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EXPERIMENTAL MODELLING OF DYNAMIC ADDITIONAL LOAD OF TENSION CLAMPS USED FOR FASTENING THE RAILS

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At constructing the track the tension clamps are currently used for fastening the rails [1], [2]. At present assembling technology the whole track panels are assembled at the assembling-base and they are then transported on the transporting chassis to the laying place . During a transport the tension clamps are stressed with additional forces from the gravity of hanging sleepers and from the inertial forces arising due to oscillating motion of rail fields. If this additional load cross the certain value, it can cause the overloading a tension clamp and to cause the rise of permanent irreversible deformations and in this way to reduce the require magnitude of compression force, by which the tension clamp press on the foot of rail. In this contribution the methodology of experimental modelling of additional forces acting on tension clamps during the transport of track panels is described and the influence of them on the change of deforming states of tension clamps.

Key words: experimental investigation, model testing, tension clamps, static and dynamic additional load, elastic fastening of rails.

1. Introduction

Using the rails with higher bending stiffness bring the certain changes to the classical construction of track too. At the present time more kinds of tension clamps for fastening the rails as PANDROL, EWEM, VOSLOH, SKL ... are used. At the present technology the track panels are assembled at the assembling-base and they are then transported on the transporting chassis (for example type 53) to the laying place. During a transport the tension clamps are stressed with additional forces from the gravity of hanging sleepers and from the inertial forces arising due to oscillating motion of rail fields. If this additional load cross the certain value, it can cause the overloading a tension clamp and to cause the rise of permanent irreversible deformations and in this way to reduce the require magnitude of compression force, by which the tension clamp press on the foot of rail. It was the reason for modelling in laboratory the operating conditions to which the track panels are subjected during the transport. It was experimentally tested, if the static and especially dynamic values of additional load, acting on tension clamps, does not reach such magnitudes, which could develop the rise of permanent irreversible deformations and in this way to reduce the require magnitude of compression force, by which the tension clamp press on the foot of rail.

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2. Tension clamp and its stress

EWEM tension clamps are the topic of analysis. EWEM tension clamp is plug-in by the lower part of its fixing arm into the cut in the rib of sole plate at the installation. The lower part of the pressing arm abuts on the foot of rail. During this process the tension clamp is stressed, the pressing arm is picked up in horizontal direction and the tension clamp starts to press on the foot of rail with the pressing force proportional to the picking up of the pressing arm. The tension clamp acts as a linear element only to the certain value of picking up of the pressing arm. After the crossing of the limit value of picking up the plastic deformations come into existence. The tension clamp is weakened by this process because of its ability to activate pressing force is reduced proportionally to the value of the permanent irreversible deformation. There is possible to determine the limit value of the picking up from the stiffness characteristic. For every followed tension clamp the distance between contact points on the left and right pressing arm and the bottom of sole plate was measured. Measurement was made by the calliper through the drilled hole in sole plate as it is shown in the Fig. 1.

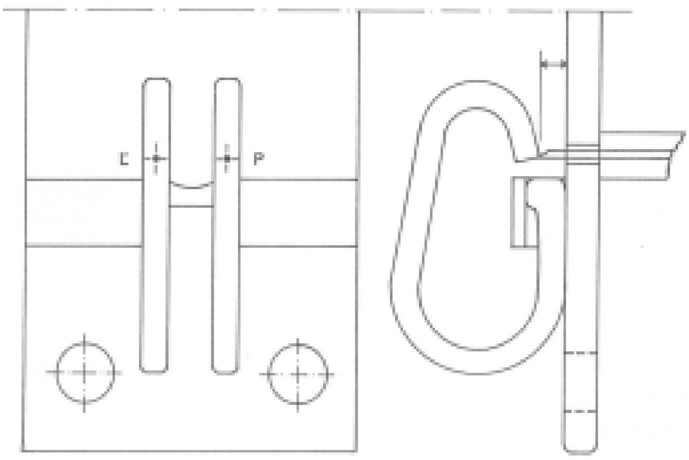


Fig. 1

At the static behaviour the tension clamps are also pressed by the gravity force acting on the mass of hanging sleepers. The additional force equal to one half of dead load of the sleeper acts on the one junction. The mass of the sleeper SB8 is 270 kg and the value of gravity force acting on one junction is F_G = 135 kg . 9,81 m.s^{-2} = 1 324,35 N = 1, 32435 kN. At the dynamic behaviour the tension clamps are above pressed by the inertial forces due to oscillation. The inertial forces are dependent on the magnitude of oscillating mass, on the magnitude of deflection and on the frequency of oscillation. Assume that the track panel oscillates in the *j-th* natural mode by the natural frequency $f_{(j)}$, than by the Fig. 2 the inertial force $F_{in,i(j)}$ acts on the sleeper *i*.

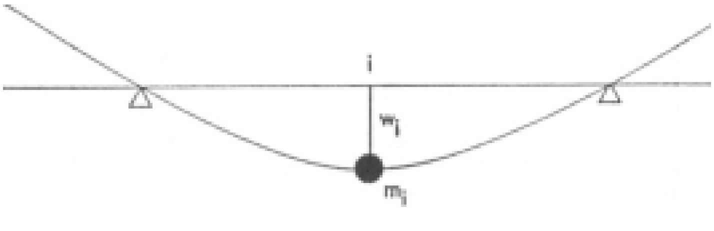


Fig. 2

At the oscillation in the *j-th* natural mode the sleeper *i* moves harmonically

$$w_{i(j)}(t) = w_i \,.\, \sin(\omega_{(j)} \,.\, t) \,. \qquad (1)$$

The acceleration of the motion is

$$\ddot{w}_{i(j)}(t) = - w_i \,.\, \omega_{(j)}^2 \,.\, \sin(\omega_{(j)} \,.\, t) \,. \qquad (2)$$

The inertial force acts on the sleeper within the motion

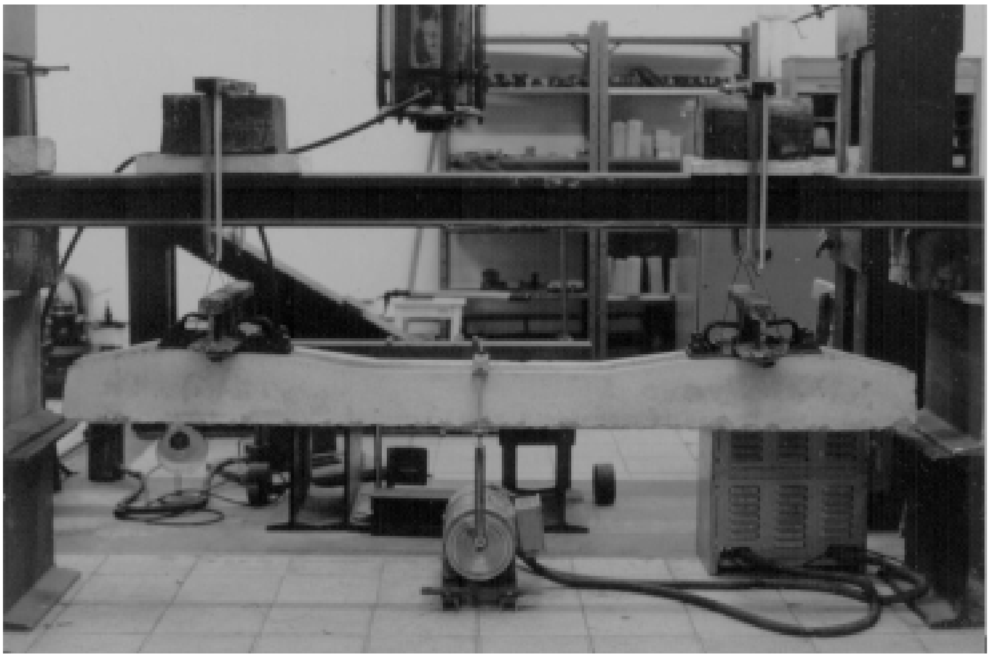
$$F_{in,i(j)}(t) = F_{in,i(j)} \,.\, \sin(\omega_{(j)} \,.\, t) = - m_i \,.\, \ddot{w}_{i(j)}(t) = + m_i \,.\, w_i \,.\, \omega_{(j)}^2 \,.\, \sin(\omega_{(j)} \,.\, t) \,. \qquad (3)$$

The amplitude of inertial force is

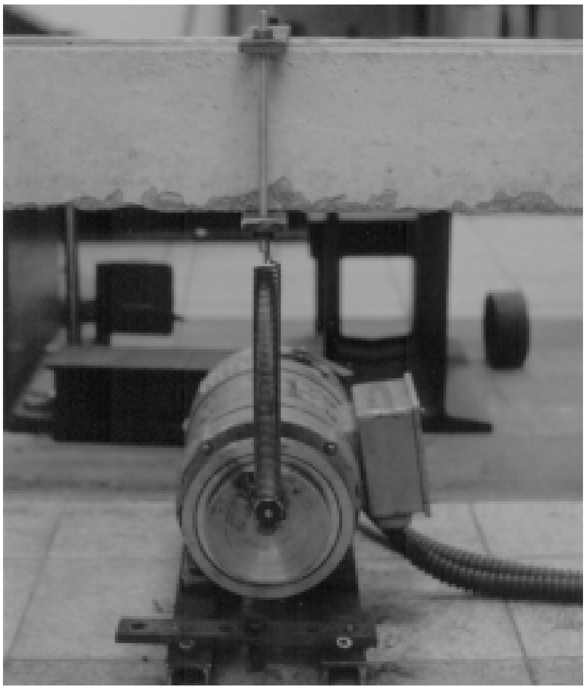
$$F_{in,i(j)} = + m_i \,.\, w_i \,.\, \omega_{(j)}^2 \,. \qquad (4)$$

3. Experimental measurements

The tension clamps additional load by the inertial force within oscillation of track panels was modelled in laboratory conditions. The model is pictured in the Fig. 3 and 4. The sleeper SB8 was hanged on springs by two short rails installed by tested tension clamps into sole plates, as it is seen from the Fig. 3. The sleeper was wobbled by kinematics exciter especially arranged for this case. The amplitude of sleeper oscillation was $\pm$ 6,0 cm, Fig. 4. In respect of the spring stiffness the frequency of oscillation was 125 cyc/min, that is 2,08 Hz. This frequency corresponds to the 3rd natural frequency $f_{(3)}$ of track panel natural oscillation ($f_{(3)}$ = 2,138 Hz). The sleeper oscillated by this way 15 hours, which is certainly more than the time needed for transport in Slovak Republic form the assembling-base to the laying place.



Obr. 3



Obr. 4

4. Conclusions

Before and after the tests the distances between contact points on pressing arms of tension clamps and the bottom of sole plate were measured. The results in [mm] are in the Tab. 1.

Tab. 1

Tension clamps	Before test		After test	
	Ľ	P	Ľ	P
b	8,2	7,7	8,5	7,9
h	7,7	7,7	7,8	7,9
m	10,4	10,5	10,5	10,6
n	9,7	10,1	9,8	10,3

The tension clamps show small permanent deformations after test, which have only small influence on the decrement of pressing force. It results from this that the present technology of the track panel transport is possible and there is no risk of tension clamps overloading. The numerical analysis also confirms that the additional forces acting on tension clamps during the transport of track panels does not reach such value which could lead to the origin of plastic deformations.

References

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