In **bump test** both wheels of one axle were excited in phase, whilst in **roll test** they were excited out of phase.

For the natural frequency and critical damping evaluation, the EU (Directive 92/7/EEC) **drop test** for road vehicles was used – simultaneously drop of both actuators of one axle at 5 to 30 mm was performed (until the natural frequency was excited) and the damping was resolved by measuring the exponential decay of successive peaks of wagon body displacement response.

The wagon stability was tested using sinusoidal and trapezoidal excitation of front wheels during **CTT** and **TCT tests**, just simulating the over travel of rail unevenness or discontinuity.

The behaviour of the wagon at real conditions was simulated by a **track profile test**. The wheels were excited in vertical direction with four 1 km long track quality sections, selected from measurements taken on the UK freight acceptance route. The test was performed at three different vehicle speeds.

During this test, vehicle dynamic loading was evaluated. The dynamic load coefficient has been calculated from the force data, supposing, that the wear or damage of railroad is related to this coefficient, as it is known for pavements. This coefficient is given, as ratio of standard deviation of the dynamic load and its mean value.

Conclusion

The tests have shown that reliable and consistent damping lead to lower dynamic loading and better ride quality.

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